Ramp/Weave Analysis

o   2012 Existing

o   2035 No Build

o   2035 Build Alternatives

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Ex7_SB-On_AM)
Agency/Co.:   VHB
Date performed: 7/3/2012
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2012 Existing Conditions
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   1830   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   655   vph
Length of first accel/decel lane   600   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent Ramp   vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1830	655		vph
Peak-hour factor, PHF	0.89	0.85		
Peak 15-min volume, v15	514	193		v
Trucks and buses	4	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.980	0.990	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2097	778	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 1.000 \qquad \text{Using Equation } 0$$

$$v_{12} = v_F (P_{FM}) = 2097 \quad \text{pc/h}$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	2875	4600	No
v_{R12}	2875	4600	No

_____Level of Service Determination (if not F)_____

$$\text{Density, } D = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 23.8 \quad \text{pc/mi/ln}$$

Level of service for ramp-freeway junction areas of influence   C

_____Speed Estimation_____

Intermediate speed variable, $M_S = 0.348$

Space mean speed in ramp influence area, $S_R = 53.7$ mph

Space mean speed in outer lanes, $S_0 = N/A$ mph

Space mean speed for all vehicles, $S = 53.7$ mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Ex6_SB-On_AM)
Agency/Co.:   VHB
Date performed: 7/3/2012
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 6 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2012 Existing Conditions
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   2550   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   385   vph
Length of first accel/decel lane   300   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   655   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   1500   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2550	385	655	vph
Peak-hour factor, PHF	0.89	0.93	0.80	
Peak 15-min volume, v15	716	103	205	v
Trucks and buses	4	2	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.980	0.990	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2922	418	819	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 1.000 \quad \text{Using Equation } 0$$

$$v_{12} = v_F (P_{FM}) = 2922 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	3340	4600	No
v_{R12}	3340	4600	No

_____Level of Service Determination (if not F)_____

Density, $D = 5.475 + 0.00734 \, v_R + 0.0078 \, v_{12} - 0.00627 \, L_A = 29.5$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

_____Speed Estimation_____

Intermediate speed variable,	$M_S = 0.410$	
Space mean speed in ramp influence area,	$S_R = 52.6$	mph
Space mean speed in outer lanes,	$S_O = N/A$	mph
Space mean speed for all vehicles,	$S = 52.6$	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Ex6_NB-Off_AM)
Agency/Co.:   VHB
Date performed: 7/3/2012
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2012 Existing Condition
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   1825   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   45.0   mph
Volume on ramp   955   vph
Length of first accel/decel lane   275   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent ramp   vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1825	955		vph
Peak-hour factor, PHF	0.91	0.85		
Peak 15-min volume, v15	501	281		v
Trucks and buses	5	1		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

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Heavy vehicle adjustment, fHV            0.976       0.995
Driver population factor, fP             1.00        1.00
Flow rate, vp                            2056        1129                   pcph
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_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = \quad 1.000 \qquad \text{Using Equation } 0$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = \quad 2056 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2056	4600	No
v_{12}	2056	4400	No
$v_{FO} = v_F - v_R$	927	4600	No
v_R	1129	2100	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 4.252 + 0.0086 \ v_{12} - 0.009 \ L_D = \quad 19.5 \quad$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.400$

Space mean speed in ramp influence area, $S_R = 52.8 \quad$ mph

Space mean speed in outer lanes, $S_0 = N/A \quad$ mph

Space mean speed for all vehicles, $S = 52.8 \quad$ mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

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Agency/Co.:   VHB
Date performed: 7/3/2012
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2012 Existing Conditions
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   870   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   40.0   mph
Volume on ramp   610   vph
Length of first accel/decel lane   250   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent Ramp   vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	870	610		vph
Peak-hour factor, PHF	0.91	0.92		
Peak 15-min volume, v15	239	166		v
Trucks and buses	5	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.976	0.990	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	980	670	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \quad\quad\text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = \quad 1.000 \quad\quad \text{Using Equation} \quad 0$$

$$v_{12} = v_F (P_{FM}) = \quad 980 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	1650	4600	No
v_{R12}	1650	4600	No

_____Level of Service Determination (if not F)_____

$$\text{Density, } D = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A = 16.5 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence   B

_____Speed Estimation_____

Intermediate speed variable,	M_S = 0.321	
Space mean speed in ramp influence area,	S_R = 54.2	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 54.2	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

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Agency/Co.:   VHB
Date performed: 7/3/2012
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 7 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2012 Existing Condition
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   1480   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   45.0   mph
Volume on ramp   545   vph
Length of first accel/decel lane   325   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent ramp   vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1480	545		vph
Peak-hour factor, PHF	0.91	0.68		
Peak 15-min volume, v15	407	200		v
Trucks and buses	5	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.976	0.990	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1667	809	pcph

_____Estimation of V12 Diverge Areas_____

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

P_{FD} =   1.000   Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ =   1667   pc/h

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1667	4600	No
v_{12}	1667	4400	No
$v_{FO} = v_F - v_R$	858	4600	No
v_R	809	2100	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ =   15.7   pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, D_S = 0.371

Space mean speed in ramp influence area, S_R = 53.3   mph

Space mean speed in outer lanes, S_0 = N/A   mph

Space mean speed for all vehicles, S = 53.3   mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Ex7_SB-On_PM)
Agency/Co.:   VHB
Date performed: 7/3/2012
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2012 Existing Conditions
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   1585   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   390   vph
Length of first accel/decel lane   600   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent Ramp   vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components   Freeway   Ramp   Adjacent
                                                        Ramp
Volume, V (vph)   1585   390   vph
Peak-hour factor, PHF   0.92   0.86
Peak 15-min volume, v15   431   113   v
Trucks and buses   5   2   %
Recreational vehicles   0   0   %
Terrain type: Level   Level
      Grade   %   %   %
      Length   mi   mi   mi
Trucks and buses PCE, ET   1.5   1.5
Recreational vehicle PCE, ER   1.2   1.2
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Heavy vehicle adjustment, fHV              0.976     0.990
Driver population factor, fP               1.00      1.00
Flow rate, vp                              1766      458                    pcph
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_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \qquad\qquad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = \quad 1.000 \qquad \text{Using Equation} \quad 0$$

$$v_{12} = v_F (P_{FM}) = \quad 1766 \quad \text{pc/h}$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	2224	4600	No
v_{R12}	2224	4600	No

_____Level of Service Determination (if not F)_____

Density, $D = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A = 18.8$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence   B

_____Speed Estimation_____

Intermediate speed variable, M_S = 0.315

Space mean speed in ramp influence area, S_R = 54.3   mph

Space mean speed in outer lanes, S_0 = N/A   mph

Space mean speed for all vehicles, S = 54.3   mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Ex6_SB-On_PM)
Agency/Co.:   VHB
Date performed: 7/3/2012
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 6 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2012 Existing Conditions
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   2075   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   335   vph
Length of first accel/decel lane   300   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   405   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   1500   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2075	335	405	vph
Peak-hour factor, PHF	0.92	0.96	0.87	
Peak 15-min volume, v15	564	87	116	v
Trucks and buses	5	1	1	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.995	0.995	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2312	351	468	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 1.000 \qquad \text{Using Equation } 0$$

$$v_{12} = v_F (P_{FM}) = 2312 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	2663	4600	No
v_{R12}	2663	4600	No

_____Level of Service Determination (if not F)_____

Density, $D = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 24.2 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence C

_____Speed Estimation_____

Intermediate speed variable,	$M_S = 0.356$	
Space mean speed in ramp influence area,	$S_R = 53.6$	mph
Space mean speed in outer lanes,	$S_0 = N/A$	mph
Space mean speed for all vehicles,	$S = 53.6$	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Ex6_NB-Off_PM)
Agency/Co.:   VHB
Date performed: 7/3/2012
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2012 Existing Condition
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   3310   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   45.0   mph
Volume on ramp   1070   vph
Length of first accel/decel lane   275   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent ramp   vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3310	1070		vph
Peak-hour factor, PHF	0.91	0.94		
Peak 15-min volume, v15	909	285		v
Trucks and buses	5	1		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.976	0.995
Driver population factor, fP	1.00	1.00
Flow rate, vp	3728	1144	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 1.000 \qquad \text{Using Equation } 0$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 3728 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3728	4600	No
v_{12}	3728	4400	No
$v_{FO} = v_F - v_R$	2584	4600	No
v_R	1144	2100	No

_____Level of Service Determination (if not F)_____

Density, $D = 4.252 + 0.0086 \, v_R - 0.009 \, L_{12} = 33.8 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence D

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.401$

Space mean speed in ramp influence area, $S_R = 52.8 \quad$ mph

Space mean speed in outer lanes, $S_0 = N/A \quad$ mph

Space mean speed for all vehicles, $S = 52.8 \quad$ mph

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Agency/Co.:   VHB
Date performed: 7/3/2012
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Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2012 Existing Conditions
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   2240   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   40.0   mph
Volume on ramp   910   vph
Length of first accel/decel lane   250   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent Ramp   vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2240	910		vph
Peak-hour factor, PHF	0.91	0.94		
Peak 15-min volume, v15	615	242		v
Trucks and buses	5	1		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.976	0.995	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2523	973	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 1.000 \qquad \text{Using Equation } 0$$

$$v_{12} = v_F (P_{FM}) = 2523 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	3496	4600	No
v_{R12}	3496	4600	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 30.7$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence   D

_____Speed Estimation_____

Intermediate speed variable,	$M_S = 0.430$	
Space mean speed in ramp influence area,	$S_R = 52.3$	mph
Space mean speed in outer lanes,	$S_0 = N/A$	mph
Space mean speed for all vehicles,	$S = 52.3$	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Ex7_NB-Off_PM)
Agency/Co.:   VHB
Date performed: 7/3/2012
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 7 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2012 Existing Condition
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   3150   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   45.0   mph
Volume on ramp   950   vph
Length of first accel/decel lane   325   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent ramp   vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3150	950		vph
Peak-hour factor, PHF	0.91	0.91		
Peak 15-min volume, v15	865	261		v
Trucks and buses	5	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.976	1.000
Driver population factor, fP	1.00	1.00
Flow rate, vp	3548	1044	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \quad\quad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 1.000 \quad\quad \text{Using Equation } 0$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 3548 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3548	4600	No
v_{12}	3548	4400	No
$v_{FO} = v_F - v_R$	2504	4600	No
v_R	1044	2100	No

_____Level of Service Determination (if not F)_____

Density, $\quad\quad D = 4.252 + 0.0086\ v_R - 0.009\ L_{12} = 31.8 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence D

_____Speed Estimation_____

Intermediate speed variable, $\quad\quad D_S = 0.392$

Space mean speed in ramp influence area, $\quad\quad S_R = 52.9 \quad mph$

Space mean speed in outer lanes, $\quad\quad S_0 = N/A \quad mph$

Space mean speed for all vehicles, $\quad\quad S = 52.9 \quad mph$

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Operational Analysis_____

Analyst: NBS (Ex6_SB_AM)
Agency/Co.:   VHB
Date Performed: 7/3/2012
Analysis Time Period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Weaving Location: Exit 6
Jurisdiction: NHDOT
Analysis Year: 2012 Existing Condition
Description: FEET I-293

_____Inputs_____

Freeway free-flow speed, SFF   60   mph
Weaving number of lanes, N   3
Weaving segment length, L   500   ft
Terrain type   Level
    Grade   %
    Length   mi
Weaving type   A
Volume ratio, VR   0.43
Weaving ratio, R   0.49

_____Conversion to pc/h Under Base Conditions_____

	Non-Weaving		Weaving		
	V	V	V	V	
	A-C	B-D	A-D	B-C	
Volume, V	1835	5	650	715	veh/h
Peak-hour factor, PHF	0.89	0.93	0.80	0.93	
Peak 15-min volume, v15	515	2	203	192	v
Trucks and buses	4	1	0	1	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.980	0.995	1.000	0.995	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	2103	5	812	772	pc/h

_____Weaving and Non-Weaving Speeds_____

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.15	0.00
b (Exhibit 24-6)	2.20	4.00
c (Exhibit 24-6)	0.97	1.30
d (Exhibit 24-6)	0.80	0.75
Weaving intensity factor, Wi	2.27	1.44
Weaving and non-weaving speeds, Si	30.30	35.52

Number of lanes required for

```
unconstrained operation, Nw (Exhibit 24-7)        1.32
Maximum number of lanes, Nw (max) (Exhibit 24-7)  1.40
Type of operation is                              Unconstrained
```

_____Weaving Segment Speed, Density, Level of Service and Capacity_____

```
Weaving segment speed, S               33.08   mph
Weaving segment density, D             37.20   pc/mi/ln
Level of service, LOS                  E
Capacity of base condition, cb         4099    pc/h
Capacity as a 15-minute flow rate, c   4019    pc/h
Capacity as a full-hour volume, ch     3540    pc/h
```

_____Limitations on Weaving Segments_____

	Analyzed	If Max Exceeded See Note Maximum	Note
Weaving flow rate, Vw	1584	2800	a
Average flow rate (pcphpl)	1230	2300	b
Volume ratio, VR	0.43	0.45	c
Weaving ratio, R	0.49	N/A	d
Weaving length (ft)	500	2500	e

Notes:
a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

VHB, Inc
VHB
101 Walnut St.
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_____Operational Analysis_____

Analyst: NBS (Ex6_SB_PM)
Agency/Co.:   VHB
Date Performed: 7/3/2012
Analysis Time Period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Weaving Location: Exit 6
Jurisdiction: NHDOT
Analysis Year: 2012 Existing Condition
Description: FEET I-293

_____Inputs_____

Freeway free-flow speed, SFF		60	mph
Weaving number of lanes, N		3	
Weaving segment length, L		500	ft
Terrain type		Level	
Grade			%
Length			mi
Weaving type		A	
Volume ratio, VR		0.38	
Weaving ratio, R		0.43	

_____Conversion to pc/h Under Base Conditions_____

	Non-Weaving		Weaving		
	V	V	V	V	
	A-C	B-D	A-D	B-C	
Volume, V	1570	5	400	500	veh/h
Peak-hour factor, PHF	0.92	0.80	0.87	0.80	
Peak 15-min volume, v15	427	2	115	156	v
Trucks and buses	5	0	1	0	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.976	1.000	0.995	1.000	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	1749	6	462	624	pc/h

_____Weaving and Non-Weaving Speeds_____

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.15	0.00
b (Exhibit 24-6)	2.20	4.00
c (Exhibit 24-6)	0.97	1.30
d (Exhibit 24-6)	0.80	0.75
Weaving intensity factor, Wi	1.63	0.89
Weaving and non-weaving speeds, Si	33.98	41.40

Number of lanes required for

```
unconstrained operation, Nw (Exhibit 24-7)          1.17
Maximum number of lanes, Nw (max) (Exhibit 24-7)    1.40
Type of operation is                                Unconstrained
```

_____Weaving Segment Speed, Density, Level of Service and Capacity_____

```
Weaving segment speed, S                  38.21   mph
Weaving segment density, D                24.78   pc/mi/ln
Level of service, LOS                     C
Capacity of base condition, cb            4235     pc/h
Capacity as a 15-minute flow rate, c      4132     pc/h
Capacity as a full-hour volume, ch        3667     pc/h
```

_____Limitations on Weaving Segments_____

| | Analyzed | If Max Exceeded See Note | |
		Maximum	Note
Weaving flow rate, Vw	1086	2800	a
Average flow rate (pcphpl)	947	2300	b
Volume ratio, VR	0.38	0.45	c
Weaving ratio, R	0.43	N/A	d
Weaving length (ft)	500	2500	e

Notes:

a. Weaving segments longer than 2500 ft. are treated as isolated merge and
    diverge areas using the procedures of Chapter 25, "Ramps and Ramp
    Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater
    than 0.45. Poor operations and some local queuing are expected in such
    cases.
e. Four-lane Type A segments do not operate well at volume ratios greater
    than 0.35. Poor operations and some local queuing are expected in such
    cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h
    (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater
    than 0.20. Poor operations and some local queuing are expected in such
    cases.
h. Type B weaving segments do not operate well at volume ratios greater
    than 0.80. Poor operations and some local queuing are expected in such
    cases.
i. Type C weaving segments do not operate well at volume ratios greater
    than 0.50. Poor operations and some local queuing are expected in such
    cases.

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Ex7_SB-On_AM)
Agency/Co.:   VHB
Date performed: 7/31/2012
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 No Build
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   2300   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   825   vph
Length of first accel/decel lane   600   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent Ramp   vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2300	825		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	639	229		v
Trucks and buses	4	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.980	0.990	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2607	926	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 1.000 \qquad \text{Using Equation } 0$$

$$v_{12} = v_F (P_{FM}) = 2607 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	3533	4600	No
v_{R12}	3533	4600	No

_____Level of Service Determination (if not F)_____

$$\text{Density, } D = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 28.8 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence   D

_____Speed Estimation_____

Intermediate speed variable,	M_S = 0.412		
Space mean speed in ramp influence area,	S_R = 52.6	mph	
Space mean speed in outer lanes,	S_0 = N/A	mph	
Space mean speed for all vehicles,	S = 52.6	mph	

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Ex6_SB-On_AM)
Agency/Co.:   VHB
Date performed: 7/31/2012
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 6 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 No Build
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   3205   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   485   vph
Length of first accel/decel lane   300   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   825   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   1500   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3205	485	825	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	890	135	229	v
Trucks and buses	4	2	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV		0.980	0.990	1.000	
Driver population factor, fP		1.00	1.00	1.00	
Flow rate, vp		3632	544	917	pcph

Estimation of V12 Merge Areas

$$L_{EQ} = \qquad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 1.000 \qquad \text{Using Equation } 0$$

$$v_{12} = v_F (P_{FM}) = 3632 \quad pc/h$$

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4176	4600	No
v_{R12}	4176	4600	No

Level of Service Determination (if not F)

$$\text{Density, } D = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 35.9 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence E

Speed Estimation

Intermediate speed variable,	$M_S = 0.554$	
Space mean speed in ramp influence area,	$S_R = 50.0$	mph
Space mean speed in outer lanes,	$S_0 = N/A$	mph
Space mean speed for all vehicles,	$S = 50.0$	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

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E-mail:

_____Diverge Analysis_____

Analyst: NBS (Ex6_NB-Off_AM)
Agency/Co.:   VHB
Date performed: 7/31/2012
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 No Build
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   2295   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   45.0   mph
Volume on ramp   1200   vph
Length of first accel/decel lane   275   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent ramp   vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2295	1200		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	637	333		v
Trucks and buses	5	1		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

```
Heavy vehicle adjustment, fHV          0.976     0.995
Driver population factor, fP           1.00      1.00
Flow rate, vp                          2614      1340                    pcph
```

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 1.000 \qquad \text{Using Equation } 0$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 2614 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2614	4600	No
v_{12}	2614	4400	No
$v_{FO} = v_F - v_R$	1274	4600	No
v_R	1340	2100	No

_____Level of Service Determination (if not F)_____

Density, $\qquad D = 4.252 + 0.0086\ v_R - 0.009\ L_{12} = 24.3 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence C

_____Speed Estimation_____

Intermediate speed variable, $\qquad D_S = 0.419$

Space mean speed in ramp influence area, $\qquad S_R = 52.5 \quad$ mph

Space mean speed in outer lanes, $\qquad S_0 = N/A \quad$ mph

Space mean speed for all vehicles, $\qquad S = 52.5 \quad$ mph

HCS2000: Ramps and Ramp Junctions Release 4.1f

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Ex6_NB-On_AM)
Agency/Co.:   VHB
Date performed: 7/31/2012
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 No Build
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   1095   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   40.0   mph
Volume on ramp   765   vph
Length of first accel/decel lane   250   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent Ramp   vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1095	765		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	304	212		v
Trucks and buses	5	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

```
Heavy vehicle adjustment, fHV              0.976     0.990
Driver population factor, fP               1.00      1.00
Flow rate, vp                              1247      858                pcph
```

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = \quad 1.000 \qquad \text{Using Equation } 0$$

$$v_{12} = v_F (P_{FM}) = \quad 1247 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	2105	4600	No
v_{R12}	2105	4600	No

_____Level of Service Determination (if not F)_____

$$\text{Density, } D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 19.9 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence   B

_____Speed Estimation_____

Intermediate speed variable, M_S = 0.333

Space mean speed in ramp influence area, S_R = 54.0   mph

Space mean speed in outer lanes, S_0 = N/A   mph

Space mean speed for all vehicles, S = 54.0   mph

HCS2000: Ramps and Ramp Junctions Release 4.1f

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
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_____Diverge Analysis_____

Analyst: NBS (Ex7_NB-Off_AM)
Agency/Co.:   VHB
Date performed: 7/31/2012
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 7 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 No Build
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   1860   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   45.0   mph
Volume on ramp   685   vph
Length of first accel/decel lane   325   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent ramp   vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1860	685		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	517	190		v
Trucks and buses	5	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.976	0.990	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2118	769	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 1.000 \qquad \text{Using Equation } 0$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 2118 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2118	4600	No
v_{12}	2118	4400	No
$v_{FO} = v_F - v_R$	1349	4600	No
v_R	769	2100	No

_____Level of Service Determination (if not F)_____

Density, $\qquad D = 4.252 + 0.0086\ v_R - 0.009\ L_{12} \quad D = \quad 19.5 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $\qquad D_S = 0.367$

Space mean speed in ramp influence area, $\qquad S_R = 53.4 \quad mph$

Space mean speed in outer lanes, $\qquad S_0 = N/A \quad mph$

Space mean speed for all vehicles, $\qquad S = 53.4 \quad mph$

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Ex7_SB-On_PM)
Agency/Co.:   VHB
Date performed: 7/31/2012
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 No Build
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   1995   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   490   vph
Length of first accel/decel lane   600   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent Ramp   vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1995	490		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	554	136		v
Trucks and buses	5	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.976	0.990	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2272	550	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 1.000 \qquad \text{Using Equation } 0$$

$$v_{12} = v_F (P_{FM}) = 2272 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	2822	4600	No
v_{R12}	2822	4600	No

_____Level of Service Determination (if not F)_____

$$\text{Density, } D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 23.5 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence   C

_____Speed Estimation_____

Intermediate speed variable,	$M_S = 0.345$	
Space mean speed in ramp influence area,	$S_R = 53.8$	mph
Space mean speed in outer lanes,	$S_0 = N/A$	mph
Space mean speed for all vehicles,	$S = 53.8$	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Ex6_SB-On_PM)
Agency/Co.:   VHB
Date performed: 7/31/2012
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 6 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 No Build
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   2610   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   420   vph
Length of first accel/decel lane   300   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   510   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   1500   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2610	420	510	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	725	117	142	v
Trucks and buses	5	1	1	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.995	0.995	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2972	469	570	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = \quad 1.000 \qquad \text{Using Equation} \quad 0$$

$$v_{12} = v_{F}(P_{FM}) = \quad 2972 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	3441	4600	No
v_{R12}	3441	4600	No

_____Level of Service Determination (if not F)_____

$$\text{Density, } D = 5.475 + 0.00734\, v_{R} + 0.0078\, v_{12} - 0.00627\, L_{A} = 30.2 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence D

_____Speed Estimation_____

Intermediate speed variable,	M_{S} = 0.422	
Space mean speed in ramp influence area,	S_{R} = 52.4	mph
Space mean speed in outer lanes,	S_{0} = N/A	mph
Space mean speed for all vehicles,	S = 52.4	mph

HCS2000: Ramps and Ramp Junctions Release 4.1f

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Ex6_NB-Off_PM)
Agency/Co.:   VHB
Date performed: 7/31/2012
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 No Build
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   4160   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   45.0   mph
Volume on ramp   1345   vph
Length of first accel/decel lane   275   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent ramp   vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4160	1345		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1156	374		v
Trucks and buses	5	1		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.976	0.995	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4738	1502	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \quad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 1.000 \quad \text{Using Equation } 0$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 4738 \quad \text{pc/h}$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4738	4600	Yes
v_{12}	4738	4400	Yes
$v_{FO} = v_F - v_R$	3236	4600	No
v_R	1502	2100	No

_____Level of Service Determination (if not F)_____

Density, $\quad D = 4.252 + 0.0086\ v_R - 0.009\ L_D = 42.5 \quad$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

_____Speed Estimation_____

Intermediate speed variable, $\qquad D_S = 0.433$

Space mean speed in ramp influence area, $\quad S_R = 52.2 \quad$ mph

Space mean speed in outer lanes, $\qquad S_0 = $ N/A $\quad$ mph

Space mean speed for all vehicles, $\qquad S = 52.2 \quad$ mph

HCS2000: Ramps and Ramp Junctions Release 4.1f

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Ex6_NB-On_PM)
Agency/Co.:   VHB
Date performed: 7/31/2012
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 No Build
Description: FEET I-293

_____Freeway Data_____

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	60.0	mph
Volume on freeway	2815	vph

_____On Ramp Data_____

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	40.0	mph
Volume on ramp	1145	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2815	1145		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	782	318		v
Trucks and buses	5	1		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.976	0.995	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3206	1279	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 1.000 \qquad \text{Using Equation } 0$$

$$v_{12} = v_F(P_{FM}) = 3206 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	4485	4600	No
v_{R12}	4485	4600	No

_____Level of Service Determination (if not F)_____

$$\text{Density, } D = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 38.3 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence   E

_____Speed Estimation_____

Intermediate speed variable, $M_S = 0.647$

Space mean speed in ramp influence area, $S_R = 48.4$ mph

Space mean speed in outer lanes, $S_0 = N/A$ mph

Space mean speed for all vehicles, $S = 48.4$ mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Ex7_NB-Off_PM)
Agency/Co.:   VHB
Date performed: 7/31/2012
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 7 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 No Build
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   2
Free-flow speed on freeway   60.0   mph
Volume on freeway   3960   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   45.0   mph
Volume on ramp   1195   vph
Length of first accel/decel lane   325   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   No
Volume on adjacent ramp   vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3960	1195		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1100	332		v
Trucks and buses	5	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.976	1.000	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4510	1328	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \quad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 1.000 \quad \text{Using Equation } 0$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 4510 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4510	4600	No
v_{12}	4510	4400	Yes
$v_{FO} = v_F - v_R$	3182	4600	No
v_R	1328	2100	No

_____Level of Service Determination (if not F)_____

Density, $D = 4.252 + 0.0086 \, v_R - 0.009 \, L_{12} = 40.1 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence F

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.418$

Space mean speed in ramp influence area, $S_R = 52.5 \quad mph$

Space mean speed in outer lanes, $S_0 = N/A \quad mph$

Space mean speed for all vehicles, $S = 52.5 \quad mph$

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Operational Analysis_____

Analyst: NBS (Ex6_SB_AM)
Agency/Co.:   VHB
Date Performed: 7/31/2012
Analysis Time Period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Weaving Location: Exit 6
Jurisdiction: NHDOT
Analysis Year: 2035 No Build
Description: FEET I-293

_____Inputs_____

Freeway free-flow speed, SFF   60   mph
Weaving number of lanes, N   3
Weaving segment length, L   500   ft
Terrain type   Level
    Grade   %
    Length   mi
Weaving type   A
Volume ratio, VR   0.42
Weaving ratio, R   0.48

_____Conversion to pc/h Under Base Conditions_____

	Non-Weaving		Weaving		
	V A-C	V B-D	V A-D	V B-C	
Volume, V	2305	5	820	900	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	640	2	228	250	v
Trucks and buses	4	1	0	1	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.980	0.995	1.000	0.995	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	2612	5	911	1004	pc/h

_____Weaving and Non-Weaving Speeds_____

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.15	0.00
b (Exhibit 24-6)	2.20	4.00
c (Exhibit 24-6)	0.97	1.30
d (Exhibit 24-6)	0.80	0.75
Weaving intensity factor, Wi	2.74	1.84
Weaving and non-weaving speeds, Si	28.38	32.60

Number of lanes required for

```
unconstrained operation, Nw (Exhibit 24-7)        1.34
Maximum number of lanes, Nw (max) (Exhibit 24-7)  1.40
Type of operation is                              Unconstrained
```

_____Weaving Segment Speed, Density, Level of Service and Capacity_____

```
Weaving segment speed, S                 30.67   mph
Weaving segment density, D               49.25   pc/mi/ln
Level of service, LOS                    F
Capacity of base condition, cb           4117    pc/h
Capacity as a 15-minute flow rate, c     4036    pc/h
Capacity as a full-hour volume, ch       3632    pc/h
```

_____Limitations on Weaving Segments_____

	Analyzed	If Max Exceeded See Note Maximum	Note
Weaving flow rate, Vw	1915	2800	a
Average flow rate (pcphpl)	1510	2300	b
Volume ratio, VR	0.42	0.45	c
Weaving ratio, R	0.48	N/A	d
Weaving length (ft)	500	2500	e

Notes:
a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Operational Analysis_____

Analyst: NBS (Ex6_SB_PM)
Agency/Co.:   VHB
Date Performed: 7/31/2012
Analysis Time Period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Weaving Location: Exit 6
Jurisdiction: NHDOT
Analysis Year: 2035 No Build
Description: FEET I-293

_____Inputs_____

Freeway free-flow speed, SFF   60   mph
Weaving number of lanes, N   3
Weaving segment length, L   500   ft
Terrain type   Level
    Grade   %
    Length   mi
Weaving type   A
Volume ratio, VR   0.36
Weaving ratio, R   0.45

_____Conversion to pc/h Under Base Conditions_____

	Non-Weaving		Weaving		
	V	V	V	V	
	A-C	B-D	A-D	B-C	
Volume, V	1980	5	505	630	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	550	2	140	175	v
Trucks and buses	5	0	1	0	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.976	1.000	0.995	1.000	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	2255	5	563	700	pc/h

_____Weaving and Non-Weaving Speeds_____

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.15	0.00
b (Exhibit 24-6)	2.20	4.00
c (Exhibit 24-6)	0.97	1.30
d (Exhibit 24-6)	0.80	0.75
Weaving intensity factor, Wi	1.94	1.10
Weaving and non-weaving speeds, Si	32.02	38.77

Number of lanes required for

unconstrained operation, Nw (Exhibit 24-7)   1.16
Maximum number of lanes, Nw (max) (Exhibit 24-7)   1.40
Type of operation is   Unconstrained

_____Weaving Segment Speed, Density, Level of Service and Capacity_____

Weaving segment speed, S   36.04   mph
Weaving segment density, D   32.58   pc/mi/ln
Level of service, LOS   D
Capacity of base condition, cb   4309   pc/h
Capacity as a 15-minute flow rate, c   4204   pc/h
Capacity as a full-hour volume, ch   3784   pc/h

_____Limitations on Weaving Segments_____

		If Max Exceeded See Note
	Analyzed	Maximum	Note
Weaving flow rate, Vw	1263	2800	a
Average flow rate (pcphpl)	1174	2300	b
Volume ratio, VR	0.36	0.45	c
Weaving ratio, R	0.45	N/A	d
Weaving length (ft)	500	2500	e

Notes:
a. Weaving segments longer than 2500 ft. are treated as isolated merge and
    diverge areas using the procedures of Chapter 25, "Ramps and Ramp
    Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater
    than 0.45. Poor operations and some local queuing are expected in such
    cases.
e. Four-lane Type A segments do not operate well at volume ratios greater
    than 0.35. Poor operations and some local queuing are expected in such
    cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h
    (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater
    than 0.20. Poor operations and some local queuing are expected in such
    cases.
h. Type B weaving segments do not operate well at volume ratios greater
    than 0.80. Poor operations and some local queuing are expected in such
    cases.
i. Type C weaving segments do not operate well at volume ratios greater
    than 0.50. Poor operations and some local queuing are expected in such
    cases.

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-4&8_Ex6_NB-Off_AM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&8
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2270   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   1200   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   835   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   3100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2270	1200	835	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	631	333	232	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976      0.990       0.990
Driver population factor, fP           1.00       1.00        1.00
Flow rate, vp                          2585       1347        937      pcph
```

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad\qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.633 \qquad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 2131 \quad pc/h$$

_____Capacity Checks_____

```
                      Actual         Maximum            LOS F?
v   = v               2585           6900               No
 Fi    F
v                     2131           4400               No
 12
v   = v  - v          1238           6900               No
 FO    F    R
v                     1347           2000               No
 R
```

_____Level of Service Determination (if not F)_____

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D = 18.2 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.549$

Space mean speed in ramp influence area, $S_R = 50.1 \quad mph$

Space mean speed in outer lanes, $S_O = 65.8 \quad mph$

Space mean speed for all vehicles, $S = 52.3 \quad mph$

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-4&9_Ex6_NB-Off_AM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&9
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2270   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   1200   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   685   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   3100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2270	1200	685	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	631	333	190	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.990       0.990
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2585        1347        769         pcph
```

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.633 \qquad \text{Using Equation } 5$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 2131 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2585	6900	No
v_{12}	2131	4400	No
$v_{FO} = v_F - v_R$	1238	6900	No
v_R	1347	2000	No

_____Level of Service Determination (if not F)_____

Density, $D = 4.252 + 0.0086 \, v_{12} - 0.009 \, L_D = 18.2$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.549$

Space mean speed in ramp influence area, $S_R = 50.1$ mph

Space mean speed in outer lanes, $S_0 = 65.8$ mph

Space mean speed for all vehicles, $S = 52.3$ mph

HCS2000: Ramps and Ramp Junctions Release 4.1f

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-4&10_Ex6_NB-Off_AM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&10
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2270   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   1180   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   575   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   3100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2270	1180	575	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	631	328	160	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV        0.976      0.990      0.990
Driver population factor, fP         1.00       1.00       1.00
Flow rate, vp                        2585       1324       645        pcph
```

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \quad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.634 \quad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 2124 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2585	6900	No
v_{12}	2124	4400	No
$v_{FO} = v_F - v_R$	1261	6900	No
v_R	1324	2000	No

_____Level of Service Determination (if not F)_____

Density, $D = 4.252 + 0.0086\ v_R - 0.009\ L_{12} = 18.1 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.547$

Space mean speed in ramp influence area, $S_R = 50.2 \quad mph$

Space mean speed in outer lanes, $S_0 = 65.8 \quad mph$

Space mean speed for all vehicles, $S = 52.4 \quad mph$

HCS2000: Ramps and Ramp Junctions Release 4.1f

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-4&8_Ex6_NB-Off_PM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&8
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   4000   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   1350   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   1350   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   3100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4000	1350	1350	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1111	375	375	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4556	1515	1515	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.576 \qquad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R)\, P_{FD} = 3268 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4556	6900	No
v_{12}	3268	4400	No
$v_{FO} = v_F - v_R$	3041	6900	No
v_R	1515	2000	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D = 28.0{-} \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence C

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.564$

Space mean speed in ramp influence area, $S_R = 49.8 \quad mph$

Space mean speed in outer lanes, $S_0 = 64.7 \quad mph$

Space mean speed for all vehicles, $S = 53.3 \quad mph$

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-4&9_Ex6_NB-Off_PM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&9
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   4000   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   1350   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   1150   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   3100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4000	1350	1150	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1111	375	319	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990
Driver population factor, fP	1.00	1.00	1.00
Flow rate, vp	4556	1515	1291	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.576 \qquad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 3268 \quad \text{pc/h}$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4556	6900	No
v_{12}	3268	4400	No
$v_{FO} = v_F - v_R$	3041	6900	No
v_R	1515	2000	No

_____Level of Service Determination (if not F)_____

Density,
$$D = 4.252 + 0.0086\ v_R - 0.009\ L_D \quad = \quad 28.0 - \quad \text{pc/mi/ln}$$
$$\qquad\qquad\qquad\qquad\qquad\qquad\qquad 12$$

Level of service for ramp-freeway junction areas of influence C

_____Speed Estimation_____

Intermediate speed variable,	$D_S = 0.564$	
Space mean speed in ramp influence area,	$S_R = 49.8$	mph
Space mean speed in outer lanes,	$S_0 = 64.7$	mph
Space mean speed for all vehicles,	$S = 53.3$	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-4&10_Ex6_NB-Off_PM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&10
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   4000   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   1295   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   1035   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   3100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4000	1295	1035	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1111	360	288	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4556	1453	1162	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.579 \quad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 3250 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4556	6900	No
v_{12}	3250	4400	No
$v_{FO} = v_F - v_R$	3103	6900	No
v_R	1453	2000	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 4.252 + 0.0086 \, v_{12} - 0.009 \, L_D = 27.8$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.559$

Space mean speed in ramp influence area, $S_R = 49.9$ mph

Space mean speed in outer lanes, $S_0 = 64.6$ mph

Space mean speed for all vehicles, $S = 53.4$ mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-4&9_Ex6_NB-On_AM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&9
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   1070   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   685   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   1200   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   3100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1070	685	1200	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	297	190	333	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1219	769	1347	pcph

_____ Estimation of V12 Merge Areas _____

$$L_{EQ} = 208.83 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F (P_{FM}) = 731 \quad \text{pc/h}$$

_____ Capacity Checks _____

	Actual	Maximum	LOS F?
v_{FO}	1988	6900	No
v_{R12}	1500	4600	No

_____ Level of Service Determination (if not F) _____

$$\text{Density, } D = 5.475 + 0.00734 \, v_R + 0.0078 \, v_{12} - 0.00627 \, L_A = 11.8 \quad \text{pc/mi/ln}$$

Level of service for ramp-freeway junction areas of influence   B

_____ Speed Estimation _____

Intermediate speed variable,	M_S	= 0.282	
Space mean speed in ramp influence area,	S_R	= 54.9	mph
Space mean speed in outer lanes,	S_0	= 60.0	mph
Space mean speed for all vehicles,	S	= 56.1	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-4&10_Ex6_NB-On_AM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&10
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   1090   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   575   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   1180   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   3100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1090	575	1180	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	303	160	328	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1241	645	1324	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 187.00 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F (P_{FM}) = 744 \quad \text{pc/h}$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	1886	6900	No
v_{R12}	1389	4600	No

_____Level of Service Determination (if not F)_____

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 11.0$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence   B

_____Speed Estimation_____

Intermediate speed variable,	$M_S = 0.281$		
Space mean speed in ramp influence area,	$S_R = 54.9$	mph	
Space mean speed in outer lanes,	$S_0 = 60.0$	mph	
Space mean speed for all vehicles,	$S = 56.2$	mph	

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-4&9_Ex6_NB-On_PM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&9
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2650   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   1150   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   1350   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   3100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2650	1150	1350	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	736	319	375	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV            0.976      0.990      0.990
Driver population factor, fP             1.00       1.00       1.00
Flow rate, vp                            3018       1291       1515     pcph
```

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 705.53 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation} \quad 1$$

$$v_{12} = v_F(P_{FM}) = 1810 \quad pc/h$$

_____Capacity Checks_____

```
                   Actual        Maximum         LOS F?
v                  4309          6900            No
 FO
v                  3101          4600            No
 R12
```

_____Level of Service Determination (if not F)_____

$$\text{Density, } D = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 24.1 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence   C

_____Speed Estimation_____

Intermediate speed variable, M_S = 0.352

Space mean speed in ramp influence area, S_R = 53.7   mph

Space mean speed in outer lanes, S_0 = 57.5   mph

Space mean speed for all vehicles, S = 54.7   mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-4&10_Ex6_NB-On_PM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&10
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2705   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   1035   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   1295   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   3100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2705	1035	1295	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	751	287	360	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV        0.976     0.990     0.990
Driver population factor, fP         1.00      1.00      1.00
Flow rate, vp                        3081      1161      1453    pcph
```

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 691.19 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F (P_{FM}) = 1848 \quad pc/h$$

_____Capacity Checks_____

```
                Actual        Maximum        LOS F?
v               4242          6900           No
 FO
v               3009          4600           No
 R12
```

_____Level of Service Determination (if not F)_____

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 23.4$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence   C

_____Speed Estimation_____

Intermediate speed variable, $M_S = 0.344$

Space mean speed in ramp influence area, $S_R = 53.8$ mph

Space mean speed in outer lanes, $S_0 = 57.4$ mph

Space mean speed for all vehicles, $S = 54.8$ mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-4&9_Ex6_SB-Off_AM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 6 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&9
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   3005   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   1100   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   485   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   4000   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3005	1100	485	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	835	306	135	v
Trucks and buses	4	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.980	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3406	1234	544	pcph

_____Estimation of V12 Diverge Areas_____

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

$P_{FD} = 0.618$ Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD} = 2576$ pc/h

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3406	6900	No
v_{12}	2576	4400	No
$v_{FO} = v_F - v_R$	2172	6900	No
v_R	1234	2000	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D = 22.0$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.539$

Space mean speed in ramp influence area, $S_R = 50.3$ mph

Space mean speed in outer lanes, $S_0 = 65.8$ mph

Space mean speed for all vehicles, $S = 53.4$ mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-4&10_Ex6_SB-Off_AM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 6 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&10
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2955   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   1050   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   485   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   4000   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2955	1050	485	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	821	292	135	v
Trucks and buses	4	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.980	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3349	1178	544	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.622 \qquad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R)\, P_{FD} = 2529 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3349	6900	No
v_{12}	2529	4400	No
$v_{FO} = v_F - v_R$	2171	6900	No
v_R	1178	2000	No

_____Level of Service Determination (if not F)_____

Density, $\quad D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D = 21.6 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence C

_____Speed Estimation_____

Intermediate speed variable, $\qquad D_S = 0.534$

Space mean speed in ramp influence area, $\quad S_R = 50.4 \quad$ mph

Space mean speed in outer lanes, $\qquad S_0 = 65.8 \quad$ mph

Space mean speed for all vehicles, $\qquad S = 53.5 \quad$ mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-4&9_Ex6_SB-Off_PM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 6 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&9
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2385   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   530   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   420   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   4000   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2385	530	420	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	662	147	117	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2716	595	471	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.665 \qquad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 2005 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2716	6900	No
v_{12}	2005	4400	No
$v_{FO} = v_F - v_R$	2121	6900	No
v_R	595	2000	No

_____Level of Service Determination (if not F)_____

Density,
$$D = 4.252 + 0.0086 \, v_R - 0.009 \, L_D = 17.1 \quad pc/mi/ln$$
Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $\qquad D_S = 0.482$

Space mean speed in ramp influence area, $\quad S_R = 51.3 \quad$ mph

Space mean speed in outer lanes, $\qquad S_0 = 65.8 \quad$ mph

Space mean speed for all vehicles, $\qquad S = 54.5 \quad$ mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-4&10_Ex6_SB-Off_PM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 6 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&10
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2300   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   470   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   420   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   4000   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2300	470	420	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	639	131	117	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2619	527	471	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.670 \qquad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 1929 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2619	6900	No
v_{12}	1929	4400	No
$v_{FO} = v_F - v_R$	2092	6900	No
v_R	527	2000	No

_____Level of Service Determination (if not F)_____

Density, $\qquad D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D = 16.5 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable,	D_S	= 0.475	
Space mean speed in ramp influence area,	S_R	= 51.4	mph
Space mean speed in outer lanes,	S_0	= 65.8	mph
Space mean speed for all vehicles,	S	= 54.6	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-4&8_Ex6_SB-On)
Agency/Co.:   VBB
Date performed: 3/19/2013
Analysis time period: AM Peak
Freeway/Dir of Travel: I-293 / Southbound
Junction: Exit 6 SB On Ramp (Eddy Rd NB)
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&8
Description: I-293   #52196

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   3230   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   485   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   1325   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   On
Distance to adjacent Ramp   1100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3230	485	1325	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	897	135	368	v
Trucks and buses	4	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.980	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3661	544	1487	pcph

_____Estimation of V12 Merge Areas_____

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

P_{FM} =   0.600   Using Equation 1

$v_{12} = v_F (P_{FM}) =$ 2196   pc/h

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	4205	6900	No
v_{R12}	2740	4600	No

_____Level of Service Determination (if not F)_____

Density, $D = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A =$ 21.6   pc/mi/ln

Level of service for ramp-freeway junction areas of influence   C

_____Speed Estimation_____

Intermediate speed variable, M_S = 0.325

Space mean speed in ramp influence area, S_R = 54.1   mph

Space mean speed in outer lanes, S_0 = 56.5   mph

Space mean speed for all vehicles, S = 54.9   mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-4&9_Ex6_SB-On)
Agency/Co.:   VBB
Date performed: 3/19/2013
Analysis time period: AM Peak
Freeway/Dir of Travel: I-293 / Southbound
Junction: Exit 6 SB On Ramp (Eddy Rd NB)
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&9
Description: I-293   #52196

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   3230   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   485   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   1325   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   On
Distance to adjacent Ramp   1100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3230	485	1325	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	897	135	368	v
Trucks and buses	4	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.980	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3661	544	1487	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \qquad\qquad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \qquad \text{Using Equation 1}$$

$$v_{12} = v_F (P_{FM}) = 2196 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	4205	6900	No
v_{R12}	2740	4600	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A = 21.6$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence   C

_____Speed Estimation_____

Intermediate speed variable,	$M_S = 0.325$		
Space mean speed in ramp influence area,	$S_R = 54.1$	mph	
Space mean speed in outer lanes,	$S_0 = 56.5$	mph	
Space mean speed for all vehicles,	$S = 54.9$	mph	

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-4&10_Ex6_SB-On)
Agency/Co.:   VBB
Date performed: 3/19/2013
Analysis time period: AM Peak
Freeway/Dir of Travel: I-293 / Southbound
Junction: Exit 6 SB On Ramp (Eddy Rd NB)
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&10
Description: I-293   #52196

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   3180   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   485   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   1275   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   On
Distance to adjacent Ramp   1100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3180	485	1275	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	883	135	354	v
Trucks and buses	4	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV		0.980	0.990	0.990	
Driver population factor, fP		1.00	1.00	1.00	
Flow rate, vp		3604	544	1431	pcph

_____Estimation of V12 Merge Areas_____

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

P_{FM} =   0.600   Using Equation 1

$v_{12} = v_F (P_{FM})$ =   2162   pc/h

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	4148	6900	No
v_{R12}	2706	4600	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ =   21.3   pc/mi/ln

Level of service for ramp-freeway junction areas of influence   C

_____Speed Estimation_____

Intermediate speed variable, M_S = 0.323

Space mean speed in ramp influence area, S_R = 54.2   mph

Space mean speed in outer lanes, S_0 = 56.6   mph

Space mean speed for all vehicles, S = 55.0   mph

```
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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone:  617-924-1770                       Fax:
E-mail:

_____Merge Analysis_____

Analyst:              NBS (Alt-4&8_Ex6_SB-On_PM)
Agency/Co.:           VBB
Date performed:       3/19/2013
Analysis time period: PM Peak
Freeway/Dir of Travel: I-293 / Southbound
Junction:             Exit 6 SB On Ramp (Eddy Rd NB)
Jurisdiction:         NHDOT
Analysis Year:        2035 Build - Alt-4&8
Description:  I-293   #52196

_____Freeway Data_____

Type of analysis                         Merge
Number of lanes in freeway               3
Free-flow speed on freeway               60.0          mph
Volume on freeway                        2490          vph

_____On Ramp Data_____

Side of freeway                          Right
Number of lanes in ramp                  1
Free-flow speed on ramp                  35.0          mph
Volume on ramp                           420           vph
Length of first accel/decel lane         800           ft
Length of second accel/decel lane                      ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?                Yes
Volume on adjacent Ramp                  635           vph
Position of adjacent Ramp                Upstream
Type of adjacent Ramp                    On
Distance to adjacent Ramp                1100          ft

_____Conversion to pc/h Under Base Conditions_____
```

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2490	420	635	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	692	117	176	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2836	471	713	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \qquad \text{Using Equation 1}$$

$$v_{12} = v_F (P_{FM}) = 1701 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	3307	6900	No
v_{R12}	2172	4600	No

_____Level of Service Determination (if not F)_____

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 17.2$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence   B

_____Speed Estimation_____

Intermediate speed variable,	$M_S = 0.299$	
Space mean speed in ramp influence area,	$S_R = 54.6$	mph
Space mean speed in outer lanes,	$S_0 = 57.7$	mph
Space mean speed for all vehicles,	$S = 55.6$	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-4&9_Ex6_SB-On_PM)
Agency/Co.:   VBB
Date performed: 3/19/2013
Analysis time period: PM Peak
Freeway/Dir of Travel: I-293 / Southbound
Junction: Exit 6 SB On Ramp (Eddy Rd NB)
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&9
Description: I-293   #52196

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2490   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   420   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   635   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   On
Distance to adjacent Ramp   1100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2490	420	635	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	692	117	176	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976      0.990      0.990
Driver population factor, fP           1.00       1.00       1.00
Flow rate, vp                          2836       471        713       pcph
```

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = \quad 0.600 \qquad \text{Using Equation} \quad 1$$

$$v_{12} = v_F (P_{FM}) = \quad 1701 \quad \text{pc/h}$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	3307	6900	No
v_{R12}	2172	4600	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A = 17.2$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence   B

_____Speed Estimation_____

Intermediate speed variable, $M_S = 0.299$

Space mean speed in ramp influence area, $S_R = 54.6$ mph

Space mean speed in outer lanes, $S_0 = 57.7$ mph

Space mean speed for all vehicles, $S = 55.6$ mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-4&10_Ex6_SB-On_PM)
Agency/Co.:   VBB
Date performed: 3/19/2013
Analysis time period: PM Peak
Freeway/Dir of Travel: I-293 / Southbound
Junction: Exit 6 SB On Ramp (Eddy Rd NB)
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-4&10
Description: I-293   #52196

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2440   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   420   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   610   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   On
Distance to adjacent Ramp   1100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2440	420	610	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	678	117	169	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV            0.976      0.990      0.990
Driver population factor, fP             1.00       1.00       1.00
Flow rate, vp                            2779       471        685     pcph
```

_____Estimation of V12 Merge Areas_____

$$L = \quad\quad\quad\quad\text{(Equation 25-2 or 25-3)}$$
$$\text{EQ}$$

$$P = 0.600 \quad\quad \text{Using Equation } 1$$
$$\text{FM}$$

$$v = v (P) = 1667 \quad pc/h$$
$$12 \quad F \quad FM$$

_____Capacity Checks_____

```
              Actual       Maximum        LOS F?
 v            3250         6900           No
  FO
 v            2138         4600           No
  R12
```

_____Level of Service Determination (if not F)_____

Density, $D = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A = 16.9 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence   B

_____Speed Estimation_____

```
Intermediate speed variable,             M  = 0.298
                                          S
Space mean speed in ramp influence area, S  = 54.6     mph
                                          R
Space mean speed in outer lanes,         S  = 57.8     mph
                                          0
Space mean speed for all vehicles,       S  = 55.7     mph
```

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-567&9_Ex6_NB-Off_AM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-5,6,7&9
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2270   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   1200   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   320   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   1700   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2270	1200	320	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	631	333	89	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990
Driver population factor, fP	1.00	1.00	1.00
Flow rate, vp	2585	1347	359	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad\qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.633 \qquad \text{Using Equation } 5$$

$$v_{12} = v_R + (v_F - v_R)\, P_{FD} = 2131 \quad \text{pc/h}$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2585	6900	No
v_{12}	2131	4400	No
$v_{FO} = v_F - v_R$	1238	6900	No
v_R	1347	2000	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D = 18.2$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.549$

Space mean speed in ramp influence area, $S_R = 50.1$ mph

Space mean speed in outer lanes, $S_0 = 65.8$ mph

Space mean speed for all vehicles, $S = 52.3$ mph

```
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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone:  617-924-1770                          Fax:
E-mail:

_____Diverge Analysis_____

Analyst:                 NBS (Alt-567&9_Ex6_NB-Off_PM)
Agency/Co.:              VHB
Date performed:          3/19/2013
Analysis time period:    PM Peak Hour
Freeway/Dir of Travel:   I-293 / NB
Junction:                Exit 6 NB Off Ramp
Jurisdiction:            NHDOT
Analysis Year:           2035 Build - Alt-5,6,7&9
Description:  FEET I-293

_____Freeway Data_____

Type of analysis                      Diverge
Number of lanes in freeway            3
Free-flow speed on freeway            60.0        mph
Volume on freeway                     4000        vph

_____Off Ramp Data_____

Side of freeway                       Right
Number of lanes in ramp               1
Free-Flow speed on ramp               35.0        mph
Volume on ramp                        1350        vph
Length of first accel/decel lane      486         ft
Length of second accel/decel lane                 ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?             Yes
Volume on adjacent ramp               535         vph
Position of adjacent ramp             Downstream
Type of adjacent ramp                 On
Distance to adjacent ramp             1700        ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components              Freeway      Ramp        Adjacent
                                                          Ramp
Volume, V (vph)                  4000         1350        535        vph
Peak-hour factor, PHF            0.90         0.90        0.90
Peak 15-min volume, v15          1111         375         149        v
Trucks and buses                 5            2           2          %
Recreational vehicles            0            0           0          %
Terrain type:                    Level        Level       Level
       Grade                     0.00    %    0.00    %   0.00    %
       Length                    0.00    mi   0.00    mi  0.00    mi
Trucks and buses PCE, ET         1.5          1.5         1.5
Recreational vehicle PCE, ER     1.2          1.2         1.2
```

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4556	1515	600	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \quad\quad\quad (Equation\ 25\text{-}8\ or\ 25\text{-}9)$$

$$P_{FD} = \quad 0.576 \quad Using\ Equation\ 5$$

$$v_{12} = v_R + (v_F - v_R)\ P_{FD} = \quad 3268 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4556	6900	No
v_{12}	3268	4400	No
$v_{FO} = v_F - v_R$	3041	6900	No
v_R	1515	2000	No

_____Level of Service Determination (if not F)_____

Density, $\quad\quad D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D = \quad 28.0-$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

_____Speed Estimation_____

Intermediate speed variable, $\quad\quad D_S = 0.564$

Space mean speed in ramp influence area, $\quad S_R = 49.8 \quad$ mph

Space mean speed in outer lanes, $\quad\quad S_0 = 64.7 \quad$ mph

Space mean speed for all vehicles, $\quad\quad S = 53.3 \quad$ mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-567&9_Ex6_NB-On1_AM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB On Ramp (first ramp)
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-5,6,7&9
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   1070   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   320   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   1200   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   1700   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1070	320	1200	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	297	89	333	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1219	359	1347	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 121.09 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F (P_{FM}) = 731 \quad \text{pc/h}$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	1578	6900	No
v_{R12}	1090	4600	No

_____Level of Service Determination (if not F)_____

$$\text{Density, } D = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 8.8 \quad \text{pc/mi/ln}$$

Level of service for ramp-freeway junction areas of influence   A

_____Speed Estimation_____

Intermediate speed variable, $M_S = 0.277$

Space mean speed in ramp influence area, $S_R = 55.0$ mph

Space mean speed in outer lanes, $S_0 = 60.0$ mph

Space mean speed for all vehicles, $S = 56.5$ mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-567&9_Ex6_NB-On1_PM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB On Ramp (first ramp)
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-5,6,7&9
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2650   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   535   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   1350   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   1700   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2650	535	1350	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	736	149	375	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3018	600	1515	pcph

Estimation of V12 Merge Areas

$$L_{EQ} = 557.65 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation } 1$$

$$v_{12} = v_F(P_{FM}) = 1810 \quad pc/h$$

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3618	6900	No
v_{R12}	2410	4600	No

Level of Service Determination (if not F)

$$\text{Density, } D = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A = 19.0 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence   B

Speed Estimation

Intermediate speed variable, $M_S = 0.308$

Space mean speed in ramp influence area, $S_R = 54.4$ mph

Space mean speed in outer lanes, $S_0 = 57.5$ mph

Space mean speed for all vehicles, $S = 55.4$ mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-567&9_Ex6_NB-On2_AM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB On Ramp (2nd ramp)
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-5,6,7&9
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   1390   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   365   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   320   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   On
Distance to adjacent Ramp   1700   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1390	365	320	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	386	101	89	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1583	410	359	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 209.90 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F(P_{FM}) = 950 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	1993	6900	No
v_{R12}	1360	4600	No

_____Level of Service Determination (if not F)_____

$$\text{Density, } D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 10.9 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, M_S = 0.280

Space mean speed in ramp influence area, S_R = 55.0   mph

Space mean speed in outer lanes, S_0 = 59.5   mph

Space mean speed for all vehicles, S = 56.3   mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-567&9_Ex6_NB-On2_PM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 6 NB On Ramp (2nd ramp)
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-5,6,7&9
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   3185   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   615   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   535   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   On
Distance to adjacent Ramp   1700   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3185	615	535	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	885	171	149	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976      0.990      0.990
Driver population factor, fP           1.00       1.00       1.00
Flow rate, vp                          3627       690        600       pcph
```

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation } 1$$

$$v_{12} = v_F (P_{FM}) = 2176 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	4317	6900	No
v_{R12}	2866	4600	No

_____Level of Service Determination (if not F)_____

$$\text{Density, } D = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 22.5 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence   C

_____Speed Estimation_____

Intermediate speed variable, M_S = 0.334

Space mean speed in ramp influence area, S_R = 54.0   mph

Space mean speed in outer lanes, S_0 = 56.6   mph

Space mean speed for all vehicles, S = 54.8   mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-567&9_Ex6_SB-Off_AM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 6 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-5,6,7&9
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   3005   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   1100   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   1810   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   2100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3005	1100	1810	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	835	306	503	v
Trucks and buses	4	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.980	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3406	1234	2031	pcph

_____Estimation of V12 Diverge Areas_____

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

P_{FD} =   0.618   Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ =   2576   pc/h

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3406	6900	No
v_{12}	2576	4400	No
$v_{FO} = v_F - v_R$	2172	6900	No
v_R	1234	2000	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D$ =   22.0   pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

_____Speed Estimation_____

Intermediate speed variable, D_S = 0.539

Space mean speed in ramp influence area, S_R = 50.3   mph

Space mean speed in outer lanes, S_0 = 65.8   mph

Space mean speed for all vehicles, S = 53.4   mph

HCS2000: Ramps and Ramp Junctions Release 4.1f

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-567&9_Ex6_SB-Off_PM)
Agency/Co.:   VHB
Date performed: 3/19/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 6 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-5,6,7&9
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2405   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   530   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   1055   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   2100   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2405	530	1055	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	668	147	293	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2739	595	1184	pcph

_____Estimation of V12 Diverge Areas_____

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

$P_{FD} = 0.664$ Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD} = 2019$ pc/h

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2739	6900	No
v_{12}	2019	4400	No
$v_{FO} = v_F - v_R$	2144	6900	No
v_R	595	2000	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D = 17.2$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.482$

Space mean speed in ramp influence area, $S_R = 51.3$ mph

Space mean speed in outer lanes, $S_0 = 65.8$ mph

Space mean speed for all vehicles, $S = 54.5$ mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-9&4567_Ex7_NB-Off_AM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 7 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-9 & 4,5,6,7
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   1755   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   570   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   305   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   2400   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1755	570	305	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	487	158	85	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1999	640	342	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.681 \qquad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R)\, P_{FD} = 1565 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1999	6900	No
v_{12}	1565	4400	No
$v_{FO} = v_F - v_R$	1359	6900	No
v_R	640	2000	No

_____Level of Service Determination (if not F)_____

Density, $\qquad D = 4.252 + 0.0086\, v_{12} - 0.009\, L_D = 13.3 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $\qquad D_S = 0.486$

Space mean speed in ramp influence area, $\quad S_R = 51.3 \quad mph$

Space mean speed in outer lanes, $\qquad S_0 = 65.8 \quad mph$

Space mean speed for all vehicles, $\qquad S = 53.8 \quad mph$

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-9&4567_Ex7_NB-Off_PM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 7 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt-9 & 4,5,6,7
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   3800   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   1000   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   360   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   2400   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3800	1000	360	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1056	278	100	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4328	1122	404	pcph

_____Estimation of V12 Diverge Areas_____

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

P_{FD} = 0.600 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3046 pc/h

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4328	6900	No
v_{12}	3046	4400	No
$v_{FO} = v_F - v_R$	3206	6900	No
v_R	1122	2000	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D$ = 26.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

_____Speed Estimation_____

Intermediate speed variable,	D_S = 0.529	
Space mean speed in ramp influence area,	S_R = 50.5	mph
Space mean speed in outer lanes,	S_0 = 64.7	mph
Space mean speed for all vehicles,	S = 54.0	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-10&4_Ex7_NB-Off_AM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 7 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 10 & 4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   1665   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   590   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   565   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   2400   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1665	590	565	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	462	164	157	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1896	662	634	pcph

_____Estimation of V12 Diverge Areas_____

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

$P_{FD} = $ 0.682   Using Equation   5

$v_{12} = v_R + (v_F - v_R) P_{FD} = $ 1504   pc/h

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1896	6900	No
v_{12}	1504	4400	No
$v_{FO} = v_F - v_R$	1234	6900	No
v_R	662	2000	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 4.252 + 0.0086 \, v_{12} - 0.009 \, L_D = $ 12.8   pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.488$

Space mean speed in ramp influence area, $S_R = 51.2$ mph

Space mean speed in outer lanes, $S_0 = 65.8$ mph

Space mean speed for all vehicles, $S = 53.7$ mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-10&4_Ex7_NB-Off_PM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 7 NB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 10 & 4
Description: FEET I-293

_____Freeway Data_____

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	3740	vph

_____Off Ramp Data_____

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1055	vph
Length of first accel/decel lane	486	ft
Length of second accel/decel lane		ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	575	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2400	ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3740	1055	575	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1039	293	160	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990
Driver population factor, fP	1.00	1.00	1.00
Flow rate, vp	4259	1184	645 pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.599 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3026 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4259	6900	No
v_{12}	3026	4400	No
$v_{FO} = v_F - v_R$	3075	6900	No
v_R	1184	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D$ = 25.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S	= 0.535	
Space mean speed in ramp influence area,	S_R	= 50.4	mph
Space mean speed in outer lanes,	S_O	= 64.9	mph
Space mean speed for all vehicles,	S	= 53.9	mph

```
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VHB, Inc
VHB
101 Walnut St.
Watertown MA


Phone:   617-924-1770                        Fax:
E-mail:


_____Merge Analysis_____

Analyst:                 NBS (Alt-9&4567_Ex7_NB-On_AM)
Agency/Co.:              VHB
Date performed:          3/20/2013
Analysis time period:    AM Peak Hour
Freeway/Dir of Travel:   I-293 / NB
Junction:                Exit 7 NB On Ramp
Jurisdiction:            NHDOT
Analysis Year:           2035 Build - Alt 9 & 4,5,6&7
Description:  FEET I-293


_____Freeway Data_____

Type of analysis                     Merge
Number of lanes in freeway           3
Free-flow speed on freeway           60.0          mph
Volume on freeway                    1185          vph


_____On Ramp Data_____

Side of freeway                      Right
Number of lanes in ramp              1
Free-flow speed on ramp              35.0          mph
Volume on ramp                       305           vph
Length of first accel/decel lane     800           ft
Length of second accel/decel lane                  ft


_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?            Yes
Volume on adjacent Ramp              570           vph
Position of adjacent Ramp            Upstream
Type of adjacent Ramp                Off
Distance to adjacent Ramp            2400          ft


_____Conversion to pc/h Under Base Conditions_____

Junction Components          Freeway      Ramp        Adjacent
                                                      Ramp
Volume, V (vph)              1185         305         570       vph
Peak-hour factor, PHF        0.90         0.90        0.90
Peak 15-min volume, v15      329          85          158       v
Trucks and buses             5            2           2         %
Recreational vehicles        0            0           0         %
Terrain type:                Level        Level       Level
     Grade                                %           %         %
     Length                               mi          mi       mi
Trucks and buses PCE, ET     1.5          1.5         1.5
Recreational vehicle PCE, ER 1.2          1.2         1.2
```

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1350	342	640	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 145.49 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F (P_{FM}) = 810 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	1692	6900	No
v_{R12}	1152	4600	No

_____Level of Service Determination (if not F)_____

Density, $D = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A = 9.3 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence A

_____Speed Estimation_____

Intermediate speed variable, $\qquad M_S = 0.277$

Space mean speed in ramp influence area, $\quad S_R = 55.0 \quad$ mph

Space mean speed in outer lanes, $\qquad S_0 = 59.9 \quad$ mph

Space mean speed for all vehicles, $\qquad S = 56.5 \quad$ mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-9&4567_Ex7_NB-On_PM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 7 NB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 9 & 4,5,6&7
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2800   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   360   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   1000   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   2400   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2800	360	1000	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	778	100	278	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976      0.990      0.990
Driver population factor, fP           1.00       1.00       1.00
Flow rate, vp                          3189       404        1122      pcph
```

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 552.30 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F (P_{FM}) = 1913 \quad pc/h$$

_____Capacity Checks_____

```
                  Actual        Maximum         LOS F?
v                 3593          6900            No
 FO

v                 2317          4600            No
 R12
```

_____Level of Service Determination (if not F)_____

$$\text{Density, } D = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 18.3 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence   B

_____Speed Estimation_____

Intermediate speed variable, M_S = 0.305

Space mean speed in ramp influence area, S_R = 54.5   mph

Space mean speed in outer lanes, S_O = 57.2   mph

Space mean speed for all vehicles, S = 55.4   mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-10&4_Ex7_NB-On_AM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 7 NB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 10 & 4
Description: FEET I-293

_____Freeway Data_____

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	1075	vph

_____On Ramp Data_____

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	565	vph
Length of first accel/decel lane	800	ft
Length of second accel/decel lane		ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	590	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2400	ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1075	565	590	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	299	157	164	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1224	634	662	pcph

_____Estimation of V12 Merge Areas_____

L_{EQ} = 181.01   (Equation 25-2 or 25-3)

P_{FM} = 0.600   Using Equation 1

$v_{12} = v_F (P_{FM})$ = 734   pc/h

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	1858	6900	No
v_{R12}	1368	4600	No

_____Level of Service Determination (if not F)_____

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 10.8   pc/mi/ln

Level of service for ramp-freeway junction areas of influence   B

_____Speed Estimation_____

Intermediate speed variable, M_S = 0.280

Space mean speed in ramp influence area, S_R = 55.0   mph

Space mean speed in outer lanes, S_0 = 60.0   mph

Space mean speed for all vehicles, S = 56.2   mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-10&4_Ex7_NB-On_PM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 7 NB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 10 & 4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2685   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   575   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   1055   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   2400   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2685	575	1055	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	746	160	293	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3058	645	1184	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 575.84 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F (P_{FM}) = 1834 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	3703	6900	No
v_{R12}	2479	4600	No

_____Level of Service Determination (if not F)_____

$$\text{Density, } D = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 19.5 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable,	$M_S = 0.312$	
Space mean speed in ramp influence area,	$S_R = 54.4$	mph
Space mean speed in outer lanes,	$S_0 = 57.4$	mph
Space mean speed for all vehicles,	$S = 55.3$	mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-9&4_Ex7_SB-Off_AM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 9 & 4
Description: FEET I-293

_____Freeway Data_____

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	2590	vph

_____Off Ramp Data_____

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	210	vph
Length of first accel/decel lane	486	ft
Length of second accel/decel lane		ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	625	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1200	ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2590	210	625	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	719	58	174	v
Trucks and buses	4	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.980	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2935	236	701	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.676 \qquad \text{Using Equation } 5$$

$$v_{12} = v_R + (v_F - v_R)\, P_{FD} = 2060 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2935	6900	No
v_{12}	2060	4400	No
$v_{FO} = v_F - v_R$	2699	6900	No
v_R	236	2000	No

_____Level of Service Determination (if not F)_____

Density, $\qquad D = 4.252 + 0.0086\, v_R - 0.009\, L_D = 17.6 \quad pc/mi/ln$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad 12$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $\qquad D_S = 0.449$

Space mean speed in ramp influence area, $\quad S_R = 51.9 \quad mph$

Space mean speed in outer lanes, $\qquad S_O = 65.8 \quad mph$

Space mean speed for all vehicles, $\qquad S = 55.4 \quad mph$

_____

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-9&4_Ex7_SB-Off_PM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 9 & 4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2310   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   275   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   350   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   1200   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2310	275	350	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	642	76	97	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976        0.990        0.990
Driver population factor, fP           1.00         1.00         1.00
Flow rate, vp                          2631         309          393          pcph
```

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.680 \qquad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R)\, P_{FD} = 1888 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2631	6900	No
v_{12}	1888	4400	No
$v_{FO} = v_F - v_R$	2322	6900	No
v_R	309	2000	No

_____Level of Service Determination (if not F)_____

Density, $D = 4.252 + 0.0086\, v_R - 0.009\, L_D = 16.1$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.456$

Space mean speed in ramp influence area, $S_R = 51.8$ mph

Space mean speed in outer lanes, $S_0 = 65.8$ mph

Space mean speed for all vehicles, $S = 55.1$ mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-10&4_Ex7_SB-Off_AM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 10 & 4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2690   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   410   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   675   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   1200   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2690	410	675	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	747	114	188	v
Trucks and buses	4	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.980      0.990      0.990
Driver population factor, fP           1.00       1.00       1.00
Flow rate, vp                          3049       460        758       pcph
```

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.663 \qquad \text{Using Equation } 5$$

$$v_{12} = v_R + (v_F - v_R)\, P_{FD} = 2176 \quad pc/h$$

_____Capacity Checks_____

```
                 Actual        Maximum           LOS F?
v   = v          3049          6900              No
 Fi   F
v                2176          4400              No
 12
v   = v - v      2589          6900              No
 FO   F   R
v                460           2000              No
 R
```

_____Level of Service Determination (if not F)_____

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D = 18.6$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.469$

Space mean speed in ramp influence area, $S_R = 51.6$ mph

Space mean speed in outer lanes, $S_O = 65.8$ mph

Space mean speed for all vehicles, $S = 55.0$ mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-10&4_Ex7_SB-Off_PM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 10 & 4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2460   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   535   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   375   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   1200   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2460	535	375	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	683	149	104	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2802	600	421	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.662 \qquad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 2058 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2802	6900	No
v_{12}	2058	4400	No
$v_{FO} = v_F - v_R$	2202	6900	No
v_R	600	2000	No

_____Level of Service Determination (if not F)_____

Density, $\qquad D = 4.252 + 0.0086\ v_{12} - 0.009\ L_D = 17.6 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $\qquad D_S = 0.482$

Space mean speed in ramp influence area, $\qquad S_R = 51.3 \quad mph$

Space mean speed in outer lanes, $\qquad S_O = 65.8 \quad mph$

Space mean speed for all vehicles, $\qquad S = 54.5 \quad mph$

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-9&567_Ex7_SB-Off_AM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 9 & 5,6&7
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2590   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   210   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   625   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   1200   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2590	210	625	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	719	58	174	v
Trucks and buses	4	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.980     0.990     0.990
Driver population factor, fP           1.00      1.00      1.00
Flow rate, vp                          2935      236       701       pcph
```

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad\qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.676 \qquad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R)\,P_{FD} = 2060 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2935	6900	No
v_{12}	2060	4400	No
$v_{FO} = v_F - v_R$	2699	6900	No
v_R	236	2000	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 4.252 + 0.0086\,v_{12} - 0.009\,L_D = 17.6 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $D_S = 0.449$

Space mean speed in ramp influence area, $S_R = 51.9 \quad mph$

Space mean speed in outer lanes, $S_0 = 65.8 \quad mph$

Space mean speed for all vehicles, $S = 55.4 \quad mph$

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-9&567_Ex7_SB-Off_PM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 9 & 5,6&7
Description: FEET I-293

_____Freeway Data_____

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	2330	vph

_____Off Ramp Data_____

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	275	vph
Length of first accel/decel lane	486	ft
Length of second accel/decel lane		ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	350	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1200	ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2330	275	350	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	647	76	97	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00	%
Length	0.00 mi	0.00 mi	0.00	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2654	309	393	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.679 \qquad \text{Using Equation } 5$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 1902 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2654	6900	No
v_{12}	1902	4400	No
$v_{FO} = v_F - v_R$	2345	6900	No
v_R	309	2000	No

_____Level of Service Determination (if not F)_____

Density, $\qquad D = 4.252 + 0.0086\ v_R - 0.009\ L_{12} = 16.2 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $\qquad D_S = 0.456$

Space mean speed in ramp influence area, $\qquad S_R = 51.8 \quad$ mph

Space mean speed in outer lanes, $\qquad S_0 = 65.8 \quad$ mph

Space mean speed for all vehicles, $\qquad S = 55.1 \quad$ mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-9&4_Ex7_SB-On_AM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build Alt 9&4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2380   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   625   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   210   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   1200   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2380	625	210	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	661	174	58	v
Trucks and buses	4	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.980      0.990      0.990
Driver population factor, fP           1.00       1.00       1.00
Flow rate, vp                          2697       701        236        pcph
```

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 510.57 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F (P_{FM}) = 1618 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	3398	6900	No
v_{R12}	2319	4600	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 18.2 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence   B

_____Speed Estimation_____

Intermediate speed variable, $M_S = 0.305$

Space mean speed in ramp influence area, $S_R = 54.5 \quad mph$

Space mean speed in outer lanes, $S_0 = 57.9 \quad mph$

Space mean speed for all vehicles, $S = 55.6 \quad mph$

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-9&4_Ex7_SB-On_PM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build Alt 9&4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2035   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   350   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   275   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   1200   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2035	350	275	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	565	97	76	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade		%	%	%
Length		mi	mi	mi
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990
Driver population factor, fP	1.00	1.00	1.00
Flow rate, vp	2318	393	309 pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 363.55 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F(P_{FM}) = 1391 \quad \text{pc/h}$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	2711	6900	No
v_{R12}	1784	4600	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A = 14.2$ pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable,	$M_S = 0.288$	
Space mean speed in ramp influence area,	$S_R = 54.8$	mph
Space mean speed in outer lanes,	$S_O = 58.5$	mph
Space mean speed for all vehicles,	$S = 56.0$	mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-10&4_Ex7_SB-On_AM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build Alt 10&4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2280   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   675   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   410   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   1200   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2280	675	410	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	633	188	114	v
Trucks and buses	4	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.980      0.990      0.990
Driver population factor, fP           1.00       1.00       1.00
Flow rate, vp                          2584       758        460        pcph
```

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 498.59 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F (P_{FM}) = 1550 \quad pc/h$$

_____Capacity Checks_____

```
                  Actual       Maximum        LOS F?
v                 3342         6900           No
 FO
v                 2308         4600           No
 R12
```

_____Level of Service Determination (if not F)_____

$$\text{Density, } D = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A = 18.1 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence   B

_____Speed Estimation_____

Intermediate speed variable, M_S = 0.304

Space mean speed in ramp influence area, S_R = 54.5   mph

Space mean speed in outer lanes, S_O = 58.1   mph

Space mean speed for all vehicles, S = 55.6   mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-10&4_Ex7_SB-On_PM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build Alt 10&4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   1925   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   375   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   535   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   1200   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1925	375	535	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	535	104	149	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV        0.976       0.990       0.990
Driver population factor, fP          1.00        1.00        1.00
Flow rate, vp                         2192         421         600        pcph
```

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 342.58 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F(P_{FM}) = 1315 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	2613	6900	No
v_{R12}	1736	4600	No

_____Level of Service Determination (if not F)_____

$$\text{Density, } D = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 13.8 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence   B

_____Speed Estimation_____

Intermediate speed variable, $M_S = 0.287$

Space mean speed in ramp influence area, $S_R = 54.8$ mph

Space mean speed in outer lanes, $S_O = 58.6$ mph

Space mean speed for all vehicles, $S = 56.1$ mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-9&567_Ex7_SB-On_AM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 9 & 5,6,7
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2380   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   625   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   210   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   1200   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2380	625	210	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	661	174	58	v
Trucks and buses	4	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, f_{HV}	0.980	0.990	0.990
Driver population factor, f_P	1.00	1.00	1.00
Flow rate, v_p	2697	701	236	pcph

Estimation of V12 Merge Areas

$$L_{EQ} = 510.57 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation } 1$$

$$v_{12} = v_F(P_{FM}) = 1618 \quad pc/h$$

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3398	6900	No
v_{R12}	2319	4600	No

Level of Service Determination (if not F)

$$\text{Density, } D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 18.2 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence   B

Speed Estimation

Intermediate speed variable,	$M_S = 0.305$	
Space mean speed in ramp influence area,	$S_R = 54.5$	mph
Space mean speed in outer lanes,	$S_0 = 57.9$	mph
Space mean speed for all vehicles,	$S = 55.6$	mph

```
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VHB, Inc
VHB
101 Walnut St.
Watertown MA


Phone:   617-924-1770                        Fax:
E-mail:


_____Merge Analysis_____

Analyst:                NBS (Alt-9&567_Ex7_SB-On_PM)
Agency/Co.:             VHB
Date performed:         3/20/2013
Analysis time period:   PM Peak Hour
Freeway/Dir of Travel:  I-293 / SB
Junction:               Exit 7 SB On Ramp
Jurisdiction:           NHDOT
Analysis Year:          2035 Build - Alt 9 & 5,6,7
Description:  FEET I-293


_____Freeway Data_____

Type of analysis                        Merge
Number of lanes in freeway              3
Free-flow speed on freeway              60.0           mph
Volume on freeway                       2055           vph


_____On Ramp Data_____

Side of freeway                         Right
Number of lanes in ramp                 1
Free-flow speed on ramp                 35.0           mph
Volume on ramp                          350            vph
Length of first accel/decel lane        800            ft
Length of second accel/decel lane                      ft


_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?               Yes
Volume on adjacent Ramp                 275            vph
Position of adjacent Ramp               Upstream
Type of adjacent Ramp                   Off
Distance to adjacent Ramp               1200           ft


_____Conversion to pc/h Under Base Conditions_____

Junction Components         Freeway     Ramp        Adjacent
                                                    Ramp
Volume, V (vph)             2055        350         275        vph
Peak-hour factor, PHF       0.90        0.90        0.90
Peak 15-min volume, v15     571         97          76         v
Trucks and buses            5           2           2          %
Recreational vehicles       0           0           0          %
Terrain type:               Level       Level       Level
     Grade                          %           %           %
     Length                         mi          mi          mi
Trucks and buses PCE, ET    1.5         1.5         1.5
Recreational vehicle PCE, ER 1.2        1.2         1.2
```

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2340	393	309	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 368.26 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F(P_{FM}) = 1404 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	2733	6900	No
v_{R12}	1797	4600	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 5.475 + 0.00734 \, v_R + 0.0078 \, v_{12} - 0.00627 \, L_A = 14.3 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable,	$M_S = 0.289$	
Space mean speed in ramp influence area,	$S_R = 54.8$	mph
Space mean speed in outer lanes,	$S_O = 58.4$	mph
Space mean speed for all vehicles,	$S = 56.0$	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-8&4_Ex7_NB-On_AM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 7 NB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 8&4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   935   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   155   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   970   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   2300   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	935	155	970	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	260	43	269	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1065	174	1089	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 48.55 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.600 \quad \text{Using Equation 1}$$

$$v_{12} = v_F (P_{FM}) = 639 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	1239	6900	No
v_{R12}	813	4600	No

_____Level of Service Determination (if not F)_____

$$\text{Density, } D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A = 6.7 \quad pc/mi/ln$$

Level of service for ramp-freeway junction areas of influence   A

_____Speed Estimation_____

Intermediate speed variable,	M_S	= 0.274	
Space mean speed in ramp influence area,	S_R	= 55.1	mph
Space mean speed in outer lanes,	S_0	= 60.0	mph
Space mean speed for all vehicles,	S	= 56.7	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-8&4_Ex7_NB-On_PM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Junction: Exit 7 NB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 8&4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2700   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   160   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   1300   vph
Position of adjacent Ramp   Upstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   2300   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2700	160	1300	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	750	44	361	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3075	180	1459	pcph

_____Estimation of V12 Merge Areas_____

L_{EQ} = 479.97   (Equation 25-2 or 25-3)

P_{FM} = 0.600   Using Equation 1

$v_{12} = v_F(P_{FM})$ = 1845   pc/h

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	3255	6900	No
v_{R12}	2025	4600	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 16.2   pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, M_S = 0.295

Space mean speed in ramp influence area, S_R = 54.7   mph

Space mean speed in outer lanes, S_O = 57.4   mph

Space mean speed for all vehicles, S = 55.7   mph

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VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst.:   NBS (Alt-8&4_Ex7_SB-Off_AM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 8 & 4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2240   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   260   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   1025   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   2000   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2240	260	1025	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	622	72	285	v
Trucks and buses	4	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.980	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2539	292	1150	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.683 \qquad \text{Using Equation } 5$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 1827 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2539	6900	No
v_{12}	1827	4400	No
$v_{FO} = v_F - v_R$	2247	6900	No
v_R	292	2000	No

_____Level of Service Determination (if not F)_____

Density, $\qquad D = 4.252 + 0.0086 \, v_{12} - 0.009 \, L_D = 15.6 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable, $\qquad D_S = 0.454$

Space mean speed in ramp influence area, $\qquad S_R = 51.8 \quad$ mph

Space mean speed in outer lanes, $\qquad S_0 = 65.8 \quad$ mph

Space mean speed for all vehicles, $\qquad S = 55.1 \quad$ mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Diverge Analysis_____

Analyst: NBS (Alt-8&4_Ex7_SB-Off_PM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB Off Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build - Alt 8 & 4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Diverge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   2120   vph

_____Off Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-Flow speed on ramp   35.0   mph
Volume on ramp   375   vph
Length of first accel/decel lane   486   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent ramp   650   vph
Position of adjacent ramp   Downstream
Type of adjacent ramp   On
Distance to adjacent ramp   2000   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2120	375	650	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	589	104	181	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2414	421	729	pcph

_____Estimation of V12 Diverge Areas_____

$$L_{EQ} = \qquad \text{(Equation 25-8 or 25-9)}$$

$$P_{FD} = 0.680 \qquad \text{Using Equation 5}$$

$$v_{12} = v_R + (v_F - v_R) P_{FD} = 1777 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2414	6900	No
v_{12}	1777	4400	No
$v_{FO} = v_F - v_R$	1993	6900	No
v_R	421	2000	No

_____Level of Service Determination (if not F)_____

Density, $\qquad D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D = 15.2 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable,	$D_S = 0.466$	
Space mean speed in ramp influence area,	$S_R = 51.6$	mph
Space mean speed in outer lanes,	$S_0 = 65.8$	mph
Space mean speed for all vehicles,	$S = 54.7$	mph

HCS2000: Ramps and Ramp Junctions Release 4.1f

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Merge Analysis_____

Analyst: NBS (Alt-8&4_Ex7_SB-On_PM)
Agency/Co.:   VHB
Date performed: 3/20/2013
Analysis time period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Junction: Exit 7 SB On Ramp
Jurisdiction: NHDOT
Analysis Year: 2035 Build Alt 8&4
Description: FEET I-293

_____Freeway Data_____

Type of analysis   Merge
Number of lanes in freeway   3
Free-flow speed on freeway   60.0   mph
Volume on freeway   1745   vph

_____On Ramp Data_____

Side of freeway   Right
Number of lanes in ramp   1
Free-flow speed on ramp   35.0   mph
Volume on ramp   650   vph
Length of first accel/decel lane   800   ft
Length of second accel/decel lane   ft

_____Adjacent Ramp Data (if one exists)_____

Does adjacent ramp exist?   Yes
Volume on adjacent Ramp   540   vph
Position of adjacent Ramp   Downstream
Type of adjacent Ramp   Off
Distance to adjacent Ramp   1900   ft

_____Conversion to pc/h Under Base Conditions_____

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1745	650	540	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	485	181	150	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1987	729	606	pcph

_____Estimation of V12 Merge Areas_____

$$L_{EQ} = 3104.51 \quad \text{(Equation 25-2 or 25-3)}$$

$$P_{FM} = 0.633 \quad \text{Using Equation } 3$$

$$v_{12} = v_F(P_{FM}) = 1257 \quad pc/h$$

_____Capacity Checks_____

	Actual	Maximum	LOS F?
v_{FO}	2716	6900	No
v_{R12}	1986	4600	No

_____Level of Service Determination (if not F)_____

Density, $D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 15.6 \quad pc/mi/ln$

Level of service for ramp-freeway junction areas of influence B

_____Speed Estimation_____

Intermediate speed variable,	M_S	= 0.293	
Space mean speed in ramp influence area,	S_R	= 54.7	mph
Space mean speed in outer lanes,	S_0	= 59.2	mph
Space mean speed for all vehicles,	S	= 55.8	mph

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail: .

_____Operational Analysis_____

Analyst: NBS (A_Alt-4&8_Ex6-7_NB_AM)
Agency/Co.:   VHB
Date Performed: 3/20/2013
Analysis Time Period: AM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Weaving Location: Exit 6 to Exit 7
Jurisdiction: NHDOT
Analysis Year: 2035 Build Alt 4 & 8
Description: FEET I-293

_____Inputs_____

Freeway free-flow speed, SFF	60	mph
Weaving number of lanes, N	4	
Weaving segment length, L	1550	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	A	
Volume ratio, VR	0.84	
Weaving ratio, R	0.46	

_____Conversion to pc/h Under Base Conditions_____

	Non-Weaving		Weaving		
	V	V	V	V	
	A-C	B-D	A-D	B-C	
Volume, V	200	100	870	735	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	56	28	242	204	v
Trucks and buses	5	2	2	2	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.976	0.990	0.990	0.990	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	227	112	976	824	pc/h

_____Weaving and Non-Weaving Speeds_____

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.15	0.00
b (Exhibit 24-6)	2.20	4.00
c (Exhibit 24-6)	0.97	1.30
d (Exhibit 24-6)	0.80	0.75
Weaving intensity factor, Wi	1.67	0.33
Weaving and non-weaving speeds, Si	33.76	52.66
Number of lanes required for		

unconstrained operation, Nw (Exhibit 24-7)   2.85
Maximum number of lanes, Nw (max) (Exhibit 24-7)   1.40
Type of operation is   Constrained

_____Weaving Segment Speed, Density, Level of Service and Capacity_____

Weaving segment speed, S   35.80   mph
Weaving segment density, D   14.94   pc/mi/ln
Level of service, LOS   B
Capacity of base condition, cb   6843   pc/h
Capacity as a 15-minute flow rate, c   6676   pc/h
Capacity as a full-hour volume, ch   6008   pc/h

_____Limitations on Weaving Segments_____

	Analyzed	If Max Exceeded See Note Maximum	Note
Weaving flow rate, Vw	1800	2800	a
Average flow rate (pcphpl)	534	2300	b
Volume ratio, VR	0.84	0.35	c
Weaving ratio, R	0.46	N/A	d
Weaving length (ft)	1550	2500	e

Notes:
a. Weaving segments longer than 2500 ft. are treated as isolated merge and
   diverge areas using the procedures of Chapter 25, "Ramps and Ramp
   Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater
   than 0.45. Poor operations and some local queuing are expected in such
   cases.
e. Four-lane Type A segments do not operate well at volume ratios greater
   than 0.35. Poor operations and some local queuing are expected in such
   cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h
   (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater
   than 0.20. Poor operations and some local queuing are expected in such
   cases.
h. Type B weaving segments do not operate well at volume ratios greater
   than 0.80. Poor operations and some local queuing are expected in such
   cases.
i. Type C weaving segments do not operate well at volume ratios greater
   than 0.50. Poor operations and some local queuing are expected in such
   cases.

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Operational Analysis_____

Analyst: NBS (A_Alt-4&8_Ex6-7_NB_PM)
Agency/Co.:   VHB
Date Performed: 3/20/2013
Analysis Time Period: PM Peak Hour
Freeway/Dir of Travel: I-293 / NB
Weaving Location: Exit 6 to Exit 7
Jurisdiction: NHDOT
Analysis Year: 2035 Build Alt 4 & 8
Description: FEET I-293

_____Inputs_____

Freeway free-flow speed, SFF   60   mph
Weaving number of lanes, N   4
Weaving segment length, L   1550   ft
Terrain type   Level
    Grade   %
    Length   mi
Weaving type   A
Volume ratio, VR   0.61
Weaving ratio, R   0.49

_____Conversion to pc/h Under Base Conditions_____

| | Non-Weaving | | Weaving | | |
	V A-C	V B-D	V A-D	V B-C	
Volume, V	1450	100	1200	1250	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	403	28	333	347	v
Trucks and buses	5	2	2	2	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.976	0.990	0.990	0.990	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	1651	112	1346	1402	pc/h

_____Weaving and Non-Weaving Speeds_____

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.15	0.00
b (Exhibit 24-6)	2.20	4.00
c (Exhibit 24-6)	0.97	1.30
d (Exhibit 24-6)	0.80	0.75
Weaving intensity factor, Wi	2.55	0.50
Weaving and non-weaving speeds, Si	29.07	48.24
Number of lanes required for		

unconstrained operation, Nw (Exhibit 24-7)   2.50
Maximum number of lanes, Nw (max) (Exhibit 24-7)   1.40
Type of operation is   Constrained

_____Weaving Segment Speed, Density, Level of Service and Capacity_____

Weaving segment speed, S   34.42   mph
Weaving segment density, D   32.77   pc/mi/ln
Level of service, LOS   D
Capacity of base condition, cb   6843   pc/h
Capacity as a 15-minute flow rate, c 6676   pc/h
Capacity as a full-hour volume, ch 6008   pc/h

_____Limitations on Weaving Segments_____

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	2748	2800	a
Average flow rate (pcphpl)	1127	2300	b
Volume ratio, VR	0.61	0.35	c
Weaving ratio, R	0.49	N/A	d
Weaving length (ft)	1550	2500	e

Notes:
a. Weaving segments longer than 2500 ft. are treated as isolated merge and
    diverge areas using the procedures of Chapter 25, "Ramps and Ramp
    Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater
    than 0.45. Poor operations and some local queuing are expected in such
    cases.
e. Four-lane Type A segments do not operate well at volume ratios greater
    than 0.35. Poor operations and some local queuing are expected in such
    cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h
    (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater
    than 0.20. Poor operations and some local queuing are expected in such
    cases.
h. Type B weaving segments do not operate well at volume ratios greater
    than 0.80. Poor operations and some local queuing are expected in such
    cases.
i. Type C weaving segments do not operate well at volume ratios greater
    than 0.50. Poor operations and some local queuing are expected in such
    cases.

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Operational Analysis_____

Analyst: NBS (A_Alt-4&8_Ex6-7_SB_AM)
Agency/Co.:   VHB
Date Performed: 3/20/2013
Analysis Time Period: AM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Weaving Location: Exit 6 to Exit 7
Jurisdiction: NHDOT
Analysis Year: 2035 Build Alt 4 & 8
Description: FEET I-293

_____Inputs_____

Freeway free-flow speed, SFF   60   mph
Weaving number of lanes, N   4
Weaving segment length, L   1600   ft
Terrain type   Level
    Grade   %
    Length   mi
Weaving type   A
Volume ratio, VR   0.64
Weaving ratio, R   0.48

_____Conversion to pc/h Under Base Conditions_____

	Non-Weaving		Weaving		
	V	V	V	V	
	A-C	B-D	A-D	B-C	
Volume, V	980	100	1000	925	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	272	28	278	257	v
Trucks and buses	4	2	2	2	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.980	0.990	0.990	0.990	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	1110	112	1122	1038	pc/h

_____Weaving and Non-Weaving Speeds_____

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.15	0.00
b (Exhibit 24-6)	2.20	4.00
c (Exhibit 24-6)	0.97	1.30
d (Exhibit 24-6)	0.80	0.75
Weaving intensity factor, Wi	1.96	0.36
Weaving and non-weaving speeds, Si	31.90	51.66

Number of lanes required for

```
unconstrained operation, Nw (Exhibit 24-7)          2.50
Maximum number of lanes, Nw (max) (Exhibit 24-7)    1.40
Type of operation is                                Constrained
```

_____Weaving Segment Speed, Density, Level of Service and Capacity_____

```
Weaving segment speed, S              37.01  mph
Weaving segment density, D            22.84  pc/mi/ln
Level of service, LOS                 C
Capacity of base condition, cb        6876   pc/h
Capacity as a 15-minute flow rate, .c 6741   pc/h
Capacity as a full-hour volume, ch    6067   pc/h
```

_____Limitations on Weaving Segments_____

		If Max Exceeded	See Note
	Analyzed	Maximum	Note
Weaving flow rate, Vw	2160	2800	a
Average flow rate (pcphpl)	845	2300	b
Volume ratio, VR	0.64	0.35	c
Weaving ratio, R	0.48	N/A	d
Weaving length (ft)	1600	2500	e

Notes:

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

VHB, Inc
VHB
101 Walnut St.
Watertown MA

Phone: 617-924-1770   Fax:
E-mail:

_____Operational Analysis_____

Analyst: NBS (A_Alt-4&8_Ex6-7_SB_PM)
Agency/Co.:   VHB
Date Performed: 3/20/2013
Analysis Time Period: PM Peak Hour
Freeway/Dir of Travel: I-293 / SB
Weaving Location: Exit 6 to Exit 7
Jurisdiction: NHDOT
Analysis Year: 2035 Build Alt 4 & 8
Description: FEET I-293

_____Inputs_____

Freeway free-flow speed, SFF	60	mph
Weaving number of lanes, N	4	
Weaving segment length, L	1600	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	A	
Volume ratio, VR	0.45	
Weaving ratio, R	0.45	

_____Conversion to pc/h Under Base Conditions_____

	Non-Weaving		Weaving		
	V	V	V	V	
	A-C	B-D	A-D	B-C	
Volume, V	1255	50	490	600	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	349	14	136	167	v
Trucks and buses	5	2	2	2	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.976	0.990	0.990	0.990	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	1429	56	549	673	pc/h

_____Weaving and Non-Weaving Speeds_____

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.15	0.00
b (Exhibit 24-6)	2.20	4.00
c (Exhibit 24-6)	0.97	1.30
d (Exhibit 24-6)	0.80	0.75
Weaving intensity factor, Wi	1.21	0.17
Weaving and non-weaving speeds, Si	37.64	57.82

Number of lanes required for

unconstrained operation, Nw (Exhibit 24-7)   1.94
Maximum number of lanes, Nw (max) (Exhibit 24-7)   1.40
Type of operation is   Constrained

_____Weaving Segment Speed, Density, Level of Service and Capacity_____

Weaving segment speed, S   46.55   mph
Weaving segment density, D   14.54   pc/mi/ln
Level of service, LOS   B
Capacity of base condition, cb   6876   pc/h
Capacity as a 15-minute flow rate, c   6708   pc/h
Capacity as a full-hour volume, ch   6037   pc/h

_____Limitations on Weaving Segments_____

	Analyzed	If Max Exceeded See Note Maximum	Note
Weaving flow rate, Vw	1222	2800	a
Average flow rate (pcphpl)	676	2300	b
Volume ratio, VR	0.45	0.35	c
Weaving ratio, R	0.45	N/A	d
Weaving length (ft)	1600	2500	e

Notes:
a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.