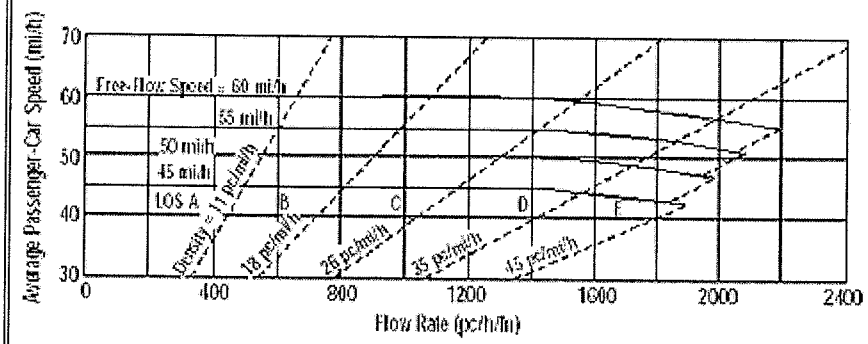
MULTILANE HIGHWAYS WORKSHEET(Direction 2)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKP
Agency or Company	MRO Engineers, Inc.
Date Performed	10/29/2007
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Todd Valley W to Owl Hill Ct
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1082	Peak-Hour Factor, PHF	0.79
AADT(veh/h)		%Trucks and Buses, P_T	2
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	1.20
Driver Type Adjustment	1.00	Up/Down %	-3.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.986

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	4
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.0
f_M (mi/h)	1.6
FFS (mi/h)	57.4

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	694
Speed, S (mi/h)	57.4
D (pc/mi/ln)	12.1
LOS	B

Design

Design (N)

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

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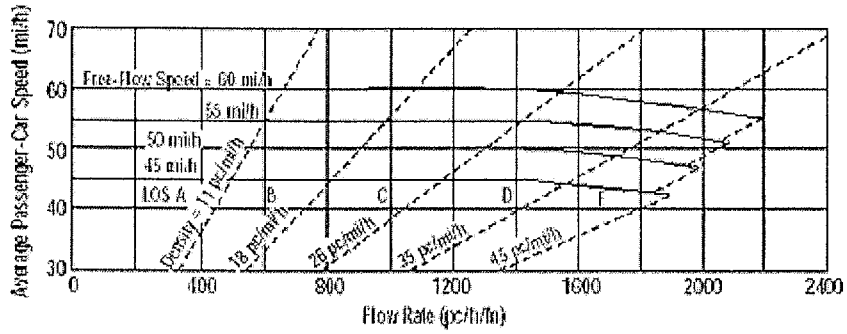
MULTILANE HIGHWAYS WORKSHEET(Direction 1)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKL
Agency or Company	MRO Engineers, Inc.
Date Performed	4/3/2007
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Bridge to Spring Garden Rd
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1574	Peak-Hour Factor, PHF	0.88
AADT(veh/h)		%Trucks and Buses, P_T	1
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	4.00
Driver Type Adjustment	1.00	Up/Down %	3.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	3.0
E_T	3.0	f_{HV}	0.943

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	2
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	0.5
f_M (mi/h)	1.6
FFS (mi/h)	57.9

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	947
Speed, S (mi/h)	57.9
D (pc/mi/ln)	16.4
LOS	B

Design

Design (N)

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

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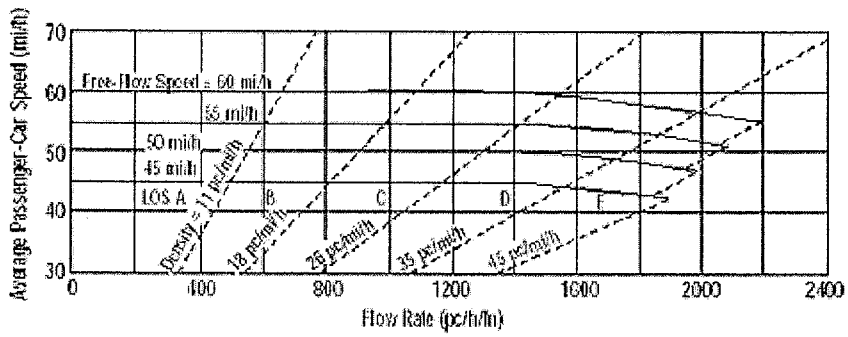
MULTILANE HIGHWAYS WORKSHEET(Direction 2)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKL
Agency or Company	MRO Engineers, Inc.
Date Performed	4/3/2007
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Bridge to Spring Garden Rd
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1210	Peak-Hour Factor, PHF	0.76
AADT(veh/h)		%Trucks and Buses, P_T	4
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	4.00
Driver Type Adjustment	1.00	Up/Down %	-3.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.977

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	2
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	0.5
f_M (mi/h)	1.6
FFS (mi/h)	57.9

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	815
Speed, S (mi/h)	57.9
D (pc/mi/ln)	14.1
LOS	B

Design

Design (N)

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

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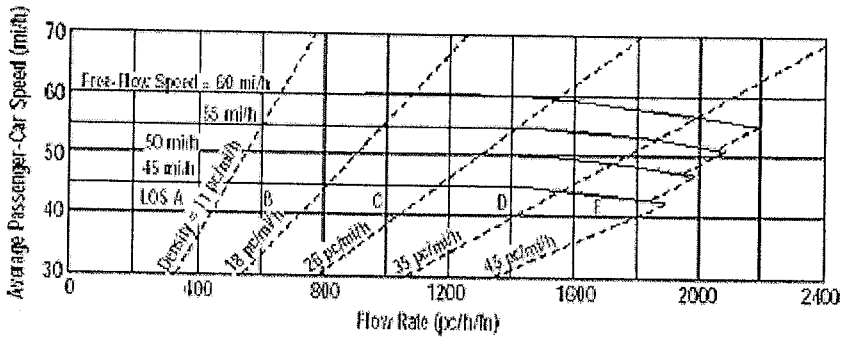
MULTILANE HIGHWAYS WORKSHEET(Direction 1)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKL
Agency or Company	MRO Engineers, Inc.
Date Performed	4/3/2007
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Spring Garden to Todd Valley W
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1117	Peak-Hour Factor, PHF	0.88
AADT(veh/h)		%Trucks and Buses, P_T	2
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	1.70
Driver Type Adjustment	1.00	Up/Down %	3.40
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	3.0
E_T	4.0	f_{HV}	0.909

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	4
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_w (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.0
f_M (mi/h)	1.6
FFS (mi/h)	57.4

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	698
Speed, S (mi/h)	57.4
D (pc/mi/ln)	12.2
LOS	B

Design

Design (N)

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

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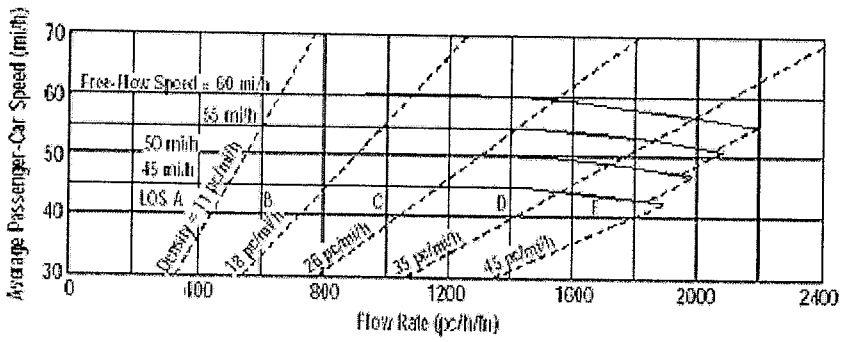
MULTILANE HIGHWAYS WORKSHEET(Direct 2)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKL
Agency or Company	MRO Engineers, Inc.
Date Performed	4/3/2007
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Spring Garden to Todd Valley W
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1305	Peak-Hour Factor, PHF	0.88
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	1.70
Driver Type Adjustment	1.00	Up/Down %	-3.40
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.981

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	5
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.3
f_M (mi/h)	1.6
FFS (mi/h)	57.2

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	755
Speed, S (mi/h)	57.2
D (pc/mi/ln)	13.2
LOS	B

Design

Design (N)

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

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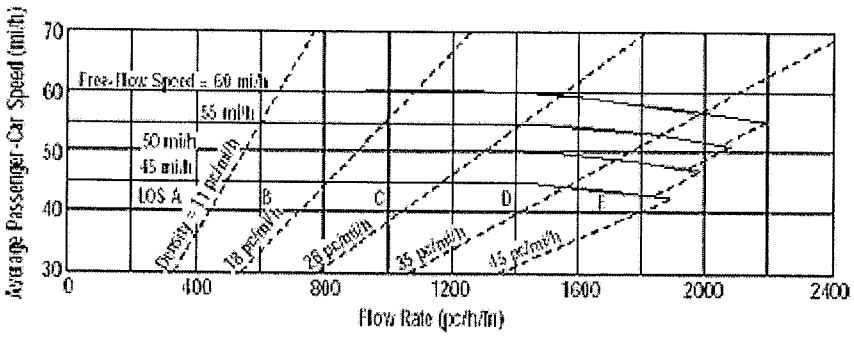
MULTILANE HIGHWAYS WORKSHEET(Direction 1)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKP
Agency or Company	MRO Engineers, Inc.
Date Performed	10/29/2007
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Todd Valley W to Owl Hill Ct
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1026	Peak-Hour Factor, PHF	0.85
AADT(veh/h)		%Trucks and Buses, P_T	2
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	1.20
Driver Type Adjustment	1.00	Up/Down %	3.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	3.0
E_T	2.5	f_{HV}	0.935

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	3
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	0.8
f_M (mi/h)	1.6
FFS (mi/h)	57.7

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	645
Speed, S (mi/h)	57.7
D (pc/mi/ln)	11.2
LOS	B

Design

Design (N)

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

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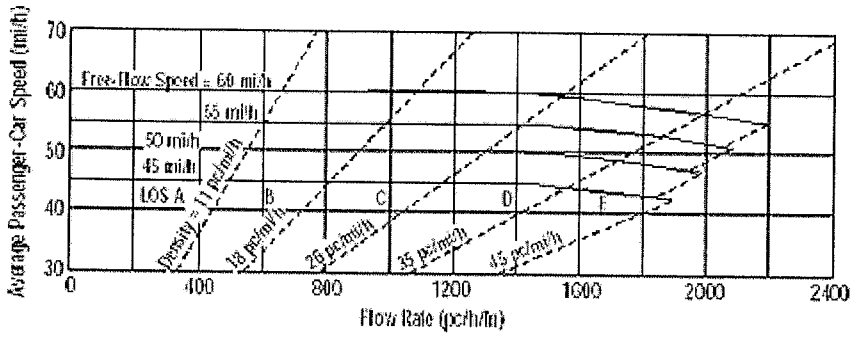
MULTILANE HIGHWAYS WORKSHEET(Direction 2)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKP
Agency or Company	MRO Engineers, Inc.
Date Performed	10/29/2007
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Todd Valley W to Owl Hill Ct
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1233	Peak-Hour Factor, PHF	0.88
AADT(veh/h)		%Trucks and Buses, P_T	4
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	1.20
Driver Type Adjustment	1.00	Up/Down %	-3.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.977

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	4
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.0
f_M (mi/h)	1.6
FFS (mi/h)	57.4

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	717
Speed, S (mi/h)	57.4
D (pc/mi/ln)	12.5
LOS	B

Design

Design (N)

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

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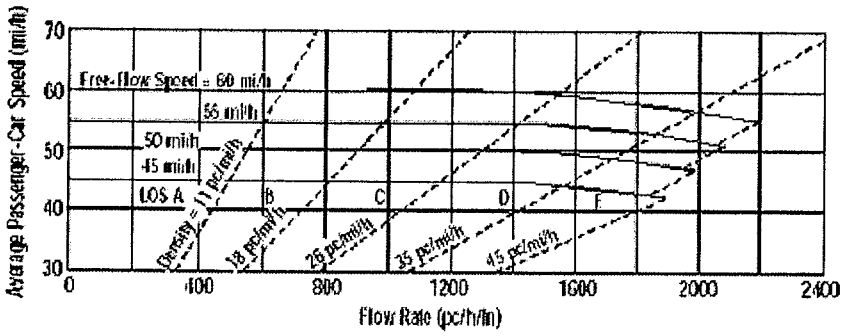
MRO ENGINEERS

MODIFIED LEVEL OF SERVICE CRITERIA
LEVEL OF SERVICE CALCULATION WORKSHEETS
BUILDOUT "WITHOUT FOREST RANCH" SCENARIO

MULTILANE HIGHWAYS WORKSHEET(Direction 1)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKL
Agency or Company	MRO Engineers, Inc.
Date Performed	4/3/2007
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Bridge to Spring Garden Rd
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1040	Peak-Hour Factor, PHF	0.88
AADT(veh/h)		%Trucks and Buses, P_T	6
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	4.00
Driver Type Adjustment	1.00	Up/Down %	3.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	3.0
E_T	2.5	f_{HV}	0.885

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	2
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	0.5
f_M (mi/h)	1.6
FFS (mi/h)	57.9

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	667
Speed, S (mi/h)	57.9
D (pc/mi/ln)	11.5
LOS	B

Design

Design (N)

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

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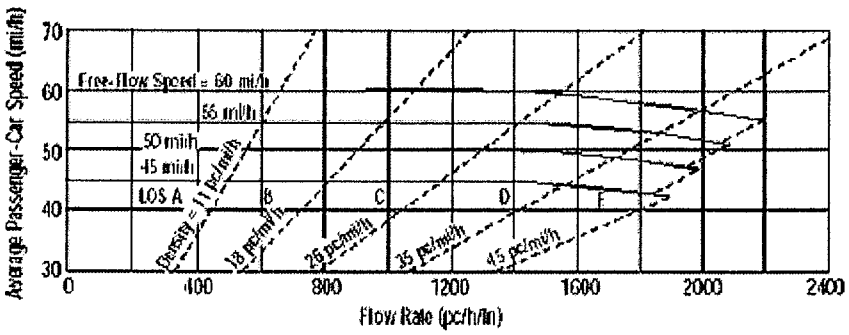
MULTILANE HIGHWAYS WORKSHEET(Direction 2)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKL
Agency or Company	MRO Engineers, Inc.
Date Performed	4/3/2007
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Bridge to Spring Garden Rd
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1768	Peak-Hour Factor, PHF	0.88
AADT(veh/h)		%Trucks and Buses, P_T	2
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	4.00
Driver Type Adjustment	1.00	Up/Down %	-3.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.986

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	2
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	0.5
f_M (mi/h)	1.6
FFS (mi/h)	57.9

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	1018
Speed, S (mi/h)	57.9
D (pc/mi/ln)	17.6
LOS	B

Design

Design (N)

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

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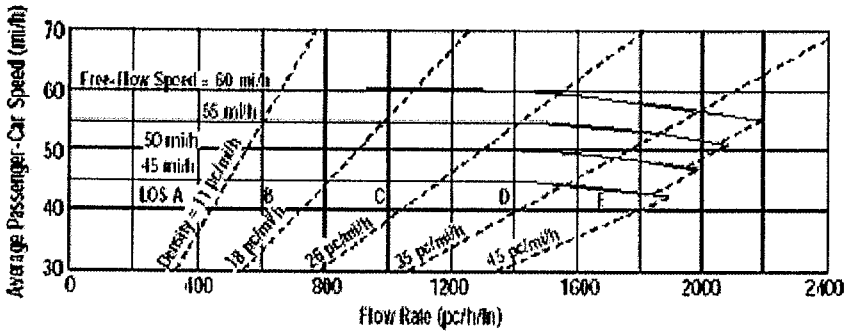
MULTILANE HIGHWAYS WORKSHEET(Direction 1)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKL
Agency or Company	MRO Engineers, Inc.
Date Performed	4/3/2007
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Spring Garden to Todd Valley W
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1160	Peak-Hour Factor, PHF	0.75
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	1.70
Driver Type Adjustment	1.00	Up/Down %	3.40
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	3.0
E_T	3.8	f_{HV}	0.891

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	4
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.0
f_M (mi/h)	1.6
FFS (mi/h)	57.4

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	868
Speed, S (mi/h)	57.4
D (pc/mi/ln)	15.1
LOS	B

Design

Design (N)

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

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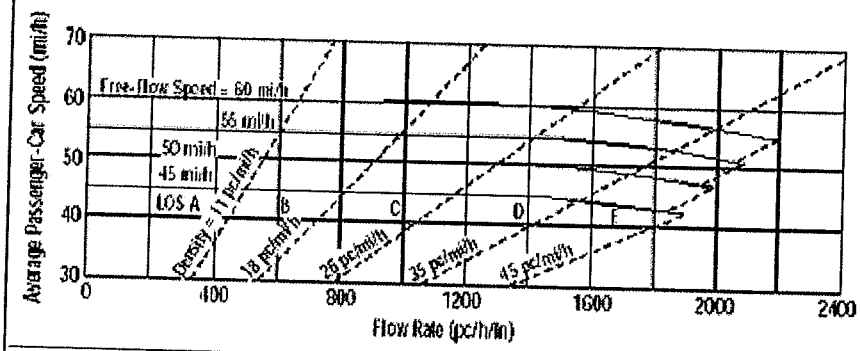
MULTILANE HIGHWAYS WORKSHEET(Direction 2)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKL
Agency or Company	MRO Engineers, Inc.
Date Performed	4/3/2007
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Spring Garden to Todd Valley W
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1215	Peak-Hour Factor, PHF	0.88
AADT(veh/h)		%Trucks and Buses, P_T	2
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	1.70
Driver Type Adjustment	1.00	Up/Down %	-3.40
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.986

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	5
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.3
f_M (mi/h)	1.6
FFS (mi/h)	57.2

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	700
Speed, S (mi/h)	57.2
D (pc/mi/ln)	12.2
LOS	B

Design

Design (N)

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

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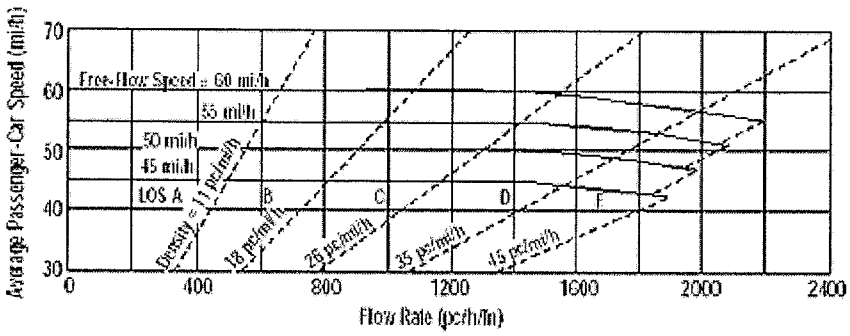
MULTILANE HIGHWAYS WORKSHEET(Direction 1)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKP
Agency or Company	MRO Engineers, Inc.
Date Performed	11/05/07
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Todd Valley W to Owl Hill Ct
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1129	Peak-Hour Factor, PHF	0.59
AADT(veh/h)		%Trucks and Buses, P_T	2
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	1.20
Driver Type Adjustment	1.00	Up/Down %	3.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	3.0
E_T	2.5	f_{HV}	0.935

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	3
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	0.8
f_M (mi/h)	1.6
FFS (mi/h)	57.7

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	1023
Speed, S (mi/h)	57.7
D (pc/mi/ln)	17.7
LOS	B

Design

Design (N)

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

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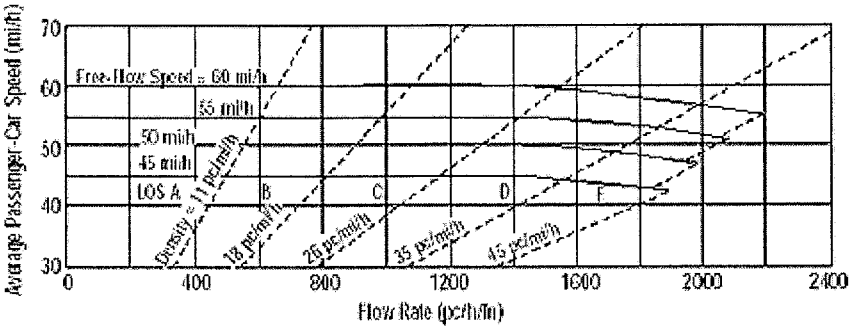
MULTILANE HIGHWAYS WORKSHEET(Direction 2)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKP
Agency or Company	MRO Engineers, Inc.
Date Performed	11/05/07
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Todd Valley W to Owl Hill Ct
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1082	Peak-Hour Factor, PHF	0.79
AADT(veh/h)		%Trucks and Buses, P_T	2
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	1.20
Driver Type Adjustment	1.00	Up/Down %	-3.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.986

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	4
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.0
f_M (mi/h)	1.6
FFS (mi/h)	57.4

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	694
Speed, S (mi/h)	57.4
D (pc/mi/ln)	12.1
LOS	B

Design

Design (N)

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

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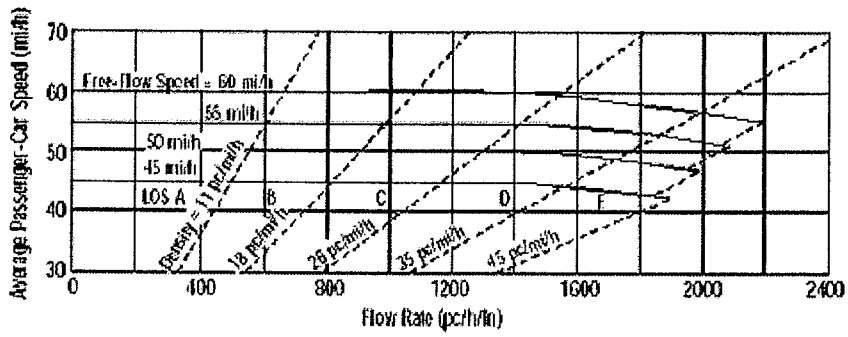
MULTILANE HIGHWAYS WORKSHEET(Direction 1)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKL
Agency or Company	MRO Engineers, Inc.
Date Performed	4/3/2007
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Bridge to Spring Garden Rd
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1574	Peak-Hour Factor, PHF	0.88
AADT(veh/h)		%Trucks and Buses, P_T	1
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	4.00
Driver Type Adjustment	1.00	Up/Down %	3.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	3.0
E_T	3.0	f_{HV}	0.943

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	2
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	0.5
f_M (mi/h)	1.6
FFS (mi/h)	57.9

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	947
Speed, S (mi/h)	57.9
D (pc/mi/ln)	16.4
LOS	B

Design

Design (N)

Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

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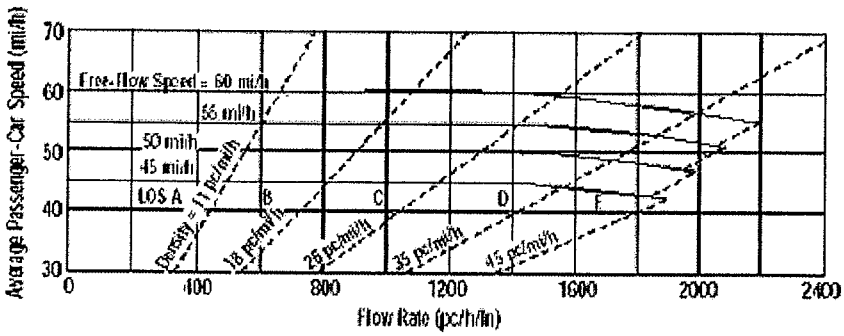
MULTILANE HIGHWAYS WORKSHEET(Direction 2)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKL
Agency or Company	MRO Engineers, Inc.
Date Performed	4/3/2007
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Bridge to Spring Garden Rd
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1210	Peak-Hour Factor, PHF	0.76
AADT(veh/h)		%Trucks and Buses, P_T	4
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	4.00
Driver Type Adjustment	1.00	Up/Down %	-3.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.977

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	2
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	0.5
f_M (mi/h)	1.6
FFS (mi/h)	57.9

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	815
Speed, S (mi/h)	57.9
D (pc/mi/ln)	14.1
LOS	B

Design

Design (N)

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

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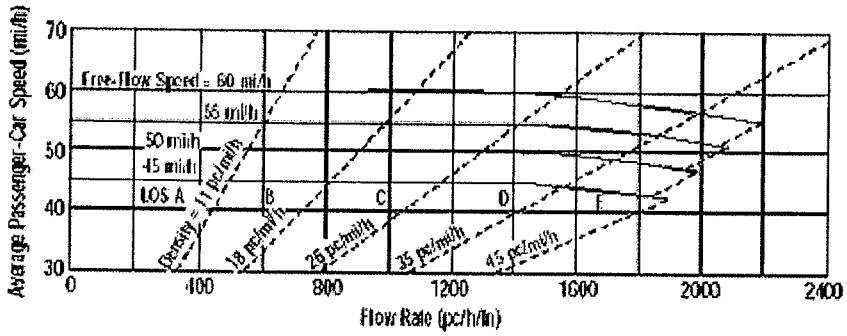
MULTILANE HIGHWAYS WORKSHEET(Direction 1)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKL
Agency or Company	MRO Engineers, Inc.
Date Performed	4/3/2007
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Spring Garden to Todd Valley W
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1117	Peak-Hour Factor, PHF	0.88
AADT(veh/h)		%Trucks and Buses, P_T	2
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	1.70
Driver Type Adjustment	1.00	Up/Down %	3.40
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	3.0
E_T	4.0	f_{HV}	0.909

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	4
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.0
f_M (mi/h)	1.6
FFS (mi/h)	57.4

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	698
Speed, S (mi/h)	57.4
D (pc/mi/ln)	12.2
LOS	B

Design

Design (N)

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

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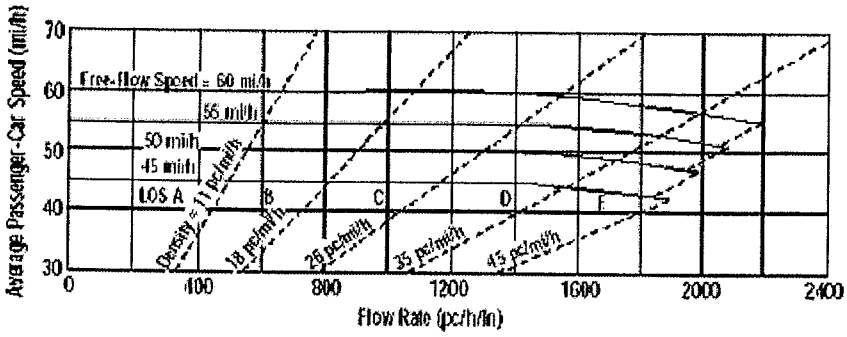
MULTILANE HIGHWAYS WORKSHEET(Direction 2)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKL
Agency or Company	MRO Engineers, Inc.
Date Performed	4/3/2007
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Spring Garden to Todd Valley W
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1305	Peak-Hour Factor, PHF	0.88
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	1.70
Driver Type Adjustment	1.00	Up/Down %	-3.40
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.981

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	5
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.3
f_M (mi/h)	1.6
FFS (mi/h)	57.2

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	755
Speed, S (mi/h)	57.2
D (pc/mi/ln)	13.2
LOS	B

Design

Design (N)

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

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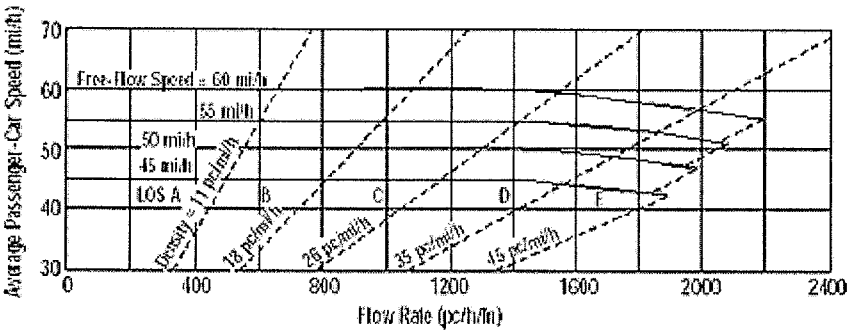
MULTILANE HIGHWAYS WORKSHEET(Direction 1)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKP
Agency or Company	MRO Engineers, Inc.
Date Performed	11/05/07
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Todd Valley W to Owl Hill Ct
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1026	Peak-Hour Factor, PHF	0.85
AADT(veh/h)		%Trucks and Buses, P_T	2
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	1.20
Driver Type Adjustment	1.00	Up/Down %	3.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	3.0
E_T	2.5	f_{HV}	0.935

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	3
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	0.8
f_M (mi/h)	1.6
FFS (mi/h)	57.7

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	645
Speed, S (mi/h)	57.7
D (pc/mi/ln)	11.2
LOS	B

Design

Design (N)

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

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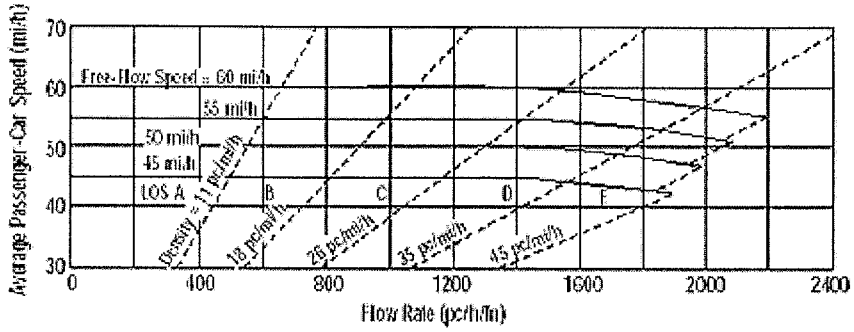
MULTILANE HIGHWAYS WORKSHEET(Direction 2)



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	MKP
Agency or Company	MRO Engineers, Inc.
Date Performed	11/05/07
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction to Travel	Foresthill Road - Mitigated
From/To	Todd Valley W to Owl Hill Ct
Jurisdiction	Placer County
Analysis Year	Buildout Without Forest Ranch

Project Description Foresthill Divide Community Plan

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1233	Peak-Hour Factor, PHF	0.88
AADT(veh/h)		%Trucks and Buses, P_T	4
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	2
Peak-Hour Direction Prop, D		General Terrain:	Grade
DDHV (veh/h)		Grade Length (mi)	1.20
Driver Type Adjustment	1.00	Up/Down %	-3.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.977

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	4
Median Type, M	Undivided
FFS (measured)	
Base Free-Flow Speed, BFFS	60.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.0
f_M (mi/h)	1.6
FFS (mi/h)	57.4

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	717
Speed, S (mi/h)	57.4
D (pc/mi/ln)	12.5
LOS	B

Design

Design (N)

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

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MRO ENGINEERS

ATTACHMENT E

TWO-LANE HIGHWAY
LEVEL OF SERVICE CALCULATION WORKSHEETS
BUILDOUT "WITH FOREST RANCH" SCENARIO

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

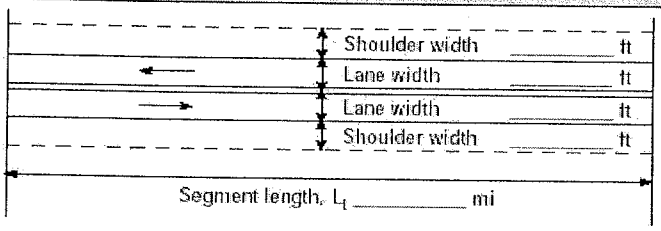
Analyst	MKL
Agency or Company	MRO Engineers, Inc.
Date Performed	3/5/07
Analysis Time Period	AM Peak Hour

Site Information

Highway / Direction of Travel	Foresthill Road - Eastbound
From/To	Bridge to Spring Garden Road
Jurisdiction	Placer County
Analysis Year	Buildout With Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 4.00 mi Up/down 3.0

Peak-hour factor, PHF 0.88

No-passing zone 55%

% Trucks and Buses , P_T 6 %

% Recreational vehicles, P_R 2%

Access points/ *mi* 2

Analysis direction vol., V_d 1126veh/h

Opposing direction vol., V_o 1853veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	5.7	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.780	0.994
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	0.95	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	1727	2118

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.5 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	0.7 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	29.0 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	0.97	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	1319	2106
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	88.9	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	45.3	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	106.3	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	F
Volume to capacity ratio, $v/c=V_p/1{,}700$	1.02
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	3455
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	12161
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	119.1

Notes

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

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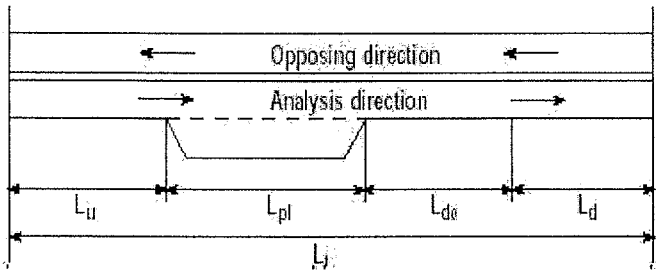
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Eastbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Bridge to Spring Garden Road*
Date Performed	*3/5/07*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Buildout With Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*10.8*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*3.0*
Length of passing lane including tapers , L_{pl} (*mi*)	*4.9*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*29.0*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*106.3*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*F*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*1.20*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.11*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*30.6*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*3.60*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-0.70*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.62*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*81.5*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*E*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*112.8*

Notes

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

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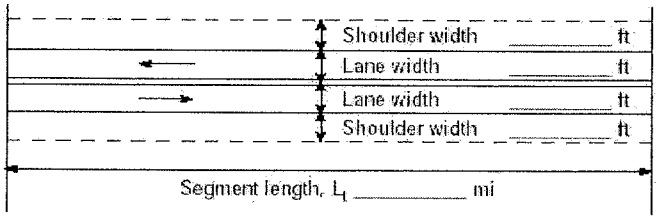
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	3/5/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Buildout With Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

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

Peak-hour factor, PHF *0.88*

No-passing zone *88%*

% Trucks and Buses , P_T *2 %*

% Recreational vehicles, P_R *2%*

Access points/ *mi* *2*

Analysis direction vol., V_d *1853*veh/h

Opposing direction vol., V_o *1126*veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	*1.1*	*5.7*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.998*	*0.914*
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	*1.00*	*0.95*
Directional flow rate[2], v_i(pc/h) $v_i=V_f/(PHF*f_{HV}*f_G)$	*2110*	*1473*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	*mi/h*	Base free-flow speed[3], $BFFS_{FM}$	*60.0 mi/h*
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	*0.0 mi/h*
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	*mi/h*	Adj. for access points[3], f_A (Exhibit 20-5)	*0.5 mi/h*
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	*0.8 mi/h*	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	*59.5 mi/h*
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	*30.9 mi/h*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	*1.00*	*0.97*
Directional flow rate[2], v_i(pc/h)$=V_f/(PHF*f_{HV}*f_G)$	*2106*	*1319*
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	*95.3*	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	*48.6*	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	*125.2*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	*F*
Volume to capacity ratio, $v/c=V_p/1{,}700$	*1.24*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	*5685*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	*20012*
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	*183.9*

Notes

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

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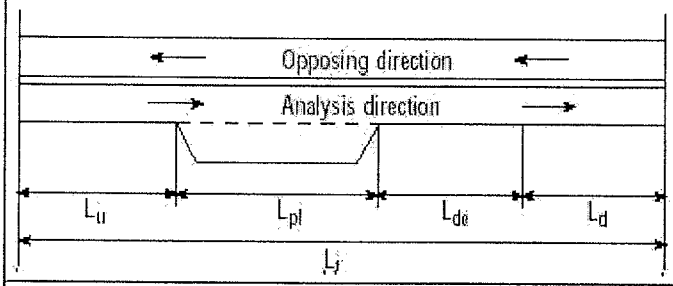
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Westbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Bridge to Spring Garden Road*
Date Performed	*3/5/07*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Buildout With Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*10.8*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*4.8*
Length of passing lane including tapers , L_{pl} (*mi*)	*1.3*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*30.9*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*125.2*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*F*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*3.00*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.11*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*31.5*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*3.60*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*1.10*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.62*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*111.5*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*F*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*180.2*

Notes

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

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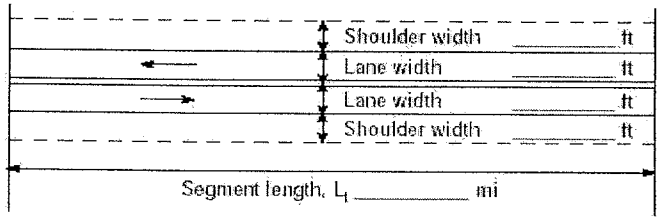
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	3/5/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Buildout With Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.70 mi Up/down 3.4

Peak-hour factor, PHF 0.75

No-passing zone 29%

% Trucks and Buses , P_T 3 %

% Recreational vehicles, P_R 2%

Access points/ *mi* 4

Analysis direction vol., V_d 1234veh/h

Opposing direction vol., V_o 1286veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	4.3	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.909	0.997
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	1810	1720

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.0 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	0.5 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.0 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	31.1 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	0.94	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	1743	1715
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	93.7	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	3.5	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	95.4	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	F
Volume to capacity ratio, $v/c=V_p/1{,}700$	1.06
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	699
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	2098
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	22.5

Notes

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

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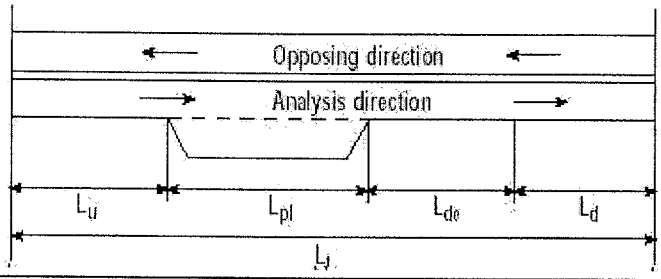
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Eastbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Spring Garden to Todd Valley W*
Date Performed	*3/5/07*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Buildout With Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*1.7*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*0.3*
Length of passing lane including tapers , L_{pl} (*mi*)	*1.2*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*31.1*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*95.4*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*F*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-1.50*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.11*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*33.8*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*3.60*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-3.40*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.62*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*65.7*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*E*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*20.7*

Notes

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

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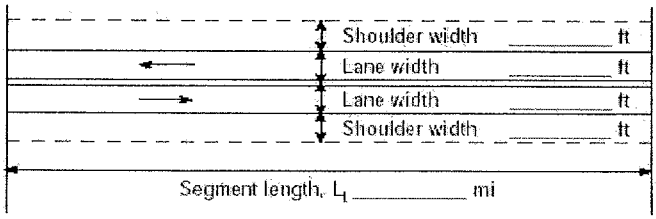
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway / Direction of Travel	*Foresthill Road - Westbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Spring Garden to Todd Valley W*
Date Performed	*3/5/07*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Buildout With Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length *1.70* mi Up/down *-3.4*

Peak-hour factor, PHF *0.88*

No-passing zone *100%*

% Trucks and Buses , P_T *2 %*

% Recreational vehicles, P_R *2%*

Access points/ *mi* *5*

Analysis direction vol., V_d *1286*veh/h

Opposing direction vol., V_o *1234*veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	*1.1*	*4.3*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.998*	*0.937*
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	*1464*	*1496*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	*mi/h*	Base free-flow speed[3], $BFFS_{FM}$	*60.0 mi/h*
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	*0.0 mi/h*
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	*mi/h*	Adj. for access points[3], f_A (Exhibit 20-5)	*1.3 mi/h*
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	*0.8 mi/h*	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	*58.8 mi/h*
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	*35.0 mi/h*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	*1.00*	*0.94*
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	*1461*	*1485*
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	*90.3*	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	*16.1*	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	*98.3*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	*E*
Volume to capacity ratio, $v/c=V_p/1{,}700$	*0.86*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	*621*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	*2186*
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	*17.8*

Notes

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

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