CAP YSIS
(2006 DEVELOPED CONDITIONS)

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: WEEKDAY PM PEAK DEVELOPED
Intersection: SR40 / SR 381S
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SR 381S
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		511	54	52	513	
Peak-Hour Factor, PHF		0.92	0.75	0.72	0.91	
Hourly Flow Rate, HFR		555	72	72	563	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	51	0	57			
Peak Hour Factor, PHF	0.71	1.00	1.00			
Hourly Flow Rate, HFR	71	0	57			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LTR				
v (vph)		72		128				
C(m) (vph)		965		238				
v/c		0.07		0.54				
95% queue length		0.24		2.89				
Control Delay		9.0		36.4				
LOS		A		E				
Approach Delay				36.4				
Approach LOS				E				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: WEEKDAY PM PEAK DEVELOPED
Intersection: SR40 / SR 381S
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SR 381S
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		511	54	52	513	
Peak-Hour Factor, PHF		0.92	0.75	0.72	0.91	
Peak-15 Minute Volume		139	18	18	141	
Hourly Flow Rate, HFR		555	72	72	563	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	51	0	57			
Peak Hour Factor, PHF	0.71	1.00	1.00			
Peak-15 Minute Volume	18	0	14			
Hourly Flow Rate, HFR	71	0	57			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0	1	0			
Configuration		LTR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		563
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1800
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1	6.5	6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			0	0	0	0			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70	0.00	0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4	6.5	6.2			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50	4.00	3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		0	0	0	0			
t(f)		2.2	3.5	4.0	3.3			

Worksheet 5-Effect of Upstream Signals

omputation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		627	1298	1298	591			
s								
Px								
V c,u,x								
r,x								
C plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500				
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	591	
Potential Capacity	511	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	511	
Probability of Queue free St.	0.89	1.00
Step 2: LT from Major St.	**4**	**1**
Conflicting Flows	627	
Potential Capacity	965	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	965	
Probability of Queue free St.	0.93	1.00
Maj L-Shared Prob Q free St.	0.89	
Step 3: TH from Minor St.	**8**	**11**
Conflicting Flows	1298	
Potential Capacity	163	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	0.89
Movement Capacity	145	
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	**7**	**10**
Conflicting Flows	1298	
Potential Capacity	180	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.89
Maj. L, Min T Adj. Imp Factor.		0.92
Cap. Adj. factor due to Impeding mvmnt	0.93	0.81
Movement Capacity	167	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1298	
Potential Capacity	163	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	0.89
Movement Capacity	145	
Result for 2 stage process:		
a		
y		
C t	145	
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1298	
Potential Capacity	180	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.89
Maj. L, Min T Adj. Imp Factor.		0.92
Cap. Adj. factor due to Impeding mvmnt	0.93	0.81
Movement Capacity	167	
Results for Two-stage process:		
a		
y		
C t	167	

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	71	0	57			
Movement Capacity (vph)	167	145	511			
Shared Lane Capacity (vph)		238				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	167	145	511			
Volume	71	0	57			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		238				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LTR				
v (vph)		72		128				
C(m) (vph)		965		238				
v/c		0.07		0.54				
95% queue length		0.24		2.89				
Control Delay		9.0		36.4				
LOS		A		E				
Approach Delay				36.4				
Approach LOS				E				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.93
v(i1), Volume for stream 2 or 5		563
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1800
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.89
d(M,LT), Delay for stream 1 or 4		9.0
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		1.0

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Intersection: SR40 / SR 381S
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SR 381S
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		560	47	50	372	
Peak-Hour Factor, PHF		0.84	0.65	0.74	0.84	
Hourly Flow Rate, HFR		666	72	67	442	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR	LT		
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	31	0	68			
Peak Hour Factor, PHF	0.86	1.00	0.78			
Hourly Flow Rate, HFR	36	0	87			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LTR				
v (vph)		67		123				
C(m) (vph)		877		302				
v/c		0.08		0.41				
95% queue length		0.25		1.90				
Control Delay		9.4		24.9				
LOS		A		C				
Approach Delay				24.9				
Approach LOS				C				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

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East/West Street: ROUTE 40
North/South Street: SR 381S
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		560	47	50	372	
Peak-Hour Factor, PHF		0.84	0.65	0.74	0.84	
Peak-15 Minute Volume		167	18	17	111	
Hourly Flow Rate, HFR		666	72	67	442	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR	LT		
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	31	0	68			
Peak Hour Factor, PHF	0.86	1.00	0.78			
Peak-15 Minute Volume	9	0	22			
Hourly Flow Rate, HFR	36	0	87			
Percent Heavy Vehicles	0	0	0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0	1	0			
Configuration		LTR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		442
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1800
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1	6.5	6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			0	0	0	0			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70	0.00	0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4	6.5	6.2			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50	4.00	3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		0	0	0	0			
t(f)		2.2	3.5	4.0	3.3			

Worksheet 5-Effect of Upstream Signals

omputation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		738	1278	1278	702			
s								
Px								
V c,u,x								
r,x								
C plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500				
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	702	
Potential Capacity	442	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	442	
Probability of Queue free St.	0.80	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	738	
Potential Capacity	877	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	877	
Probability of Queue free St.	0.92	1.00
Maj L-Shared Prob Q free St.	0.90	

Step 3: TH from Minor St.	8	11
Conflicting Flows	1278	
Potential Capacity	168	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	0.90
Movement Capacity	151	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1278	
Potential Capacity	185	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.90
Maj. L, Min T Adj. Imp Factor.		0.92
Cap. Adj. factor due to Impeding mvmnt	0.92	0.74
Movement Capacity	171	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1278	
Potential Capacity	168	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	0.90
Movement Capacity	151	
Result for 2 stage process:		
a		
y		
C t	151	
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1278	
Potential Capacity	185	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.90
Maj. L, Min T Adj. Imp Factor.		0.92
Cap. Adj. factor due to Impeding mvmnt	0.92	0.74
Movement Capacity	171	
Results for Two-stage process:		
a		
y		
C t	171	

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	36	0	87			
Movement Capacity (vph)	171	151	442			
Shared Lane Capacity (vph)		302				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	171	151	442			
Volume	36	0	87			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		302				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LTR				
v (vph)		67		123				
C(m) (vph)		877		302				
v/c		0.08		0.41				
95% queue length		0.25		1.90				
Control Delay		9.4		24.9				
OS		A		C				
pproach Delay				24.9				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.92
v(i1), Volume for stream 2 or 5		442
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1800
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.90
d(M,LT), Delay for stream 1 or 4		9.4
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		1.0

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: WEEKDAY PM PEAK DEVELOPED
Intersection: SR40 / SR 381N
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SR 381N
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	61	507			517	17
Peak-Hour Factor, PHF	0.88	0.92			0.91	0.85
Hourly Flow Rate, HFR	69	551			568	19
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				42	0	48
Peak Hour Factor, PHF				0.71	1.00	0.68
Hourly Flow Rate, HFR				59	0	70
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	69						129	
C(m) (vph)	998						273	
v/c	0.07						0.47	
95% queue length	0.22						2.37	
Control Delay	8.9						29.5	
LOS	A						D	
Approach Delay							29.5	
Approach LOS							D	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: WEEKDAY PM PEAK DEVELOPED
Intersection: SR40 / SR 381N
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SR 381N
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
.olume	61	507			517	17
Peak-Hour Factor, PHF	0.88	0.92			0.91	0.85
Peak-15 Minute Volume	17	138			142	5
Hourly Flow Rate, HFR	69	551			568	19
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				42	0	48
Peak Hour Factor, PHF				0.71	1.00	0.68
Peak-15 Minute Volume				15	0	18
Hourly Flow Rate, HFR				59	0	70
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	551	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1800	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0					0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1					6.4	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	587					1267	1267	578
s								
Px								
V c,u,x								
r,x								
plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
'(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		578
Potential Capacity		519
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		519
Probability of Queue free St.	1.00	0.87
Step 2: LT from Major St.	4	1
Conflicting Flows		587
Potential Capacity		998
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		998
Probability of Queue free St.	1.00	0.93
Maj L-Shared Prob Q free St.		0.90
tep 3: TH from Minor St.	8	11
Conflicting Flows		1267
Potential Capacity		170
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	0.90
Movement Capacity		153
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		1267
Potential Capacity		188
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.90	
Maj. L, Min T Adj. Imp Factor.	0.92	
Cap. Adj. factor due to Impeding mvmnt	0.80	0.93
Movement Capacity		175

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
tential Capacity		
edestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1267
Potential Capacity		170
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	0.90
Movement Capacity		153
Result for 2 stage process:		
a		
y		
C t		153
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1267
Potential Capacity		188
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.90	
Maj. L, Min T Adj. Imp Factor.	0.92	
Cap. Adj. factor due to Impeding mvmnt	0.80	0.93
Movement Capacity		175
Results for Two-stage process:		
a		
y		
C t		175

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				59	0	70
Movement Capacity (vph)				175	153	519
Shared Lane Capacity (vph)					273	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				175	153	519
Volume				59	0	70
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					273	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	69						129	
C(m) (vph)	998						273	
v/c	0.07						0.47	
95% queue length	0.22						2.37	
Control Delay	8.9						29.5	
LOS	A						D	
Approach Delay							29.5	
Approach LOS							D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.93	1.00
v(i1), Volume for stream 2 or 5	551	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.90	
d(M,LT), Delay for stream 1 or 4	8.9	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.9	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: SATURDAY PEAK DEVELOPED
Intersection: SR40 / SR 381N
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SR 381N
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	81	547			373	56
Peak-Hour Factor, PHF	0.91	0.84			0.84	0.78
Hourly Flow Rate, HFR	89	651			444	71
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				40	0	49
Peak Hour Factor, PHF				0.70	1.00	0.77
Hourly Flow Rate, HFR				57	0	63
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	89						120	
C(m) (vph)	1061						262	
v/c	0.08						0.46	
95% queue length	0.27						2.25	
Control Delay	8.7						29.8	
LOS	A						D	
Approach Delay							29.8	
Approach LOS							D	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: SATURDAY PEAK DEVELOPED
Intersection: SR40 / SR 381N
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SR 381N
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
.olume	81	547			373	56
Peak-Hour Factor, PHF	0.91	0.84			0.84	0.78
Peak-15 Minute Volume	22	163			111	18
Hourly Flow Rate, HFR	89	651			444	71
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT				TR	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				40	0	49
Peak Hour Factor, PHF				0.70	1.00	0.77
Peak-15 Minute Volume				14	0	16
Hourly Flow Rate, HFR				57	0	63
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	651	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1800	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0					0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1					6.4	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)	
Arrival Type	
Effective Green, g (sec)	
Cycle Length, C (sec)	
Rp (from Exhibit 16-11)	
Proportion vehicles arriving on green P	
g(q1)	
g(q2)	
g(q)	

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	515					1309	1309	480
s								
Px								
V c,u,x								
r,x								
plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
J(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		480
Potential Capacity		590
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		590
Probability of Queue free St.	1.00	0.89
Step 2: LT from Major St.	4	1
Conflicting Flows		515
Potential Capacity		1061
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1061
Probability of Queue free St.	1.00	0.92
Maj L-Shared Prob Q free St.		0.87
Step 3: TH from Minor St.	8	11
Conflicting Flows		1309
Potential Capacity		161
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.87
Movement Capacity		140
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		1309
Potential Capacity		177
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.87	
Maj. L, Min T Adj. Imp Factor.	0.90	
Cap. Adj. factor due to Impeding mvmnt	0.80	0.92
Movement Capacity		162

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1309
Potential Capacity		161
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.87
Movement Capacity		140
Result for 2 stage process:		
a		
y		
C t		140
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1309
Potential Capacity		177
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.87	
Maj. L, Min T Adj. Imp Factor.	0.90	
Cap. Adj. factor due to Impeding mvmnt	0.80	0.92
Movement Capacity		162
Results for Two-stage process:		
a		
y		
C t		162

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				57	0	63
Movement Capacity (vph)				162	140	590
Shared Lane Capacity (vph)					262	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				162	140	590
Volume				57	0	63
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					262	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	89						120	
C(m) (vph)	1061						262	
v/c	0.08						0.46	
95% queue length	0.27						2.25	
Control Delay	8.7						29.8	
LOS	A						D	
Approach Delay							29.8	
Approach LOS							D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.92	1.00
v(i1), Volume for stream 2 or 5	651	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.87	
d(M,LT), Delay for stream 1 or 4	8.7	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	1.1	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: WEEKDAY PM PEAK DEVELOPED
Intersection: SR40 / HAWES ROAD
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: HAWES ROAD
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	21	529			373	37
Peak-Hour Factor, PHF	0.66	0.92			0.91	0.66
Hourly Flow Rate, HFR	31	574			409	56
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				37	0	42
Peak Hour Factor, PHF				0.62	1.00	0.66
Hourly Flow Rate, HFR				59	0	63
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	31						122	
C(m) (vph)	1107						351	
v/c	0.03						0.35	
95% queue length	0.09						1.52	
Control Delay	8.3						20.6	
LOS	A						C	
Approach Delay							20.6	
Approach LOS							C	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: WEEKDAY PM PEAK DEVELOPED
Intersection: SR40 / HAWES ROAD
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: HAWES ROAD
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	21	529			373	37
Peak-Hour Factor, PHF	0.66	0.92			0.91	0.66
Peak-15 Minute Volume	8	144			102	14
Hourly Flow Rate, HFR	31	574			409	56
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				37	0	42
Peak Hour Factor, PHF				0.62	1.00	0.66
Peak-15 Minute Volume				15	0	16
Hourly Flow Rate, HFR				59	0	63
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	574	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1800	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

'ovement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0					0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1					6.4	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

›mputation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	465					1073	1073	437
s								
Px								
V c,u,x								
r,x								
plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
f(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		437
Potential Capacity		624
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		624
Probability of Queue free St.	1.00	0.90
Step 2: LT from Major St.	**4**	**1**
Conflicting Flows		465
Potential Capacity		1107
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1107
Probability of Queue free St.	1.00	0.97
Maj L-Shared Prob Q free St.		0.96
Step 3: TH from Minor St.	**8**	**11**
Conflicting Flows		1073
Potential Capacity		222
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity		213
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	**7**	**10**
Conflicting Flows		1073
Potential Capacity		246
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.96	
Maj. L, Min T Adj. Imp Factor.	0.97	
Cap. Adj. factor due to Impeding mvmnt	0.87	0.97
Movement Capacity		239

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1073
Potential Capacity		222
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity		213
Result for 2 stage process:		
a		
y		
C t		213
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1073
Potential Capacity		246
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.96	
Maj. L, Min T Adj. Imp Factor.	0.97	
Cap. Adj. factor due to Impeding mvmnt	0.87	0.97
Movement Capacity		239
Results for Two-stage process:		
a		
y		
C t		239

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
volume (vph)				59	0	63
Movement Capacity (vph)				239	213	624
Shared Lane Capacity (vph)					351	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				239	213	624
Volume				59	0	63
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					351	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	31						122	
C(m) (vph)	1107						351	
v/c	0.03						0.35	
95% queue length	0.09						1.52	
Control Delay	8.3						20.6	
LOS	A						C	
Approach Delay							20.6	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(i1), Volume for stream 2 or 5	574	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.96	
d(M,LT), Delay for stream 1 or 4	8.3	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.3	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: SATURDAY PEAK DEVELOPED
Intersection: SR40 / HAWES ROAD
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: HAWES ROAD
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	25	588			361	21
Peak-Hour Factor, PHF	0.78	0.84			0.84	0.58
Hourly Flow Rate, HFR	32	700			429	36
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration		LT				TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				19	0	14
Peak Hour Factor, PHF				0.79	1.00	0.58
Hourly Flow Rate, HFR				24	0	24
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	32						48	
C(m) (vph)	1107						299	
v/c	0.03						0.16	
95% queue length	0.09						0.56	
Control Delay	8.3						19.3	
LOS	A						C	
Approach Delay							19.3	
Approach LOS							C	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: SATURDAY PEAK DEVELOPED
Intersection: SR40 / HAWES ROAD
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: HAWES ROAD
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
.olume	25	588			361	21
Peak-Hour Factor, PHF	0.78	0.84			0.84	0.58
Peak-15 Minute Volume	8	175			107	9
Hourly Flow Rate, HFR	32	700			429	36
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				19	0	14
Peak Hour Factor, PHF				0.79	1.00	0.58
Peak-15 Minute Volume				6	0	6
Hourly Flow Rate, HFR				24	0	24
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	700	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1800	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

ovement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0					0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1					6.4	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

mputation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)	
Arrival Type	
Effective Green, g (sec)	
Cycle Length, C (sec)	
Rp (from Exhibit 16-11)	
Proportion vehicles arriving on green P	
g(q1)	
g(q2)	
g(q)	

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	465					1211	1211	447
s								
Px								
V c,u,x								
r,x								
plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
J(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		447
Potential Capacity		616
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		616
Probability of Queue free St.	1.00	0.96

Step 2: LT from Major St.	4	1
Conflicting Flows		465
Potential Capacity		1107
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1107
Probability of Queue free St.	1.00	0.97
Maj L-Shared Prob Q free St.		0.95

Step 3: TH from Minor St.	8	11
Conflicting Flows		1211
Potential Capacity		184
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity		175
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1211
Potential Capacity		203
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.95	
Maj. L, Min T Adj. Imp Factor.	0.96	
Cap. Adj. factor due to Impeding mvmnt	0.93	0.97
Movement Capacity		197

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1211
Potential Capacity		184
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity		175
Result for 2 stage process:		
a		
y		
C t		175
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1211
Potential Capacity		203
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.95	
Maj. L, Min T Adj. Imp Factor.	0.96	
Cap. Adj. factor due to Impeding mvmnt	0.93	0.97
Movement Capacity		197
Results for Two-stage process:		
a		
y		
C t		197

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				24	0	24
Movement Capacity (vph)				197	175	616
Shared Lane Capacity (vph)					299	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				197	175	616
Volume				24	0	24
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					299	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	32						48	
C(m) (vph)	1107						299	
v/c	0.03						0.16	
95% queue length	0.09						0.56	
Control Delay	8.3						19.3	
LOS	A						C	
Approach Delay							19.3	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(i1), Volume for stream 2 or 5	700	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.95	
d(M,LT), Delay for stream 1 or 4	8.3	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.4	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: WEEKDAY PM PEAK DEVELOPED
Intersection: SR40 / SEC. DRIVE
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SECONDARY DRIVEWAY
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	31	535			386	15
Peak-Hour Factor, PHF	0.90	0.90			0.90	0.90
Hourly Flow Rate, HFR	34	594			428	16
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				14	0	28
Peak Hour Factor, PHF				0.90	0.90	0.90
Hourly Flow Rate, HFR				15	0	31
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	34						46	
C(m) (vph)	1127						402	
v/c	0.03						0.11	
95% queue length	0.09						0.38	
Control Delay	8.3						15.1	
LOS	A						C	
Approach Delay							15.1	
Approach LOS							C	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: WEEKDAY PM PEAK DEVELOPED
Intersection: SR40 / SEC. DRIVE
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SECONDARY DRIVEWAY
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	31	535			386	15
Peak-Hour Factor, PHF	0.90	0.90			0.90	0.90
Peak-15 Minute Volume	9	149			107	4
Hourly Flow Rate, HFR	34	594			428	16
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				14	0	28
Peak Hour Factor, PHF				0.90	0.90	0.90
Peak-15 Minute Volume				4	0	8
Hourly Flow Rate, HFR				15	0	31
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	594	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1800	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

ovement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0					0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1					6.4	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

mputation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	444					1098	1098	436
s								
Px								
V c,u,x								
r,x								
plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
I(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		436
Potential Capacity		625
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		625
Probability of Queue free St.	1.00	0.95

Step 2: LT from Major St.	4	1
Conflicting Flows		444
Potential Capacity		1127
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1127
Probability of Queue free St.	1.00	0.97
Maj L-Shared Prob Q free St.		0.95

Step 3: TH from Minor St.	8	11
Conflicting Flows		1098
Potential Capacity		215
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity		205
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1098
Potential Capacity		238
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.95	
Maj. L, Min T Adj. Imp Factor.	0.97	
Cap. Adj. factor due to Impeding mvmnt	0.92	0.97
Movement Capacity		231

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1098
Potential Capacity		215
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity		205
Result for 2 stage process:		
a		
y		
C t		205
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1098
Potential Capacity		238
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.95	
Maj. L, Min T Adj. Imp Factor.	0.97	
Cap. Adj. factor due to Impeding mvmnt	0.92	0.97
Movement Capacity		231
Results for Two-stage process:		
a		
y		
C t		231

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				15	0	31
Movement Capacity (vph)				231	205	625
Shared Lane Capacity (vph)					402	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				231	205	625
Volume				15	0	31
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					402	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	34						46	
C(m) (vph)	1127						402	
v/c	0.03						0.11	
95% queue length	0.09						0.38	
Control Delay	8.3						15.1	
LOS	A						C	
Approach Delay							15.1	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(i1), Volume for stream 2 or 5	594	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.95	
d(M,LT), Delay for stream 1 or 4	8.3	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.4	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: SATURDAY PEAK DEVELOPED
Intersection: SR40 / SEC. DRIVE
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SECONDARY DRIVEWAY
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	34	573			352	17
Peak-Hour Factor, PHF	0.90	0.90			0.90	0.90
Hourly Flow Rate, HFR	37	636			391	18
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				15	0	30
Peak Hour Factor, PHF				0.90	0.90	0.90
Hourly Flow Rate, HFR				16	0	33
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	37						49	
C(m) (vph)	1161						405	
v/c	0.03						0.12	
95% queue length	0.10						0.41	
Control Delay	8.2						15.1	
LOS	A						C	
Approach Delay							15.1	
Approach LOS							C	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: SATURDAY PEAK DEVELOPED
Intersection: SR40 / SEC. DRIVE
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SECONDARY DRIVEWAY
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	34	573			352	17
Peak-Hour Factor, PHF	0.90	0.90			0.90	0.90
Peak-15 Minute Volume	9	159			98	5
Hourly Flow Rate, HFR	37	636			391	18
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT				TR	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				15	0	30
Peak Hour Factor, PHF				0.90	0.90	0.90
Peak-15 Minute Volume				4	0	8
Hourly Flow Rate, HFR				16	0	33
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	636	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1800	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

ovement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0					0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1					6.4	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

mputation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
V prog				

Total Saturation Flow Rate, s (vph)	
Arrival Type	
Effective Green, g (sec)	
Cycle Length, C (sec)	
Rp (from Exhibit 16-11)	
Proportion vehicles arriving on green P	
g(q1)	
g(q2)	
g(q)	

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	409					1110	1110	400
s								
Px								
V c,u,x								
r,x								
c plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
I(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		400
Potential Capacity		654
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		654
Probability of Queue free St.	1.00	0.95
Step 2: LT from Major St.	4	1
Conflicting Flows		409
Potential Capacity		1161
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1161
Probability of Queue free St.	1.00	0.97
Maj L-Shared Prob Q free St.		0.95
Step 3: TH from Minor St.	8	11
Conflicting Flows		1110
Potential Capacity		211
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity		201
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		1110
Potential Capacity		234
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.95	
Maj. L, Min T Adj. Imp Factor.	0.96	
Cap. Adj. factor due to Impeding mvmnt	0.91	0.97
Movement Capacity		227

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1110
Potential Capacity		211
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity		201
Result for 2 stage process:		
a		
y		
C t		201
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1110
Potential Capacity		234
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.95	
Maj. L, Min T Adj. Imp Factor.	0.96	
Cap. Adj. factor due to Impeding mvmnt	0.91	0.97
Movement Capacity		227
Results for Two-stage process:		
a		
y		
C t		227

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				16	0	33
Movement Capacity (vph)				227	201	654
Shared Lane Capacity (vph)					405	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				227	201	654
Volume				16	0	33
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					405	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	37						49	
C(m) (vph)	1161						405	
v/c	0.03						0.12	
95% queue length	0.10						0.41	
Control Delay	8.2						15.1	
LOS	A						C	
Approach Delay							15.1	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(i1), Volume for stream 2 or 5	636	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.95	
d(M,LT), Delay for stream 1 or 4	8.2	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.4	

HCS2000: Signalized Intersections Release 4.1e

Analyst: RHH
Agency: McMILLEN ENGINEERING
Date: 12/5/2005
Period: WEEKDAY PM PEAK DEVELOPED
Project ID: 2005-319
E/W St: ROUTE 40

Inter.: ROUTE 40/MAIN DRIVE
Area Type: All other areas
Jurisd:
Year : 2006

N/S St: MAIN DRIVE/MARKER ROAD

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	0	1	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Volume	62	490	8	6	342	47	3	0	10	42	0	56
Lane Width	12.0	12.0		12.0	12.0			12.0		12.0	12.0	
RTOR Vol			2			12			3			14

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A				NB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
WB Left	A				SB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	7.0	33.0					12.0			
Yellow	4.0						4.0			
All Red	2.0	2.0					2.0			

Cycle Length: 70.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	171	1710	0.40	0.10	31.1	C		
TR	831	1762	0.66	0.47	16.2	B	17.9	B
Westbound								
L	171	1710	0.04	0.10	28.6	C		
TR	822	1743	0.51	0.47	13.4	B	13.7	B
Northbound								
LTR	265	1545	0.04	0.17	24.3	C	24.3	C
Southbound								
L	244	1426	0.19	0.17	25.2	C		
TR	262	1530	0.18	0.17	25.1	C	25.2	C

Intersection Delay = 17.0 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 12/5/2005
Analysis Time Period: WEEKDAY PM PEAK DEVELOPED
Intersection: ROUTE 40/MAIN DRIVE
Area Type: All other areas
Jurisdiction:
Analysis Year: 2006
Project ID: 2005-319

East/West Street: ROUTE 40
North/South Street: MAIN DRIVE/MARKER ROAD

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	62	490	8	6	342	47	3	0	10	42	0	56
% Heavy Veh	0	2	0	0	2	0	0	2	0	0	2	0
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	17	136	2	2	95	13	1	0	3	12	0	16
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1800	1800		1800	1800			1800		1800	1800	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	12.0	12.0		12.0	12.0			12.0		12.0	12.0	
RTOR Vol			2			12			3			14
Adj Flow	69	551		7	419			11		47	47	
%InSharedLn												
Prop LTs		0.000			0.000			0.273		1.000	0.000	
Prop RTs		0.013			0.093			0.727			1.000	
Peds Bikes	0			0			0			0		
Buses	0	0		0	0			0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Priv. Type	3	3		3	3			3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0		2.0	2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination		1	2	3	4			5	6	7	8
EB	Left	A				NB	Left	A			
	Thru		A				Thru	A			
	Right		A				Right	A			
	Peds						Peds				
WB	Left	A				SB	Left	A			
	Thru		A				Thru	A			
	Right		A				Right	A			
	Peds						Peds				
NB	Right					EB	Right				
SB	Right					WB	Right				
Green		7.0	33.0					12.0			
Yellow		4.0						4.0			
All Red		2.0	2.0					2.0			

Cycle Length: 70.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	62	490	8	6	342	47	3	0	10	42	0	56
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	69	544	7	7	380	39	3	0	8	47	0	47
No. Lanes	1	1	0	1	1	0	0	1	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	69	551		7	419			11		47	47	
Prop LTs		0.000			0.000			0.273		1.000	0.000	
Prop RTs		0.013			0.093			0.727			1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound				Northbound			Southbound		
LG	L	TR		L	TR			LTR			L	TR	
So	1800	1800		1800	1800			1800			1800	1800	
Lanes	1	1	0	1	1	0	0	1	0		1	1	0
fW	1.000	1.000		1.000	1.000			1.000			1.000	1.000	
fHV	1.000	0.981		1.000	0.982			1.000			1.000	1.000	
fG	1.000	1.000		1.000	1.000			1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000			1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000			1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000			1.000			1.000	1.000	
fLU	1.000	1.000		1.000	1.000			1.000			1.000	1.000	
fRT		0.998			0.986			0.902				0.850	
fLT	0.950	1.000		0.950	1.000			0.952			0.792	1.000	
Sec.													
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	1.000	
fRpb		1.000			1.000			1.000				1.000	
S	1710	1762		1710	1743			1545			1426	1530	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	69	1710	# 0.04	0.10	171	0.40
Prot							
Perm							
Thru	TR	551	1762	# 0.31	0.47	831	0.66
Right							
Westbound							
Prot							
Perm							
Left	L	7	1710	0.00	0.10	171	0.04
Prot							
Perm							
Thru	TR	419	1743	0.24	0.47	822	0.51
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	11	1545	0.01	0.17	265	0.04
Right							
Southbound							
Prot							
Perm							
Left	L	47	1426	# 0.03	0.17	244	0.19
Prot							
Perm							
Thru	TR	47	1530	0.03	0.17	262	0.18
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.39
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.52

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.40	0.10	29.5	1.000	171	0.11	1.6	0.0	31.1	C		
TR	0.66	0.47	14.2	1.000	831	0.24	2.0	0.0	16.2	B	17.9	B
Westbound												
L	0.04	0.10	28.5	1.000	171	0.11	0.1	0.0	28.6	C		
TR	0.51	0.47	12.9	1.000	822	0.12	0.5	0.0	13.4	B	13.7	B
Northbound												
LTR	0.04	0.17	24.2	1.000	265	0.11	0.1	0.0	24.3	C	24.3	C
Southbound												
L	0.19	0.17	24.8	1.000	244	0.11	0.4	0.0	25.2	C		

TR	0.18	0.17	24.8	1.000	262	0.11	0.3	0.0	25.1	C	25.2	C

Intersection delay = 17.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				S
Cycle length, C 70.0 sec				
Total actual green time for LT lane group, G (s)				12.0
Effective permitted green time for LT lane group, g(s)				12.0
Opposing effective green time, go (s)				12.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				47
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.27
Adjusted opposing flow rate, Vo (veh/h)				11
Lost time for LT lane group, tL				6.00
Computation				
LT volume per cycle, LTC=VLTC/3600				0.91
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				0.21
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.83
ɪq, (see Exhibit C16-4,5,6,7,8)				0.00
ɡu=g-gq if gq>=gf, or = g-gf if gq<gf				12.00
n=Max(gq-gf)/2,0)				0.00
PTHo=1-PLTo				0.73
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.26
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.33
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.79
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.792

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
ɔpposed by Single(S) or Multiple(M) lane approach			M	
ɔycle length, C 70.0 sec				
Total actual green time for LT lane group, G (s)			12.0	
Effective permitted green time for LT lane group, g(s)			12.0	
Opposing effective green time, go (s)			12.0	

Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			3	
Proportion of LT in LT lane group, PLT	0.000	0.000	0.273	0.000
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			47	
Lost time for LT lane group, tL			6.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			0.06	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			0.91	
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			4.7	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.83	
gq, (see Exhibit C16-4,5,6,7,8)			0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			7.30	
n=Max(gq-gf)/2,0)			0.00	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.27	
EL1 (refer to Exhibit C16-3)			1.32	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.21	
gdiff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.95	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.952	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				

Vbicg
OCCbicg
OCCr
Number of cross-street receiving lanes, Nrec
Number of turning lanes, Nturn
ApbT
Proportion right-turns, PRT
Proportion right-turns using protected phase, PRTA
Right turn adjustment, fRpb

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

			EBLT	WBLT	NBLT	SBLT
Cycle length, C	70.0	sec				
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time r=(C-g-gq-gu)						
Arrival rate, qa=v/(3600(max[X,1.0]))						
Protected ph. departure rate, Sp=s/3600						
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 17.0 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR			LTR		L	TR	
Init Queue	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Flow Rate	69	551		7	419			11		47	47	
So	1800	1800		1800	1800			1800		1800	1800	
No.Lanes	1	1	0	1	1	0	0	1	0	1	1	0
SL	1710	1762		1710	1743			1545		1426	1530	
LnCapacity	171	831		171	822			265		244	262	
Flow Ratio	0.04	0.31		0.00	0.24			0.01		0.03	0.03	
v/c Ratio	0.40	0.66		0.04	0.51			0.04		0.19	0.18	
Grn Ratio	0.10	0.47		0.10	0.47			0.17		0.17	0.17	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3		3	3			3		3	3	
Pltn Ratio	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
PF2	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Q1	1.3	8.2		0.1	5.7			0.2		0.8	0.8	
kB	0.2	0.5		0.2	0.5			0.3		0.3	0.3	
Q2	0.1	1.0		0.0	0.5			0.0		0.1	0.1	
Q Average	1.4	9.3		0.1	6.2			0.2		0.8	0.8	
Q Spacing	25.0	25.0		25.0	25.0			25.0		25.0	25.0	
Q Storage	0	0		0	0			0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2			1.2		1.2	1.2	
BOQ	1.7	10.9		0.2	7.4			0.2		1.0	1.0	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5		1.6	1.5			1.6		1.6	1.6	
BOQ	2.2	14.1		0.2	9.6			0.3		1.3	1.3	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.7		1.8	1.7			1.8		1.8	1.8	
BOQ	2.5	15.3		0.2	10.5			0.3		1.5	1.5	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.9		2.1	1.9			2.1		2.1	2.1	
BOQ	2.9	17.2		0.3	12.0			0.4		1.7	1.7	
QSRatio												
98th Percentile Output:												
fB%	2.6	2.2		2.7	2.3			2.7		2.6	2.6	
BOQ	3.6	20.3		0.4	14.4			0.5		2.2	2.2	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: RHH
Agency: McMILLEN ENGINEERING
Date: 12/5/2005
Period: SATURDAY AM PEAK DEVELOPED
Project ID: 2005-319
E/W St: ROUTE 40

Inter.: ROUTE 40/MAIN DRIVE
Area Type: All other areas
Jurisd:
Year : 2006

N/S St: MAIN DRIVE/MARKER ROAD

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	0	1	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Volume	68	443	3	5	305	51	4	0	5	45	0	60
Lane Width	12.0	12.0		12.0	12.0			12.0		12.0	12.0	
RTOR Vol			1			13			1			15

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4			5	6	7	8
EB	Left	A				NB	Left	A			
	Thru		A				Thru	A			
	Right		A				Right	A			
	Peds						Peds				
WB	Left	A				SB	Left	A			
	Thru		A				Thru	A			
	Right		A				Right	A			
	Peds						Peds				
'B	Right					EB	Right				
;B	Right					WB	Right				
Green		7.0	33.0					12.0			
Yellow		4.0	4.0					4.0			
All Red		2.0	2.0					2.0			

Cycle Length: 70.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	171	1710	0.44	0.10	31.5	C		
TR	832	1764	0.59	0.47	14.7	B	17.0	B
Westbound								
L	171	1710	0.04	0.10	28.5	C		
TR	820	1739	0.46	0.47	12.9	B	13.2	B
Northbound								
LTR	263	1532	0.03	0.17	24.2	C	24.2	C
Southbound								
L	245	1430	0.20	0.17	25.3	C		
TR	262	1530	0.19	0.17	25.2	C	25.3	C

Intersection Delay = 16.4 (sec/veh) Intersection LOS = B

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst:	RHH
Agency/Co.:	McMILLEN ENGINEERING
Date Performed:	12/5/2005
Analysis Time Period:	SATURDAY AM PEAK DEVELOPED
Intersection:	ROUTE 40/MAIN DRIVE
Area Type:	All other areas
Jurisdiction:	
Analysis Year:	2006
Project ID: 2005-319	

East/West Street: ROUTE 40
North/South Street: MAIN DRIVE/MARKER ROAD

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	68	443	3	5	305	51	4	0	5	45	0	60
% Heavy Veh	0	2	0	0	2	0	0	2	0	0	2	0
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	19	123	1	2	85	14	1	0	2	13	0	17
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1800	1800		1800	1800			1800		1800	1800	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	12.0	12.0		12.0	12.0			12.0		12.0	12.0	
RTOR Vol			1			13			1			15
Adj Flow	76	494		6	381			8		50	50	
%InSharedLn												
Prop LTs		0.000			0.000			0.500		1.000	0.000	
Prop RTs		0.004			0.110			0.500			1.000	
Peds Bikes		0			0			0			0	
Buses	0	0		0	0			0		0	0	
%InProtPhase												

Duration 0.25 *Area Type: All other areas*

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Priv. Type	3	3		3	3			3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
PI Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0		2.0	2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left	A		
Thru		A			Thru	A		
Right		A			Right	A		
Peds					Peds			
WB Left	A				SB Left	A		
Thru		A			Thru	A		
Right		A			Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	7.0	33.0			12.0			
Yellow	4.0	4.0			4.0			
All Red	2.0	2.0			2.0			

Cycle Length: 70.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	68	443	3	5	305	51	4	0	5	45	0	60
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	76	492	2	6	339	42	4	0	4	50	0	50
No. Lanes	1	1	0	1	1	0	0	1	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	76	494		6	381			8		50	50	
Prop LTs		0.000			0.000			0.500		1.000	0.000	
Prop RTs		0.004			0.110			0.500			1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound				Northbound		Southbound		
LG	L	TR		L	TR			LTR		L	TR	
So	1800	1800		1800	1800			1800		1800	1800	
Lanes	1	1	0	1	1	0	0	1	0	1	1	0
fW	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fHV	1.000	0.980		1.000	0.983			1.000		1.000	1.000	
fG	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fLU	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fRT		0.999			0.983			0.933			0.850	
fLT	0.950	1.000		0.950	1.000			0.912		0.794	1.000	
Sec.												
pb	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
Rpb		1.000			1.000			1.000			1.000	
S	1710	1764		1710	1739			1532		1430	1530	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	76	1710	# 0.04	0.10	171	0.44
Prot							
Perm							
Thru	TR	494	1764	# 0.28	0.47	832	0.59
Right							
Westbound							
Prot							
Perm							
Left	L	6	1710	0.00	0.10	171	0.04
Prot							
Perm							
Thru	TR	381	1739	0.22	0.47	820	0.46
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	8	1532	0.01	0.17	263	0.03
Right							
Southbound							
Prot							
Perm							
Left	L	50	1430	# 0.03	0.17	245	0.20
Prot							
Perm							
Thru	TR	50	1530	0.03	0.17	262	0.19
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.36
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.48

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.44	0.10	29.7	1.000	171	0.11	1.8	0.0	31.5	C		
TR	0.59	0.47	13.6	1.000	832	0.18	1.2	0.0	14.7	B	17.0	B
Westbound												
L	0.04	0.10	28.4	1.000	171	0.11	0.1	0.0	28.5	C		
TR	0.46	0.47	12.5	1.000	820	0.11	0.4	0.0	12.9	B	13.2	B
Northbound												
LTR	0.03	0.17	24.2	1.000	263	0.11	0.0	0.0	24.2	C	24.2	C
Southbound												
L	0.20	0.17	24.9	1.000	245	0.11	0.4	0.0	25.3	C		

TR	0.19	0.17	24.8	1.000	262	0.11	0.4	0.0	25.2	C	25.3	C

Intersection delay = 16.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				S
Cycle length, C 70.0 sec				
Total actual green time for LT lane group, G (s)				12.0
Effective permitted green time for LT lane group, g(s)				12.0
Opposing effective green time, go (s)				12.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				50
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.50
Adjusted opposing flow rate, Vo (veh/h)				8
Lost time for LT lane group, tL				6.00
Computation				
LT volume per cycle, LTC=VLTC/3600				0.97
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				0.16
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.83
gq, (see Exhibit C16-4,5,6,7,8)				0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf				12.00
n=Max(gq-gf)/2,0)				0.00
PTHo=1-PLTo				0.50
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.26
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.33
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.79
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.794

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	
Cycle length, C 70.0 sec				
Total actual green time for LT lane group, G (s)			12.0	
Effective permitted green time for LT lane group, g(s)			12.0	
Opposing effective green time, go (s)			12.0	

Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			4	
Proportion of LT in LT lane group, PLT	0.000	0.000	0.500	0.000
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			50	
Lost time for LT lane group, tL			6.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			0.08	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			0.97	
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			4.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.83	
gq, (see Exhibit C16-4,5,6,7,8)			0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			7.58	
n=Max(gq-gf)/2,0)			0.00	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.50	
EL1 (refer to Exhibit C16-3)			1.32	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.25	
gdiff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.91	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.912	

For special case of single-lane approach opposed by multilane approach, see text.

If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				

Vbicg
OCCbicg
OCCr
Number of cross-street receiving lanes, Nrec
Number of turning lanes, Nturn
ApbT
Proportion right-turns, PRT
Proportion right-turns using protected phase, PRTA
Right turn adjustment, fRpb

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

			EBLT	WBLT	NBLT	SBLT
Cycle length, C	70.0	sec				
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time r=(C-g-gq-gu)						
Arrival rate, qa=v/(3600(max[X,1.0]))						
Protected ph. departure rate, Sp=s/3600						
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 16.4 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR			LTR		L	TR	
Init Queue	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Flow Rate	76	494		6	381			8		50	50	
So	1800	1800		1800	1800			1800		1800	1800	
No.Lanes	1	1	0	1	1	0	0	1	0	1	1	0
SL	1710	1764		1710	1739			1532		1430	1530	
LnCapacity	171	832		171	820			263		245	262	
Flow Ratio	0.04	0.28		0.00	0.22			0.01		0.03	0.03	
v/c Ratio	0.44	0.59		0.04	0.46			0.03		0.20	0.19	
Grn Ratio	0.10	0.47		0.10	0.47			0.17		0.17	0.17	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3		3	3			3		3	3	
Pltn Ratio	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
PF2	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Q1	1.4	7.1		0.1	5.0			0.1		0.8	0.8	
kB	0.2	0.5		0.2	0.5			0.3		0.3	0.3	
Q2	0.2	0.8		0.0	0.5			0.0		0.1	0.1	
Q Average	1.6	7.8		0.1	5.5			0.1		0.9	0.9	
Q Spacing	25.0	25.0		25.0	25.0			25.0		25.0	25.0	
Q Storage	0	0		0	0			0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2			1.2		1.2	1.2	
BOQ	1.9	9.2		0.1	6.5			0.2		1.1	1.1	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5		1.6	1.6			1.6		1.6	1.6	
BOQ	2.5	12.0		0.2	8.5			0.2		1.4	1.4	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.7		1.8	1.7			1.8		1.8	1.8	
BOQ	2.8	13.1		0.2	9.3			0.2		1.6	1.6	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.9		2.1	1.9			2.1		2.1	2.1	
BOQ	3.2	14.8		0.2	10.6			0.3		1.9	1.9	
QSRatio												
98th Percentile Output:												
fB%	2.6	2.2		2.7	2.4			2.7		2.6	2.6	
BOQ	4.0	17.6		0.3	12.9			0.4		2.4	2.4	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: WEEKDAY PM PEAK DEVELOPED
Intersection: SR40 / SMITH SCHOOL
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SMITH SCHOOL HOUSE RD
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	16	554			396	8
Peak-Hour Factor, PHF	0.67	0.94			0.94	0.67
Hourly Flow Rate, HFR	23	589			421	11
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				12	0	26
Peak Hour Factor, PHF				0.75	0.90	0.93
Hourly Flow Rate, HFR				16	0	27
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	23						43	
c(m) (vph)	1138						398	
v/c	0.02						0.11	
95% queue length	0.06						0.36	
Control Delay	8.2						15.1	
LOS	A						C	
Approach Delay							15.1	
Approach LOS							C	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: WEEKDAY PM PEAK DEVELOPED
Intersection: SR40 / SMITH SCHOOL
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SMITH SCHOOL HOUSE RD
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	16	554			396	8
Peak-Hour Factor, PHF	0.67	0.94			0.94	0.67
Peak-15 Minute Volume	6	147			105	3
Hourly Flow Rate, HFR	23	589			421	11
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				12	0	26
Peak Hour Factor, PHF				0.75	0.90	0.93
Peak-15 Minute Volume				4	0	7
Hourly Flow Rate, HFR				16	0	27
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	589	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1800	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0					0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1					6.4	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

omputation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	432					1061	1061	426
s								
Px								
V c,u,x								
r,x								
plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
I(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		426
Potential Capacity		633
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		633
Probability of Queue free St.	1.00	0.96
Step 2: LT from Major St.	4	1
Conflicting Flows		432
Potential Capacity		1138
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1138
Probability of Queue free St.	1.00	0.98
Maj L-Shared Prob Q free St.		0.97
Step 3: TH from Minor St.	8	11
Conflicting Flows		1061
Potential Capacity		226
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		219
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		1061
Potential Capacity		250
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	
Maj. L, Min T Adj. Imp Factor.	0.98	
Cap. Adj. factor due to Impeding mvmnt	0.94	0.98
Movement Capacity		245

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1061
Potential Capacity		226
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		219
Result for 2 stage process:		
a		
y		
C t		219
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1061
Potential Capacity		250
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	
Maj. L, Min T Adj. Imp Factor.	0.98	
Cap. Adj. factor due to Impeding mvmnt	0.94	0.98
Movement Capacity		245
Results for Two-stage process:		
a		
y		
C t		245

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				16	0	27
Movement Capacity (vph)				245	219	633
Shared Lane Capacity (vph)					398	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				245	219	633
Volume				16	0	27
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					398	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	23						43	
C(m) (vph)	1138						398	
v/c	0.02						0.11	
95% queue length	0.06						0.36	
Control Delay	8.2						15.1	
LOS	A						C	
Approach Delay							15.1	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	1.00
v(i1), Volume for stream 2 or 5	589	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.97	
d(M,LT), Delay for stream 1 or 4	8.2	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.2	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: SATURDAY PEAK DEVELOPED
Intersection: SR40 / SMITH SCHOOL
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SMITH SCHOOL HOUSE RD
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	14	523			446	10
Peak-Hour Factor, PHF	0.50	0.87			0.87	0.50
Hourly Flow Rate, HFR	28	601			512	20
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				8	0	12
Peak Hour Factor, PHF				0.40	0.90	0.60
Hourly Flow Rate, HFR				19	0	19
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	28						38	
C(m) (vph)	1046						301	
v/c	0.03						0.13	
95% queue length	0.08						0.43	
Control Delay	8.5						18.7	
LOS	A						C	
Approach Delay							18.7	
Approach LOS							C	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: SATURDAY PEAK DEVELOPED
Intersection: SR40 / SMITH SCHOOL
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: SMITH SCHOOL HOUSE RD
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	14	523			446	10
Peak-Hour Factor, PHF	0.50	0.87			0.87	0.50
Peak-15 Minute Volume	7	150			128	5
Hourly Flow Rate, HFR	28	601			512	20
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				8	0	12
Peak Hour Factor, PHF				0.40	0.90	0.60
Peak-15 Minute Volume				5	0	5
Hourly Flow Rate, HFR				19	0	19
Percent Heavy Vehicles				0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	601	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1800	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

ovement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0					0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1					6.4	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0	0	0
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

mputation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	532					1179	1179	522
s								
Px								
V c,u,x								
r,x								
plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
f(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		522
Potential Capacity		559
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		559
Probability of Queue free St.	1.00	0.97
Step 2: LT from Major St.	4	1
Conflicting Flows		532
Potential Capacity		1046
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1046
Probability of Queue free St.	1.00	0.97
Maj L-Shared Prob Q free St.		0.96
Step 3: TH from Minor St.	8	11
Conflicting Flows		1179
Potential Capacity		192
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity		184
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		1179
Potential Capacity		212
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.96	
Maj. L, Min T Adj. Imp Factor.	0.97	
Cap. Adj. factor due to Impeding mvmnt	0.94	0.97
Movement Capacity		206

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1179
Potential Capacity		192
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity		184
Result for 2 stage process:		
a		
y		
C t		184
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1179
Potential Capacity		212
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.96	
Maj. L, Min T Adj. Imp Factor.	0.97	
Cap. Adj. factor due to Impeding mvmnt	0.94	0.97
Movement Capacity		206
Results for Two-stage process:		
a		
y		
C t		206

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				19	0	19
Movement Capacity (vph)				206	184	559
Shared Lane Capacity (vph)					301	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				206	184	559
Volume				19	0	19
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					301	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	28						38	
C(m) (vph)	1046						301	
v/c	0.03						0.13	
95% queue length	0.08						0.43	
Control Delay	8.5						18.7	
LOS	A						C	
Approach Delay							18.7	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(i1), Volume for stream 2 or 5	601	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.96	
d(M,LT), Delay for stream 1 or 4	8.5	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.3	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: WEEKDAY PM PEAK DEVELOPED
Intersection: SR40 / DINNER BELL RD
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: DINNER BELL ROAD
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	26	504	47	14	362	38
Peak-Hour Factor, PHF	0.81	0.94	0.78	0.58	0.94	0.79
Hourly Flow Rate, HFR	32	536	60	24	385	48
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	26	7	16	36	3	15
Peak Hour Factor, PHF	0.81	0.58	0.67	0.75	0.38	0.63
Hourly Flow Rate, HFR	32	12	23	48	7	23
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	32	24		67			78	
C(m) (vph)	1137	990		228			214	
v/c	0.03	0.02		0.29			0.36	
95% queue length	0.09	0.07		1.18			1.57	
Control Delay	8.3	8.7		27.2			31.2	
LOS	A	A		D			D	
Approach Delay				27.2			31.2	
Approach LOS				D			D	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: WEEKDAY PM PEAK DEVELOPED
Intersection: SR40 / DINNER BELL RD
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: DINNER BELL ROAD
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	26	504	47	14	362	38
Peak-Hour Factor, PHF	0.81	0.94	0.78	0.58	0.94	0.79
Peak-15 Minute Volume	8	134	15	6	96	12
Hourly Flow Rate, HFR	32	536	60	24	385	48
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	26	7	16	36	3	15
Peak Hour Factor, PHF	0.81	0.58	0.67	0.75	0.38	0.63
Peak-15 Minute Volume	8	3	6	12	2	6
Hourly Flow Rate, HFR	32	12	23	48	7	23
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	536	385
Shared ln volume, major rt vehicles:	60	48
Sat flow rate, major th vehicles:	1800	1800
Sat flow rate, major rt vehicles:	1800	1800
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

'ovement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

ımputation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	433	596	1102	1111	566	1105	1117	409
s								
Px								
V c,u,x								
r,x								
plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500		1500		1500
P(x)								
J(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	566	409
Potential Capacity	528	647
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	528	647
Probability of Queue free St.	0.96	0.96
Step 2: LT from Major St.	**4**	**1**
Conflicting Flows	596	433
Potential Capacity	990	1137
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	990	1137
Probability of Queue free St.	0.98	0.97
Maj L-Shared Prob Q free St.	0.97	0.96
Step 3: TH from Minor St.	**8**	**11**
Conflicting Flows	1111	1117
Potential Capacity	211	209
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.93	0.93
Movement Capacity	196	194
Probability of Queue free St.	0.94	0.96
Step 4: LT from Minor St.	**7**	**10**
Conflicting Flows	1102	1105
Potential Capacity	191	190
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.89	0.87
Maj. L, Min T Adj. Imp Factor.	0.92	0.90
Cap. Adj. factor due to Impeding mvmnt	0.89	0.86
Movement Capacity	169	164

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
tential Capacity		
edestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1111	1117
Potential Capacity	211	209
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.93	0.93
Movement Capacity	196	194
Result for 2 stage process:		
a		
y		
C t	196	194
Probability of Queue free St.	0.94	0.96
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1102	1105
Potential Capacity	191	190
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.89	0.87
Maj. L, Min T Adj. Imp Factor.	0.92	0.90
Cap. Adj. factor due to Impeding mvmnt	0.89	0.86
Movement Capacity	169	164
Results for Two-stage process:		
a		
y		
C t	169	164

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	32	12	23	48	7	23
Movement Capacity (vph)	169	196	528	164	194	647
Shared Lane Capacity (vph)		228			214	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	169	196	528	164	194	647
Volume	32	12	23	48	7	23
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		228			214	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	32	24		67			78	
C(m) (vph)	1137	990		228			214	
v/c	0.03	0.02		0.29			0.36	
95% queue length	0.09	0.07		1.18			1.57	
Control Delay	8.3	8.7		27.2			31.2	
LOS	A	A		D			D	
Approach Delay				27.2			31.2	
Approach LOS				D			D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	0.98
v(i1), Volume for stream 2 or 5	536	385
v(i2), Volume for stream 3 or 6	60	48
s(i1), Saturation flow rate for stream 2 or 5	1800	1800
s(i2), Saturation flow rate for stream 3 or 6	1800	1800
P*(oj)	0.96	0.97
d(M,LT), Delay for stream 1 or 4	8.3	8.7
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.3	0.3

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: SATURDAY PEAK DEVELOPED
Intersection: SR40 / DINNER BELL RD
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: DINNER BELL ROAD
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	19	484	28	9	326	15
Peak-Hour Factor, PHF	0.75	0.87	0.63	0.68	0.87	0.70
Hourly Flow Rate, HFR	25	556	44	13	374	21
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	54	2	15	16	3	15
Peak Hour Factor, PHF	0.84	0.50	0.42	0.50	0.75	0.62
Hourly Flow Rate, HFR	64	4	35	32	4	24
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	25	13		103			60	
C(m) (vph)	1175	987		243			259	
v/c	0.02	0.01		0.42			0.23	
95% queue length	0.07	0.04		1.98			0.87	
Control Delay	8.1	8.7		30.3			23.0	
LOS	A	A		D			C	
Approach Delay				30.3			23.0	
Approach LOS				D			C	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: RHH
Agency/Co.: McMILLEN ENGINEERING
Date Performed: 11/23/2005
Analysis Time Period: SATURDAY PEAK DEVELOPED
Intersection: SR40 / DINNER BELL RD
Jurisdiction: WHARTON TOWNSHIP
Units: U. S. Customary
Analysis Year: 2006
Project ID: 2005-319
East/West Street: ROUTE 40
North/South Street: DINNER BELL ROAD
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
olume	19	484	28	9	326	15
Peak-Hour Factor, PHF	0.75	0.87	0.63	0.68	0.87	0.70
Peak-15 Minute Volume	6	139	11	3	94	5
Hourly Flow Rate, HFR	25	556	44	13	374	21
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	54	2	15	16	3	15
Peak Hour Factor, PHF	0.84	0.50	0.42	0.50	0.75	0.62
Peak-15 Minute Volume	16	1	9	8	1	6
Hourly Flow Rate, HFR	64	4	35	32	4	24
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	556	374
Shared ln volume, major rt vehicles:	44	21
Sat flow rate, major th vehicles:	1800	1800
Sat flow rate, major rt vehicles:	1800	1800
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

omputation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	395	600	1052	1049	578	1058	1060	384
s								
Px								
V c,u,x								
r,x								
plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500		1500		1500
P(x)								
/(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	578	384
Potential Capacity	519	668
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	519	668
Probability of Queue free St.	0.93	0.96
Step 2: LT from Major St.	**4**	**1**
Conflicting Flows	600	395
Potential Capacity	987	1175
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	987	1175
Probability of Queue free St.	0.99	0.98
Maj L-Shared Prob Q free St.	0.98	0.97
Step 3: TH from Minor St.	**8**	**11**
Conflicting Flows	1049	1060
Potential Capacity	229	226
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity	218	215
Probability of Queue free St.	0.98	0.98
Step 4: LT from Minor St.	**7**	**10**
Conflicting Flows	1052	1058
Potential Capacity	206	204
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.93	0.93
Maj. L, Min T Adj. Imp Factor.	0.95	0.95
Cap. Adj. factor due to Impeding mvmnt	0.92	0.89
Movement Capacity	189	181

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1049	1060
Potential Capacity	229	226
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity	218	215
Result for 2 stage process:		
a		
y		
C t	218	215
Probability of Queue free St.	0.98	0.98
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1052	1058
Potential Capacity	206	204
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.93	0.93
Maj. L, Min T Adj. Imp Factor.	0.95	0.95
Cap. Adj. factor due to Impeding mvmnt	0.92	0.89
Movement Capacity	189	181
Results for Two-stage process:		
a		
y		
C t	189	181

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	64	4	35	32	4	24
Movement Capacity (vph)	189	218	519	181	215	668
Shared Lane Capacity (vph)		243			259	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	189	218	519	181	215	668
Volume	64	4	35	32	4	24
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		243			259	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	25	13		103			60	
C(m) (vph)	1175	987		243			259	
v/c	0.02	0.01		0.42			0.23	
95% queue length	0.07	0.04		1.98			0.87	
Control Delay	8.1	8.7		30.3			23.0	
LOS	A	A		D			C	
Approach Delay				30.3			23.0	
Approach LOS				D			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	0.99
v(i1), Volume for stream 2 or 5	556	374
v(i2), Volume for stream 3 or 6	44	21
s(i1), Saturation flow rate for stream 2 or 5	1800	1800
s(i2), Saturation flow rate for stream 3 or 6	1800	1800
P*(oj)	0.97	0.98
d(M,LT), Delay for stream 1 or 4	8.1	8.7
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.3	0.1

APPENDIX 4

CAPACITY ANALYSIS
(2016 BASE CONDITIONS)

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: TR
Agency/Co.: McMillen Engineering
Date Performed: 10/9/2005
Analysis Time Period: Weekday PM Base
Intersection: Route 40/ SR 381 S
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2016
Project ID: Route 40 and SR 381 S
East/West Street: Route 40
North/South Street: SR 381 S
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		559	59	57	568	
Peak-Hour Factor, PHF		0.92	0.75	0.72	0.91	
Hourly Flow Rate, HFR		607	78	79	624	
Percent Heavy Vehicles		--	--	3	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR	LT		
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	56	0	62			
Peak Hour Factor, PHF	0.71	0.50	1.00			
Hourly Flow Rate, HFR	78	0	62			
Percent Heavy Vehicles	3	3	3			
Percent Grade (%)		7			3	
Flared Approach: Exists?/Storage			No /			/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LTR				
v (vph)		79		140				
C(m) (vph)		904		196				
v/c		0.09		0.71				
95% queue length		0.29		4.55				
Control Delay		9.4		59.3				
LOS		A		F				
Approach Delay				59.3				
Approach LOS				F				

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: TR
Agency/Co.: McMillen Engineering
Date Performed: 10/9/2005
Analysis Time Period: Weekday PM Base
Intersection: Route 40/ SR 381 S
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2016
Project ID: Route 40 and SR 381 S
East/West Street: Route 40
North/South Street: SR 381 S
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
.olume		559	59	57	568	
Peak-Hour Factor, PHF		0.92	0.75	0.72	0.91	
Peak-15 Minute Volume		152	20	20	156	
Hourly Flow Rate, HFR		607	78	79	624	
Percent Heavy Vehicles		--	--	3	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR	LT		
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	56	0	62			
Peak Hour Factor, PHF	0.71	0.50	1.00			
Peak-15 Minute Volume	20	0	16			
Hourly Flow Rate, HFR	78	0	62			
Percent Heavy Vehicles	3	3	3			
Percent Grade (%)		7			3	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0	1	0			
Configuration		LTR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		624
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1800
Sat flow rate, major rt vehicles:		1800
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1	6.5	6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			3	3	3	3			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.07	0.07	0.07	0.03	0.03	0.03
t(3,lt)			0.00	0.70	0.00	0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4	6.5	6.2			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50	4.00	3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		3	3	3	3			
t(f)		2.2	3.5	4.0	3.3			

Worksheet 5-Effect of Upstream Signals

omputation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		685	1428	1428	646			
s								
Px								
V c,u,x								
r,x								
plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500				
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	646	
Potential Capacity	469	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	469	
Probability of Queue free St.	0.87	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	685	
Potential Capacity	904	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	904	
Probability of Queue free St.	0.91	1.00
Maj L-Shared Prob Q free St.	0.87	
Step 3: TH from Minor St.	8	11
Conflicting Flows	1428	
Potential Capacity	134	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.87
Movement Capacity	116	
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	1428	
Potential Capacity	147	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.87
Maj. L, Min T Adj. Imp Factor.		0.90
Cap. Adj. factor due to Impeding mvmnt	0.91	0.78
Movement Capacity	134	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1428	
Potential Capacity	134	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.87
Movement Capacity	116	
Result for 2 stage process:		
a		
y		
C t	116	
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1428	
Potential Capacity	147	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.87
Maj. L, Min T Adj. Imp Factor.		0.90
Cap. Adj. factor due to Impeding mvmnt	0.91	0.78
Movement Capacity	134	
Results for Two-stage process:		
a		
y		
C t	134	

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	78	0	62			
Movement Capacity (vph)	134	116	469			
Shared Lane Capacity (vph)		196				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	134	116	469			
Volume	78	0	62			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		196				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LTR				
v (vph)		79		140				
C(m) (vph)		904		196				
v/c		0.09		0.71				
95% queue length		0.29		4.55				
Control Delay		9.4		59.3				
LOS		A		F				
Approach Delay				59.3				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.91
v(i1), Volume for stream 2 or 5		624
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1800
s(i2), Saturation flow rate for stream 3 or 6		1800
P*(oj)		0.87
d(M,LT), Delay for stream 1 or 4		9.4
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		1.3

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: TR
Agency/Co.: McMillen Engineering
Date Performed: 10/9/2005
Analysis Time Period: Saturday PeakBase
Intersection: Route 40/ SR 381 S
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2016
Project ID: Route 40 and SR 381 S
East/West Street: Route 40
North/South Street: SR 381 S
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		637	52	58	437	
Peak-Hour Factor, PHF		0.84	0.65	0.74	0.84	
Hourly Flow Rate, HFR		758	80	78	520	
Percent Heavy Vehicles		--	--	3	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	34	0	76			
Peak Hour Factor, PHF	0.86	0.50	0.78			
Hourly Flow Rate, HFR	39	0	97			
Percent Heavy Vehicles	3	3	3			
Percent Grade (%)		7			3	
Flared Approach: Exists?/Storage			No	/		/
Lanes	0	1	0			
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LTR				
v (vph)		78		136				
C(m) (vph)		792		240				
v/c		0.10		0.57				
95% queue length		0.33		3.16				
Control Delay		10.0+		38.0				
LOS		B		E				
Approach Delay				38.0				
Approach LOS				E				

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: TR
Agency/Co.: McMillen Engineering
Date Performed: 10/9/2005
Analysis Time Period: Saturday PeakBase
Intersection: Route 40/ SR 381 S
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2016
Project ID: Route 40 and SR 381 S
East/West Street: Route 40
North/South Street: SR 381 S
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
.olume		637	52	58	437	
Peak-Hour Factor, PHF		0.84	0.65	0.74	0.84	
Peak-15 Minute Volume		190	20	20	130	
Hourly Flow Rate, HFR		758	80	78	520	
Percent Heavy Vehicles		--	--	3	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR	LT		
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	34	0	76			
Peak Hour Factor, PHF	0.86	0.50	0.78			
Peak-15 Minute Volume	10	0	24			
Hourly Flow Rate, HFR	39	0	97			
Percent Heavy Vehicles	3	3	3			
Percent Grade (%)		7			3	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0	1	0			
Configuration		LTR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		520
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1800
Sat flow rate, major rt vehicles:		1800
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1	6.5	6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			3	3	3	3			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.07	0.07	0.07	0.03	0.03	0.03
t(3,lt)			0.00	0.70	0.00	0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4	6.5	6.2			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50	4.00	3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		3	3	3	3			
t(f)		2.2	3.5	4.0	3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		838	1474	1474	798			
s								
Px								
V c,u,x								
r,x								
plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500				
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	798	
Potential Capacity	384	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	384	
Probability of Queue free St.	0.75	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	838	
Potential Capacity	792	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	792	
Probability of Queue free St.	0.90	1.00
Maj L-Shared Prob Q free St.	0.86	
Step 3: TH from Minor St.	8	11
Conflicting Flows	1474	
Potential Capacity	125	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.86	0.86
Movement Capacity	108	
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	1474	
Potential Capacity	138	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.86
Maj. L, Min T Adj. Imp Factor.		0.89
Cap. Adj. factor due to Impeding mvmnt	0.90	0.67
Movement Capacity	124	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1474	
Potential Capacity	125	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.86	0.86
Movement Capacity	108	

Result for 2 stage process:		
a		
y		
C t	108	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1474	
Potential Capacity	138	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.86
Maj. L, Min T Adj. Imp Factor.		0.89
Cap. Adj. factor due to Impeding mvmnt	0.90	0.67
Movement Capacity	124	

Results for Two-stage process:	
a	
y	
C t	124

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	39	0	97			
Movement Capacity (vph)	124	108	384			
Shared Lane Capacity (vph)		240				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	124	108	384			
Volume	39	0	97			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		240				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LTR				
v (vph)		78		136				
C(m) (vph)		792		240				
v/c		0.10		0.57				
95% queue length		0.33		3.16				
Control Delay		10.0+		38.0				
LOS		B		E				
Approach Delay				38.0				
Approach LOS				E				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.90
v(i1), Volume for stream 2 or 5		520
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1800
s(i2), Saturation flow rate for stream 3 or 6		1800
P*(oj)		0.86
d(M,LT), Delay for stream 1 or 4		10.0+
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		1.4

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: TR
Agency/Co.: McMillen Engineering
Date Performed: 10/9/2005
Analysis Time Period: Weekday PM Base
Intersection: Route 40/SR 381 N
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2016
Project ID: Route 40 and SR 381 N
East/West Street: Route 40
North/South Street: SR 381 N
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	67	554			572	19
Peak-Hour Factor, PHF	0.88	0.92			0.91	0.85
Hourly Flow Rate, HFR	76	602			628	22
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				45	0	53
Peak Hour Factor, PHF				0.71	0.50	0.68
Hourly Flow Rate, HFR				63	0	77
Percent Heavy Vehicles				3	3	3
Percent Grade (%)		-5			-7	
Flared Approach: Exists?/Storage				/		No /
Lanes				0	1	0
Configuration					LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	76						140	
C(m) (vph)	931						232	
v/c	0.08						0.60	
95% queue length	0.27						3.50	
Control Delay	9.2						41.6	
LOS	A						E	
Approach Delay							41.6	
Approach LOS							E	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: TR
Agency/Co.: McMillen Engineering
Date Performed: 10/9/2005
Analysis Time Period: Weekday PM Base
Intersection: Route 40/SR 381 N
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2016
Project ID: Route 40 and SR 381 N
East/West Street: Route 40
North/South Street: SR 381 N
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
/olume	67	554			572	19
Peak-Hour Factor, PHF	0.88	0.92			0.91	0.85
Peak-15 Minute Volume	19	151			157	6
Hourly Flow Rate, HFR	76	602			628	22
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				45	0	53
Peak Hour Factor, PHF				0.71	0.50	0.68
Peak-15 Minute Volume				16	0	19
Hourly Flow Rate, HFR				63	0	77
Percent Heavy Vehicles				3	3	3
Percent Grade (%)		-5			-7	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				0	1	0
Configuration					LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	602	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1800	
Sat flow rate, major rt vehicles:	1800	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		3					3	3	3
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				-0.05	-0.05	-0.05	-0.07	-0.07	-0.07
t(3,lt)		0.00					0.70	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1					6.4	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	3					3	3	3
t(f)	2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	650					1393	1393	639
s								
Px								
V c,u,x								
r,x								
plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		639
Potential Capacity		475
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		475
Probability of Queue free St.	1.00	0.84
Step 2: LT from Major St.	4	1
Conflicting Flows		650
Potential Capacity		931
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		931
Probability of Queue free St.	1.00	0.92
Maj L-Shared Prob Q free St.		0.88
Step 3: TH from Minor St.	8	11
Conflicting Flows		1393
Potential Capacity		142
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	0.88
Movement Capacity		125
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		1393
Potential Capacity		156
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.88	
Maj. L, Min T Adj. Imp Factor.	0.91	
Cap. Adj. factor due to Impeding mvmnt	0.76	0.92
Movement Capacity		143

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1393
Potential Capacity		142
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	0.88
Movement Capacity		125
Result for 2 stage process:		
a		
y		
C t		125
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1393
Potential Capacity		156
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.88	
Maj. L, Min T Adj. Imp Factor.	0.91	
Cap. Adj. factor due to Impeding mvmnt	0.76	0.92
Movement Capacity		143
Results for Two-stage process:		
a		
y		
C t		143

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				63	0	77
Movement Capacity (vph)				143	125	475
Shared Lane Capacity (vph)					232	

'orksheet 9-Computation of Effect of Flared Minor Street Approaches

lovement	7	8	9	10	11	12
	L	T	R	L	T	R
: sep				143	125	475
'olume				63	0	77
)elay						
) sep						
) sep +1						
:ound (Qsep +1)						
ı max						
: sh					232	
3UM C sep						
ı						
: act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	76						140	
:(m) (vph)	931						232	
v/c	0.08						0.60	
95% queue length	0.27						3.50	
Control Delay	9.2						41.6	
'OS	A						E	
.pproach Delay							41.6	
Approach LOS							E	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.92	1.00
v(il), Volume for stream 2 or 5	602	
v(i2), Volume for stream 3 or 6	0	
s(il), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1800	
P*(oj)	0.88	
d(M,LT), Delay for stream 1 or 4	9.2	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	1.1	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

nalyst: TR
gency/Co.: McMillen Engineering
ate Performed: 10/9/2005
nalysis Time Period: Saturday Peak Base
ntersection: Route 40/SR 381 N
urisdiction:
nits: U. S. Customary
nalysis Year: 2016
roject ID: Route 40 and SR 381 N
ast/West Street: Route 40
orth/South Street: SR 381 N
ntersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
olume	89	624			441	65
eak-Hour Factor, PHF	0.91	0.84			0.84	0.78
ourly Flow Rate, HFR	97	742			525	83
ercent Heavy Vehicles	3	--	--		--	--
edian Type/Storage	Undivided			/		
T Channelized?						
anes	0	1			1	0
onfiguration	LT					TR
pstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
olume				46	0	54
eak Hour Factor, PHF				0.70	0.50	0.77
ourly Flow Rate, HFR				65	0	70
ercent Heavy Vehicles				3	3	3
ercent Grade (%)		-5			-7	
lared Approach: Exists?/Storage				/		No /
anes				0	1	0
onfiguration					LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	97						135	
c(m) (vph)	966						201	
v/c	0.10						0.67	
95% queue length	0.33						4.10	
Control Delay	9.1						53.3	
OS	A						F	
pproach Delay							53.3	
pproach LOS							F	

HCS2000: Unsignalized Intersections Release 4.1d

hone: Fax:
-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

nalyst: TR
gency/Co.: McMillen Engineering
ate Performed: 10/9/2005
nalysis Time Period: Saturday Peak Base
ntersection: Route 40/SR 381 N
urisdiction:
nits: U. S. Customary
nalysis Year: 2016
roject ID: Route 40 and SR 381 N
ast/West Street: Route 40
orth/South Street: SR 381 N
ntersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

lajor Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
olume	89	624			441	65
'eak-Hour Factor, PHF	0.91	0.84			0.84	0.78
'eak-15 Minute Volume	24	186			131	21
lourly Flow Rate, HFR	97	742			525	83
'ercent Heavy Vehicles	3	--	--		--	--
ledian Type/Storage	Undivided			/		
RT Channelized?						
anes	0	1			1	0
onfiguration	LT					TR
Jpstream Signal?		No			No	

linor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				46	0	54
Peak Hour Factor, PHF				0.70	0.50	0.77
Peak-15 Minute Volume				16	0	18
lourly Flow Rate, HFR				65	0	70
Percent Heavy Vehicles				3	3	3
Percent Grade (%)		-5			-7	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
anes				0	1	0
onfiguration					LTR	

Pedestrian Volumes and Adjustments

lovements	13	14	15	16
low (ped/hr)	0	0	0	0

ane Width (ft)	12.0	12.0	12.0	12.0
alking Speed (ft/sec)	4.0	4.0	4.0	4.0
ercent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
2 Left-Turn							
Through							
5 Left-Turn							
Through							

orksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
hared ln volume, major th vehicles:	742	
hared ln volume, major rt vehicles:	0	
at flow rate, major th vehicles:	1800	
at flow rate, major rt vehicles:	1800	
umber of major street through lanes:	1	

orksheet 4-Critical Gap and Follow-up Time Calculation

ritical Gap Calculation

ovement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
(c,base)		4.1					7.1	6.5	6.2
(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
(hv)		3					3	3	3
(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
rade/100				-0.05	-0.05	-0.05	-0.07	-0.07	-0.07
(3,lt)		0.00					0.70	0.00	0.00
(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
(c)	1-stage	4.1					6.4	6.5	6.2
	2-stage								

ollow-Up Time Calculations

ovement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
(f,base)	2.20					3.50	4.00	3.30
(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
(HV)	3					3	3	3
(f)	2.2					3.5	4.0	3.3

orksheet 5-Effect of Upstream Signals

mputation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
prog				

otal Saturation Flow Rate, s (vph)	
crival Type	
ffective Green, g (sec)	
ycle Length, C (sec)	
) (from Exhibit 16-11)	
roportion vehicles arriving on green P	
(q1)	
(q2)	
(q)	

omputation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
lpha				
eta				
ravel time, t(a) (sec)				
moothing Factor, F				
roportion of conflicting flow, f				
ax platooned flow, V(c,max)				
in platooned flow, V(c,min)				
uration of blocked period, t(p)				
roportion time blocked, p		0.000		0.000

omputation 3-Platoon Event Periods	Result
(2)	0.000
(5)	0.000
(dom)	
(subo)	
onstrained or unconstrained?	

roportion nblocked or minor ovements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
(1)			
(4)			
(7)			
(8)			
(9)			
(10)			
(11)			
(12)			

omputation 4 and 5 Single-Stage Process								
lovement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
c,x	608					1502	1502	566
x								
c,u,x								
r,x								
plat,x								

wo-Stage Process				
	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
(c,x)						1500		1500
(x)								
(c,u,x)								
(r,x)								
(plat,x)								

orksheet 6-Impedance and Capacity Equations

tep 1: RT from Minor St.	9	12
onflicting Flows		566
otential Capacity		522
edestrian Impedance Factor	1.00	1.00
ovement Capacity		522
robability of Queue free St.	1.00	0.87
tep 2: LT from Major St.	4	1
onflicting Flows		608
otential Capacity		966
edestrian Impedance Factor	1.00	1.00
ovement Capacity		966
robability of Queue free St.	1.00	0.90
aj L-Shared Prob Q free St.		0.83
tep 3: TH from Minor St.	8	11
onflicting Flows		1502
otential Capacity		122
edestrian Impedance Factor	1.00	1.00
ap. Adj. factor due to Impeding mvmnt	0.83	0.83
ovement Capacity		101
robability of Queue free St.	1.00	1.00
tep 4: LT from Minor St.	7	10
onflicting Flows		1502
otential Capacity		134
edestrian Impedance Factor	1.00	1.00
aj. L, Min T Impedance factor	0.83	
aj. L, Min T Adj. Imp Factor.	0.87	
ap. Adj. factor due to Impeding mvmnt	0.75	0.90
ovement Capacity		121

orksheet 7-Computation of the Effect of Two-stage Gap Acceptance

tep 3: TH from Minor St.	8	11
art 1 - First Stage		
onflicting Flows		
otential Capacity		
edestrian Impedance Factor		
ap. Adj. factor due to Impeding mvmnt		
ovement Capacity		
robability of Queue free St.		

art 2 - Second Stage		
onflicting Flows		
otential Capacity		
edestrian Impedance Factor		
ap. Adj. factor due to Impeding mvmnt		
ovement Capacity		

art 3 - Single Stage		
onflicting Flows		1502
otential Capacity		122
edestrian Impedance Factor	1.00	1.00
ap. Adj. factor due to Impeding mvmnt	0.83	0.83
ovement Capacity		101

esult for 2 stage process:

t		101
robability of Queue free St.	1.00	1.00

tep 4: LT from Minor St.	7	10

art 1 - First Stage		
onflicting Flows		
otential Capacity		
edestrian Impedance Factor		
ap. Adj. factor due to Impeding mvmnt		
ovement Capacity		

art 2 - Second Stage		
onflicting Flows		
otential Capacity		
edestrian Impedance Factor		
ap. Adj. factor due to Impeding mvmnt		
ovement Capacity		

art 3 - Single Stage		
onflicting Flows		1502
otential Capacity		134
edestrian Impedance Factor	1.00	1.00
aj. L, Min T Impedance factor	0.83	
aj. L, Min T Adj. Imp Factor.	0.87	
ap. Adj. factor due to Impeding mvmnt	0.75	0.90
ovement Capacity		121

esults for Two-stage process:

t	121

orksheet 8-Shared Lane Calculations

ovement	7 L	8 T	9 R	10 L	11 T	12 R
olume (vph)				65	0	70
ovement Capacity (vph)				121	101	522
hared Lane Capacity (vph)					201	

orksheet 9-Computation of Effect of Flared Minor Street Approaches

ovement	7 L	8 T	9 R	10 L	11 T	12 R
sep				121	101	522
olume				65	0	70
elay						
sep						
sep +1						
ound (Qsep +1)						
max						
sh					201	
UM C sep						
act						

'orksheet 10-Delay, Queue Length, and Level of Service

lovement	1	4	7	8	9	10	11	12
ane Config	LT						LTR	
(vph)	97						135	
(m) (vph)	966						201	
/c	0.10						0.67	
5% queue length	0.33						4.10	
ontrol Delay	9.1						53.3	
OS	A						F	
pproach Delay							53.3	
pproach LOS							F	

/orksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
(oj)	0.90	1.00
(il), Volume for stream 2 or 5	742	
(i2), Volume for stream 3 or 6	0	
(il), Saturation flow rate for stream 2 or 5	1800	
(i2), Saturation flow rate for stream 3 or 6	1800	
*(oj)	0.83	
(M,LT), Delay for stream 1 or 4	9.1	
, Number of major street through lanes	1	
(rank,1) Delay for stream 2 or 5	1.6	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

ıalyst: TR
ıency/Co.: McMillen Engineering
ıte Performed: 10/9/2005
ıalysis Time Period: Weekday PM Base
ıtersection: Route 40/ Hawes Road
ırisdiction:
ıits: U. S. Customary
ıalysis Year: 2016
:oject ID: Route 40 and Hawes Road
ıst/West Street: Route 40
ɔrth/South Street: Hawes Road
ıtersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

ıjor Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
ɔlume	23	576			414	41
ɜak-Hour Factor, PHF	0.66	0.92			0.91	0.66
ɔurly Flow Rate, HFR	34	626			454	62
ɜrcent Heavy Vehicles	3	--	--		--	--
ɜdian Type/Storage	Undivided			/		
? Channelized?						
ınes	0	1			1	0
ɔnfiguration	LT					TR
ɔstream Signal?		No			No	

ınor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
ɔlume				41	0	46
ɜak Hour Factor, PHF				0.62	0.50	0.66
ɔurly Flow Rate, HFR				66	0	69
ɜrcent Heavy Vehicles				3	3	3
ɜrcent Grade (%)		-5			-10	
.ared Approach: Exists?/Storage				/		No /
ınes				0	1	0
ɔnfiguration					LTR	

Delay, Queue Length, and Level of Service

ɔproach	EB	WB	Northbound			Southbound		
ɔvement	1	4	7	8	9	10	11	12
ıne Config	LT						LTR	
(vph)	34						135	
m) (vph)	1045						305	
c	0.03						0.44	
% queue length	0.10						2.16	
ıntrol Delay	8.6						25.9	
S	A						D	
proach Delay							25.9	
proach LOS							D	

HCS2000: Unsignalized Intersections Release 4.1d

one: Fax:
Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

alyst: TR
ency/Co.: McMillen Engineering
te Performed: 10/9/2005
alysis Time Period: Weekday PM Base
tersection: Route 40/ Hawes Road
risdiction:
its: U. S. Customary
alysis Year: 2016
oject ID: Route 40 and Hawes Road
st/West Street: Route 40
rth/South Street: Hawes Road
tersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

jor Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
ume	23	576			414	41
ak-Hour Factor, PHF	0.66	0.92			0.91	0.66
ak-15 Minute Volume	9	157			114	16
rly Flow Rate, HFR	34	626			454	62
rcent Heavy Vehicles	3	--	--		--	--
lian Type/Storage Channelized?	Undivided			/		
nes	0	1			1	0
nfiguration	LT				TR	
stream Signal?		No			No	

ior Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
ume				41	0	46
k Hour Factor, PHF				0.62	0.50	0.66
k-15 Minute Volume				17	0	17
rly Flow Rate, HFR				66	0	69
cent Heavy Vehicles				3	3	3
cent Grade (%)		-5			-10	
red Approach: Exists?/Storage Channelized?				/		No /
es				0	1	0
figuration					LTR	

Pedestrian Volumes and Adjustments

ements	13	14	15	16
w (ped/hr)	0	0	0	0

ıne Width (ft)	12.0	12.0	12.0	12.0
ılking Speed (ft/sec)	4.0	4.0	4.0	4.0
ırcent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
Left-Turn							
Through							
Left-Turn							
Through							

rksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
ared ln volume, major th vehicles:	626	
ared ln volume, major rt vehicles:	0	
t flow rate, major th vehicles:	1800	
t flow rate, major rt vehicles:	1800	
mber of major street through lanes:	1	

rksheet 4-Critical Gap and Follow-up Time Calculation

itical Gap Calculation

vement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
c,base)		4.1					7.1	6.5	6.2
c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ıv)		3					3	3	3
c,g)				0.20	0.20	0.10	0.20	0.20	0.10
ade/100				-0.05	-0.05	-0.05	-0.10	-0.10	-0.10
3,lt)		0.00					0.70	0.00	0.00
c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
c)	1-stage	4.1					6.4	6.5	6.2
	2-stage								

.low-Up Time Calculations

rement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
f,base)		2.20					3.50	4.00	3.30
f,HV)		0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
IV)		3					3	3	3
f)		2.2					3.5	4.0	3.3

ksheet 5-Effect of Upstream Signals

putation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
rog				

tal Saturation Flow Rate, s (vph)
rival Type
fective Green, g (sec)
cle Length, C (sec)
(from Exhibit 16-11)
oportion vehicles arriving on green P
q1)
q2)
q)

mputation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
pha				
ta				
avel time, t(a) (sec)				
oothing Factor, F				
oportion of conflicting flow, f				
x platooned flow, V(c,max)				
n platooned flow, V(c,min)				
ration of blocked period, t(p)				
oportion time blocked, p	0.000		0.000	

mputation 3-Platoon Event Periods	Result
2)	0.000
3)	0.000
dom)	
subo)	
nstrained or unconstrained?	

oportion blocked minor ements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
)			
)			
)			
)			
)			
0)			
1)			
2)			

putation 4 and 5 gle-Stage Process ement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
,x	516					1179	1179	485
,u,x								
,x								
lat,x								

-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
c,x)								
						1500		1500
x)								
c,u,x)								
r,x)								
plat,x)								

rksheet 6-Impedance and Capacity Equations

ep 1: RT from Minor St.	9	12
nflicting Flows		485
tential Capacity		581
destrian Impedance Factor	1.00	1.00
vement Capacity		581
obability of Queue free St.	1.00	0.88
ep 2: LT from Major St.	4	1
nflicting Flows		516
tential Capacity		1045
iestrian Impedance Factor	1.00	1.00
vement Capacity		1045
obability of Queue free St.	1.00	0.97
L-Shared Prob Q free St.		0.95
p 3: TH from Minor St.	8	11
flicting Flows		1179
ential Capacity		191
estrian Impedance Factor	1.00	1.00
. Adj. factor due to Impeding mvmnt	0.95	0.95
ement Capacity		181
bability of Queue free St.	1.00	1.00
p 4: LT from Minor St.	7	10
flicting Flows		1179
ential Capacity		211
estrian Impedance Factor	1.00	1.00
L, Min T Impedance factor	0.95	
L, Min T Adj. Imp Factor.	0.96	
Adj. factor due to Impeding mvmnt	0.85	0.97
ement Capacity		204

sheet 7-Computation of the Effect of Two-stage Gap Acceptance

3: TH from Minor St.	8	11
1 - First Stage		
licting Flows		
ntial Capacity		
strian Impedance Factor		
Adj. factor due to Impeding mvmnt		
ment Capacity		
ability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1179
Potential Capacity		191
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity		181
Result for 2 stage process:		
a		
,		
: t		181
robability of Queue free St.	1.00	1.00
tep 4: LT from Minor St.	7	10
art 1 - First Stage		
onflicting Flows		
otential Capacity		
edestrian Impedance Factor		
p. Adj. factor due to Impeding mvmnt		
vement Capacity		
rt 2 - Second Stage		
nflicting Flows		
tential Capacity		
lestrian Impedance Factor		
. Adj. factor due to Impeding mvmnt		
ement Capacity		
t 3 - Single Stage		
flicting Flows		1179
ential Capacity		211
estrian Impedance Factor	1.00	1.00
L, Min T Impedance factor	0.95	
L, Min T Adj. Imp Factor.	0.96	
Adj. factor due to Impeding mvmnt	0.85	0.97
ment Capacity		204
lts for Two-stage process:		
		204

heet 8-Shared Lane Calculations

ent	7 L	8 T	9 R	10 L	11 T	12 R
e (vph)				66	0	69
ent Capacity (vph)				204	181	581
l Lane Capacity (vph)					305	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				204	181	581
Volume				66	0	69
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
ı max						
: sh					305	
SUM C sep						
ı						
: act						

orksheet 10-Delay, Queue Length, and Level of Service

ovement	1	4	7	8	9	10	11	12
ıne Config	LT						LTR	
(vph)	34						135	
m) (vph)	1045						305	
c	0.03						0.44	
% queue length	0.10						2.16	
ıtrol Delay	8.6						25.9	
;	A						D	
roach Delay							25.9	
roach LOS							D	

ksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
)	0.97	1.00
), Volume for stream 2 or 5	626	
), Volume for stream 3 or 6	0	
), Saturation flow rate for stream 2 or 5	1800	
), Saturation flow rate for stream 3 or 6	1800	
j)	0.95	
LT), Delay for stream 1 or 4	8.6	
umber of major street through lanes	1	
k,1) Delay for stream 2 or 5	0.4	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: TR
Agency/Co.: McMillen Engineering
Date Performed: 10/9/2005
Analysis Time Period: Saturday Base
Intersection: Route 40/ Hawes Road
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2016
Project ID: Route 40 and Hawes Road
East/West Street: Route 40
North/South Street: Hawes Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

ajor Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
lume	28	671			431	23
ak-Hour Factor, PHF	0.78	0.84			0.84	0.58
urly Flow Rate, HFR	35	798			513	39
rcent Heavy Vehicles	3	--	--		--	--
dian Type/Storage	Undivided			/		
Channelized?						
es	0	1			1	0
figuration	LT				TR	
tream Signal?		No			No	

or Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
me				21	0	15
Hour Factor, PHF				0.79	0.50	0.58
ly Flow Rate, HFR				26	0	25
ent Heavy Vehicles				3	3	3
ent Grade (%)		-5			-10	
d Approach: Exists?/Storage			/			No /
				0	1	0
guration					LTR	

Delay, Queue Length, and Level of Service

ach	EB	WB	Northbound			Southbound		
nt	1	4	7	8	9	10	11	12
onfig	LT						LTR	
)	35						51	
vph)	1013						233	
	0.03						0.22	
ue length	0.11						0.81	
Delay	8.7						24.7	
	A						C	
h Delay							24.7	
h LOS							C	

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

nalyst:	TR
gency/Co.:	McMillen Engineering
ate Performed:	10/9/2005
nalysis Time Period:	Saturday Base
ntersection:	Route 40/ Hawes Road
urisdiction:	
nits: U. S. Customary	
nalysis Year:	2016
oject ID: Route 40 and Hawes Road	
st/West Street:	Route 40
rth/South Street:	Hawes Road

tersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

or Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
ume	28	671			431	23
k-Hour Factor, PHF	0.78	0.84			0.84	0.58
k-15 Minute Volume	9	200			128	10
rly Flow Rate, HFR	35	798			513	39
cent Heavy Vehicles	3	--	--		--	--
an Type/Storage	Undivided			/		
hannelized?						
s	0	1			1	0
iguration	LT					TR
ream Signal?		No			No	

Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
e				21	0	15
Hour Factor, PHF				0.79	0.50	0.58
15 Minute Volume				7	0	6
y Flow Rate, HFR				26	0	25
t Heavy Vehicles				3	3	3
t Grade (%)		-5			-10	
Approach: Exists?/Storage				/		No /
nnelized?						
				0	1	0
uration					LTR	

Pedestrian Volumes and Adjustments

ts	13	14	15	16
ed/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

/orksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
hared ln volume, major th vehicles:	798	
hared ln volume, major rt vehicles:	0	
ıt flow rate, major th vehicles:	1800	
ıt flow rate, major rt vehicles:	1800	
ımber of major street through lanes:	1	

rksheet 4-Critical Gap and Follow-up Time Calculation

itical Gap Calculation

vement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
:,base)		4.1					7.1	6.5	6.2
,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
v)		3					3	3	3
,g)				0.20	0.20	0.10	0.20	0.20	0.10
de/100				-0.05	-0.05	-0.05	-0.10	-0.10	-0.10
.lt)		0.00					0.70	0.00	0.00
T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
	1-stage	4.1					6.4	6.5	6.2
	2-stage								

ow-Up Time Calculations

ment	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
ıase)	2.20					3.50	4.00	3.30
:V)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	3					3	3	3
	2.2					3.5	4.0	3.3

ıeet 5-Effect of Upstream Signals

:ation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
2)	0.000
5)	0.000
dom)	
subo)	
Constrained or unconstrained?	

Proportion blocked minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
)			
)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
	552					1400	1400	532
x								
,x								

Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
·V(c,x)								
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
:onflicting Flows		532
'otential Capacity		546
'edestrian Impedance Factor	1.00	1.00
'ovement Capacity		546
robability of Queue free St.	1.00	0.95
tep 2: LT from Major St.	4	1
›nflicting Flows		552
›tential Capacity		1013
destrian Impedance Factor	1.00	1.00
vement Capacity		1013
obability of Queue free St.	1.00	0.97
j L-Shared Prob Q free St.		0.94
ep 3: TH from Minor St.	8	11
flicting Flows		1400
ential Capacity		141
estrian Impedance Factor	1.00	1.00
. Adj. factor due to Impeding mvmnt	0.94	0.94
ement Capacity		132
›ability of Queue free St.	1.00	1.00
› 4: LT from Minor St.	7	10
licting Flows		1400
ntial Capacity		155
strian Impedance Factor	1.00	1.00
L, Min T Impedance factor	0.94	
L, Min T Adj. Imp Factor.	0.95	
Adj. factor due to Impeding mvmnt	0.91	0.97
ıent Capacity		150

heet 7-Computation of the Effect of Two-stage Gap Acceptance

3: TH from Minor St.	8	11
. - First Stage		
cting Flows		
ial Capacity		
rian Impedance Factor		
dj. factor due to Impeding mvmnt		
ıt Capacity		
ility of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1400
Potential Capacity		141
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.94	0.94
Movement Capacity		132
esult for 2 stage process:		
t		132
robability of Queue free St.	1.00	1.00
ep 4: LT from Minor St.	7	10
rt 1 - First Stage		
nflicting Flows		
tential Capacity		
destrian Impedance Factor		
p. Adj. factor due to Impeding mvmnt		
vement Capacity		
t 2 - Second Stage		
flicting Flows		
ential Capacity		
estrian Impedance Factor		
. Adj. factor due to Impeding mvmnt		
ement Capacity		
t 3 - Single Stage		
flicting Flows		1400
ntial Capacity		155
strian Impedance Factor	1.00	1.00
L, Min T Impedance factor	0.94	
L, Min T Adj. Imp Factor.	0.95	
Adj. factor due to Impeding mvmnt	0.91	0.97
ment Capacity		150
lts for Two-stage process:		
		150

heet 8-Shared Lane Calculations

ent	7	8	9	10	11	12
	L	T	R	L	T	R
(vph)				26	0	25
nt Capacity (vph)				150	132	546
Lane Capacity (vph)					233	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				150	132	546
Volume				26	0	25
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
ı max						
: sh					233	
;UM C sep						
act						

orksheet 10-Delay, Queue Length, and Level of Service

ovement	1	4	7	8	9	10	11	12
ıne Config	LT						LTR	
(vph)	35						51	
m) (vph)	1013						233	
c	0.03						0.22	
ß queue length	0.11						0.81	
ıtrol Delay	8.7						24.7	
;	A						C	
roach Delay							24.7	
roach LOS							C	

ksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
)	0.97	1.00
), Volume for stream 2 or 5	798	
), Volume for stream 3 or 6	0	
), Saturation flow rate for stream 2 or 5	1800	
), Saturation flow rate for stream 3 or 6	1800	
j)	0.94	
LT), Delay for stream 1 or 4	8.7	
umber of major street through lanes	1	
k,1) Delay for stream 2 or 5	0.5	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: TR
Agency/Co.: McMillen Engineering
Date Performed: 10/9/2005
Analysis Time Period: Weekday PM Base
Intersection: Route 40/ Marker Road
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2016
Project ID: Route 40 and Marker/Proposed Main Driveway
East/West Street: Route 40
North/South Street: Marker Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

ajor Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
olume		620	9	7	455	
eak-Hour Factor, PHF		0.94	0.67	0.50	0.94	
urly Flow Rate, HFR		659	13	14	484	
rcent Heavy Vehicles		--	--	3	--	--
edian Type/Storage Channelized?	Undivided			/		
nes		1 0		0	1	
nfiguration		TR		LT		
stream Signal?		No			No	

or Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
ume	3	0	11			
Hour Factor, PHF	0.75	0.50	0.62			
ly Flow Rate, HFR	4	0	17			
ent Heavy Vehicles	3	3	3			
ent Grade (%)		-5			3	
ed Approach: Exists?/Storage			No /			/
s	0	1 0				
iguration		LTR				

Delay, Queue Length, and Level of Service

ach	EB	WB	Northbound			Southbound		
ent	1	4	7	8	9	10	11	12
Config		LT		LTR				
h)		14		21				
(vph)		914		373				
		0.02		0.06				
eue length		0.05		0.18				
l Delay		9.0		15.2				
		A		C				
ch Delay				15.2				
ch LOS				C				

HCS2000: Unsignalized Intersections Release 4.1d

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: TR
Agency/Co.: McMillen Engineering
Date Performed: 10/9/2005
Analysis Time Period: Weekday PM Base
Intersection: Route 40/ Marker Road
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2016
Project ID: Route 40 and Marker/Proposed Main Driveway
East/West Street: Route 40
North/South Street: Marker Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		620	9	7	455	
Peak-Hour Factor, PHF		0.94	0.67	0.50	0.94	
Peak-15 Minute Volume		165	3	4	121	
Hourly Flow Rate, HFR		659	13	14	484	
Percent Heavy Vehicles		--	--	3	--	--
Median Type/Storage	Undivided			/		
Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	3	0	11			
Peak Hour Factor, PHF	0.75	0.50	0.62			
Peak-15 Minute Volume	1	0	4			
Hourly Flow Rate, HFR	4	0	17			
Percent Heavy Vehicles	3	3	3			
Percent Grade (%)		-5			3	
Median Approach: Exists?/Storage			No	/		/
Channelized?						
Lanes	0	1	0			
Configuration		LTR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Volume (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

orksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
ıared ln volume, major th vehicles:		484
ıared ln volume, major rt vehicles:		0
ıt flow rate, major th vehicles:		1800
t flow rate, major rt vehicles:		1800
mber of major street through lanes:		1

:ksheet 4-Critical Gap and Follow-up Time Calculation

tical Gap Calculation

ement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
,base)			4.1	7.1	6.5	6.2			
.hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
')			3	3	3	3			
g)				0.20	0.20	0.10	0.20	0.20	0.10
e/100				-0.05	-0.05	-0.05	0.03	0.03	0.03
lt)			0.00	0.70	0.00	0.00			
T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
	1-stage		4.1	6.4	6.5	6.2			
	2-stage								

w-Up Time Calculations

ent	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
ıse)		2.20	3.50	4.00	3.30			
')	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
		3	3	3	3			
		2.2	3.5	4.0	3.3			

eet 5-Effect of Upstream Signals

ıtion 1-Queue Clearance Time at Upstream Signal

Movement 2		Movement 5	
V(t)	V(1,prot)	V(t)	V(1,prot)

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
?roportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
lpha				
eta				
ravel time, t(a) (sec)				
noothing Factor, F				
:oportion of conflicting flow, f				
ıx platooned flow, V(c,max)				
n platooned flow, V(c,min)				
ration of blocked period, t(p)				
oportion time blocked, p	0.000		0.000	

ıputation 3-Platoon Event Periods	Result
)	0.000
)	0.000
om)	
ıbo)	
strained or unconstrained?	

ortion ocked minor ments, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II

ation 4 and 5 -Stage Process nt	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
		672	1178	1178	666			

:

e Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500				
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
onflicting Flows	666	
otential Capacity	458	
edestrian Impedance Factor	1.00	1.00
ovement Capacity	458	
robability of Queue free St.	0.96	1.00
ep 2: LT from Major St.	4	1
nflicting Flows	672	
tential Capacity	914	
iestrian Impedance Factor	1.00	1.00
vement Capacity	914	
obability of Queue free St.	0.98	1.00
L-Shared Prob Q free St.	0.98	
p 3: TH from Minor St.	8	11
flicting Flows	1178	
ntial Capacity	191	
strian Impedance Factor	1.00	1.00
Adj. factor due to Impeding mvmnt	0.98	0.98
ment Capacity	187	
ability of Queue free St.	1.00	1.00
4: LT from Minor St.	7	10
icting Flows	1178	
tial Capacity	211	
trian Impedance Factor	1.00	1.00
L, Min T Impedance factor		0.98
L, Min T Adj. Imp Factor.		0.98
dj. factor due to Impeding mvmnt	0.98	0.95
nt Capacity	208	

eet 7-Computation of the Effect of Two-stage Gap Acceptance

TH from Minor St.	8	11
- First Stage		
ting Flows		
al Capacity		
ian Impedance Factor		
j. factor due to Impeding mvmnt		
Capacity		
ity of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1178	
Potential Capacity	191	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	187	

esult for 2 stage process:

t	187	
robability of Queue free St.	1.00	1.00

ep 4: LT from Minor St.	7	10

rt 1 - First Stage		
nflicting Flows		
tential Capacity		
lestrian Impedance Factor		
. Adj. factor due to Impeding mvmnt		
ement Capacity		

t 2 - Second Stage		
flicting Flows		
ential Capacity		
estrian Impedance Factor		
Adj. factor due to Impeding mvmnt		
ment Capacity		

3 - Single Stage		
licting Flows	1178	
ntial Capacity	211	
strian Impedance Factor	1.00	1.00
L, Min T Impedance factor		0.98
L, Min T Adj. Imp Factor.		0.98
Adj. factor due to Impeding mvmnt	0.98	0.95
ent Capacity	208	

ts for Two-stage process:		
	208	

eet 8-Shared Lane Calculations

nt	7 L	8 T	9 R	10 L	11 T	12 R
(vph)	4	0	17			
t Capacity (vph)	208	187	458			
Lane Capacity (vph)		373				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	208	187	458			
Volume	4	0	17			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
max						
sh		373				
UM C sep						
act						

rksheet 10-Delay, Queue Length, and Level of Service

vement	1	4	7	8	9	10	11	12
ne Config		LT		LTR				
(vph)		14		21				
1) (vph)		914		373				
		0.02		0.06				
queue length		0.05		0.18				
trol Delay		9.0		15.2				
		A		C				
roach Delay				15.2				
roach LOS				C				

sheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
)	1.00	0.98
, Volume for stream 2 or 5		484
, Volume for stream 3 or 6		0
, Saturation flow rate for stream 2 or 5		1800
, Saturation flow rate for stream 3 or 6		1800
)		0.98
T), Delay for stream 1 or 4		9.0
nber of major street through lanes		1
,1) Delay for stream 2 or 5		0.2

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

yst: TR
cy/Co.: McMillen Engineering
Performed: 10/9/2005
ysis Time Period: Saturday Base
rsection: Route 40/ Marker Road
sdiction:
s: U. S. Customary
ysis Year: 2016
ect ID: Route 40 and Marker/Proposed Main Driveway
/West Street: Route 40
/South Street: Marker Road
rsection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Street:	Approach	Eastbound			Westbound		
	Movement	1	2	3	4	5	6
		L	T	R	L	T	R
e			607	3	6	450	
Hour Factor, PHF			0.80	0.75	0.62	0.87	
y Flow Rate, HFR			758	4	9	517	
nt Heavy Vehicles			--	--	3	--	--
n Type/Storage		Undivided			/		
nnelized?							
			1 0		0 1		
uration			TR		LT		
am Signal?			No			No	

Street:	Approach	Northbound			Southbound		
	Movement	7	8	9	10	11	12
		L	T	R	L	T	R
		4	0	6			
our Factor, PHF		1.00	0.50	0.42			
Flow Rate, HFR		4	0	14			
Heavy Vehicles		3	3	3			
Grade (%)			-5			3	
Approach:	Exists?/Storage			No	/		/
		0	1 0				
ration			LTR				

Delay, Queue Length, and Level of Service

h	EB	WB	Northbound			Southbound		
t	1	4	7	8	9	10	11	12
nfig		LT		LTR				
		9		18				
h)		846		315				
		0.01		0.06				
e length		0.03		0.18				
Delay		9.3		17.1				
		A		C				
Delay				17.1				
LOS				C				

HCS2000: Unsignalized Intersections Release 4.1d

e: Fax:
il:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

/st: TR
:y/Co.: McMillen Engineering
Performed: 10/9/2005
'sis Time Period: Saturday Base
'section: Route 40/ Marker Road
diction:
: U. S. Customary
sis Year: 2016
ct ID: Route 40 and Marker/Proposed Main Driveway
West Street: Route 40
/South Street: Marker Road
section Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
		607	3	6	450	
our Factor, PHF		0.80	0.75	0.62	0.87	
5 Minute Volume		190	1	2	129	
Flow Rate, HFR		758	4	9	517	
t Heavy Vehicles		--	--	3	--	--
Type/Storage	Undivided			/		
melized?						
		1	0	0	1	
ration			TR	LT		
m Signal?		No			No	

treet Movements	7 L	8 T	9 R	10 L	11 T	12 R
	4	0	6			
ur Factor, PHF	1.00	0.50	0.42			
Minute Volume	1	0	4			
Flow Rate, HFR	4	0	14			
Heavy Vehicles	3	3	3			
Grade (%)		-5			3	
pproach: Exists?/Storage			No	/		/
elized?						
	0	1	0			
ation		LTR				

Pedestrian Volumes and Adjustments

s	13	14	15	16
i/hr)	0	0	0	0

: Width (ft)	12.0	12.0	12.0	12.0
:ing Speed (ft/sec)	4.0	4.0	4.0	4.0
:ent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
Left-Turn							
Through							
Left-Turn							
Through							

:heet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
d ln volume, major th vehicles:		517
d ln volume, major rt vehicles:		0
low rate, major th vehicles:		1800
low rate, major rt vehicles:		1800
r of major street through lanes:		1

ıeet 4-Critical Gap and Follow-up Time Calculation

:al Gap Calculation

:nt	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
se)		4.1	7.1	6.5	6.2			
)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		3	3	3	3			
			0.20	0.20	0.10	0.20	0.20	0.10
100			-0.05	-0.05	-0.05	0.03	0.03	0.03
		0.00	0.70	0.00	0.00			
: 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
1-stage		4.1	6.4	6.5	6.2			
2-stage								

Up Time Calculations

t	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
e)		2.20	3.50	4.00	3.30			
	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
		3	3	3	3			
		2.2	3.5	4.0	3.3			

t 5-Effect of Upstream Signals

ion 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)

al Saturation Flow Rate, s (vph)
ival Type
ective Green, g (sec)
e Length, C (sec)
from Exhibit 16-11)
portion vehicles arriving on green P
)
)

utation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
a				
el time, t(a) (sec)				
hing Factor, F				
rtion of conflicting flow, f				
platooned flow, V(c,max)				
platooned flow, V(c,min)				
ion of blocked period, t(p)				
rtion time blocked, p	0.000		0.000	

tation 3-Platoon Event Periods	Result
	0.000
	0.000

)
rained or unconstrained?

tion ked nor nts, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II

tion 4 and 5 Stage Process t	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
		762	1295	1295	760			

e Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
x)		1500		1500				
u,x)								
x)								
at,x)								

sheet 6-Impedance and Capacity Equations

1: RT from Minor St.	9	12
icting Flows	760	
tial Capacity	405	
trian Impedance Factor	1.00	1.00
ent Capacity	405	
bility of Queue free St.	0.97	1.00
2: LT from Major St.	4	1
cting Flows	762	
ial Capacity	846	
rian Impedance Factor	1.00	1.00
nt Capacity	846	
ility of Queue free St.	0.99	1.00
Shared Prob Q free St.	0.99	
: TH from Minor St.	8	11
cting Flows	1295	
al Capacity	162	
ian Impedance Factor	1.00	1.00
dj. factor due to Impeding mvmnt	0.99	0.99
t Capacity	160	
lity of Queue free St.	1.00	1.00
LT from Minor St.	7	10
ting Flows	1295	
al Capacity	179	
ian Impedance Factor	1.00	1.00
Min T Impedance factor		0.99
Min T Adj. Imp Factor.		0.99
. factor due to Impeding mvmnt	0.99	0.95
Capacity	177	

t 7-Computation of the Effect of Two-stage Gap Acceptance

TH from Minor St.	8	11
First Stage		
ng Flows		
Capacity		
n Impedance Factor		
factor due to Impeding mvmnt		
Capacity		
ty of Queue free St.		

2 - Second Stage		
licting Flows		
ntial Capacity		
strian Impedance Factor		
Adj. factor due to Impeding mvmnt		
ment Capacity		
3 - Single Stage		
licting Flows	1295	
ıtial Capacity	162	
ɜtrian Impedance Factor	1.00	1.00
Adj. factor due to Impeding mvmnt	0.99	0.99
ıent Capacity	160	
t for 2 stage process:		
	160	
bility of Queue free St.	1.00	1.00
4: LT from Minor St.	7	10
l - First Stage		
lcting Flows		
:ial Capacity		
:rian Impedance Factor		
dj. factor due to Impeding mvmnt		
nt Capacity		
- Second Stage		
cting Flows		
ial Capacity		
rian Impedance Factor		
dj. factor due to Impeding mvmnt		
ıt Capacity		
- Single Stage		
:ting Flows	1295	
al Capacity	179	
ian Impedance Factor	1.00	1.00
Min T Impedance factor		0.99
Min T Adj. Imp Factor.		0.99
j. factor due to Impeding mvmnt	0.99	0.95
t Capacity	177	
for Two-stage process:		
	177	

t 8-Shared Lane Calculations

	7 L	8 T	9 R	10 L	11 T	12 R
vph)	4	0	14			
Capacity (vph)	177	160	405			
ane Capacity (vph)		315				

sheet 9-Computation of Effect of Flared Minor Street Approaches

nent	7 L	8 T	9 R	10 L	11 T	12 R
ɔ	177	160	405			
ne	4	0	14			
/						
ɔ						
ɔ +1						
l (Qsep +1)						
		315				
sep						

ıeet 10-Delay, Queue Length, and Level of Service

ɜnt	1	4	7	8	9	10	11	12
:onfig		LT		LTR				
)		9		18				
vph)		846		315				
		0.01		0.06				
eue length		0.03		0.18				
l Delay		9.3		17.1				
		A		C				
:h Delay				17.1				
:h LOS				C				

:et 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
	1.00	0.99
Volume for stream 2 or 5		517
Volume for stream 3 or 6		0
Saturation flow rate for stream 2 or 5		1800
Saturation flow rate for stream 3 or 6		1800
		0.99
Delay for stream 1 or 4		9.3
:r of major street through lanes		1
) Delay for stream 2 or 5		0.1

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

yst: TR
cy/Co.: McMillen Engineering
Performed: 10/9/2005
ysis Time Period: Weekday PM Base
rsection: Route 40/Smith School Hse Road
sdiction:
s: U. S. Customary
/sis Year: 2016
ect ID: Route 40 and Smith School House Road Intersection
'West Street: Route 40
/South Street: Dinner Bell Road
section Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Street:	Approach	Eastbound			Westbound		
	Movement	1	2	3	4	5	6
		L	T	R	L	T	R
e		18	614			433	9
Hour Factor, PHF		0.67	0.94			0.94	0.67
Flow Rate, HFR		26	653			460	13
t Heavy Vehicles		3	--	--		--	--
Type/Storage		Undivided			/		
nnelized?							
		0	1			1	0
uration		LT					TR
am Signal?			No			No	

Street:	Approach	Northbound			Southbound		
	Movement	7	8	9	10	11	12
		L	T	R	L	T	R
					13	0	29
ur Factor, PHF					0.75	0.38	0.93
Flow Rate, HFR					17	0	31
Heavy Vehicles					3	3	3
Grade (%)						10	
Approach:	Exists?/Storage			/		No	/
					0	1	0
ration						LTR	

Delay, Queue Length, and Level of Service

	EB	WB	Northbound			Southbound		
	1	4	7	8	9	10	11	12
fig	LT						LTR	
	26						48	
h)	1084						356	
	0.02						0.13	
e length	0.07						0.46	
Delay	8.4						16.7	
	A						C	
Delay							16.7	
LOS							C	

HCS2000: Unsignalized Intersections Release 4.1d

e: Fax:
il:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

st: TR
y/Co.: McMillen Engineering
Performed: 10/9/2005
sis Time Period: Weekday PM Base
section: Route 40/Smith School Hse Road
diction:
: U. S. Customary
sis Year: 2016
ct ID: Route 40 and Smith School House Road Intersection
Vest Street: Route 40
South Street: Dinner Bell Road
ection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
	18	614			433	9
our Factor, PHF	0.67	0.94			0.94	0.67
5 Minute Volume	7	163			115	3
Flow Rate, HFR	26	653			460	13
Heavy Vehicles	3	--	--		--	--
Type/Storage	Undivided			/		
nelized?						
	0	1			1	0
ration	LT					TR
m Signal?		No			No	

treet Movements	7 L	8 T	9 R	10 L	11 T	12 R
				13	0	29
ir Factor, PHF				0.75	0.38	0.93
Minute Volume				4	0	8
low Rate, HFR				17	0	31
Heavy Vehicles				3	3	3
Grade (%)					10	
pproach: Exists?/Storage				/		No /
elized?						
				0	1	0
ation					LTR	

Pedestrian Volumes and Adjustments

	13	14	15	16
/hr)	0	0	0	0

Width (ft)	12.0	12.0	12.0	12.0
ing Speed (ft/sec)	4.0	4.0	4.0	4.0
ent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
eft-Turn							
hrough							
eft-Turn							
hrough							

heet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
d ln volume, major th vehicles:	653	
d ln volume, major rt vehicles:	0	
ow rate, major th vehicles:	1800	
ow rate, major rt vehicles:	1800	
of major street through lanes:	1	

eet 4-Critical Gap and Follow-up Time Calculation

al Gap Calculation

nt	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
se)	4.1					7.1	6.5	6.2
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	3					3	3	3
			0.20	0.20	0.10	0.20	0.20	0.10
00						0.10	0.10	0.10
	0.00					0.70	0.00	0.00
1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
1-stage	4.1					6.4	6.6	6.2
2-stage								

Up Time Calculations

	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
)	2.20					3.50	4.00	3.30
	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	3					3	3	3
	2.2					3.5	4.0	3.3

t 5-Effect of Upstream Signals

on 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)

l Saturation Flow Rate, s (vph)
val Type
ctive Green, g (sec)
e Length, C (sec)
from Exhibit 16-11)
ortion vehicles arriving on green P
)
)

itation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
l time, t(a) (sec)				
hing Factor, F				
rtion of conflicting flow, f				
latooned flow, V(c,max)				
latooned flow, V(c,min)				
ion of blocked period, t(p)				
ction time blocked, p	0.000		0.000	

ation 3-Platoon Event Periods	Result
	0.000
	0.000

)
ained or unconstrained?

tion ked ior its, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II

tion 4 and 5
Stage Process

	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
	473					1171	1171	466

Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
x)								
						1500		1500
u,x)								
x)								
at,x)								

sheet 6-Impedance and Capacity Equations

1: RT from Minor St.	9	12
.icting Flows		466
tial Capacity		594
trian Impedance Factor	1.00	1.00
ent Capacity		594
bility of Queue free St.	1.00	0.95
2: LT from Major St.	4	1
icting Flows		473
:ial Capacity		1084
:rian Impedance Factor	1.00	1.00
›nt Capacity		1084
›ility of Queue free St.	1.00	0.98
Shared Prob Q free St.		0.96
: TH from Minor St.	8	11
cting Flows		1171
ial Capacity		190
:ian Impedance Factor	1.00	1.00
ij. factor due to Impeding mvmnt	0.96	0.96
ıt Capacity		183
.lity of Queue free St.	1.00	1.00
LT from Minor St.	7	10
ting Flows		1171
al Capacity		211
ian Impedance Factor	1.00	1.00
Min T Impedance factor	0.96	
Min T Adj. Imp Factor.	0.97	
j. factor due to Impeding mvmnt	0.92	0.98
: Capacity		206

t 7-Computation of the Effect of Two-stage Gap Acceptance

TH from Minor St.	8	11
First Stage		
ing Flows		
l Capacity		
ın Impedance Factor		
. factor due to Impeding mvmnt		
Capacity		
.ty of Queue free St.		

2 - Second Stage		
licting Flows		
ntial Capacity		
strian Impedance Factor		
Adj. factor due to Impeding mvmnt		
ment Capacity		
3 - Single Stage		
licting Flows		1171
ntial Capacity		190
strian Impedance Factor	1.00	1.00
Adj. factor due to Impeding mvmnt	0.96	0.96
ment Capacity		183
t for 2 stage process:		
		183
bility of Queue free St.	1.00	1.00
4: LT from Minor St.	7	10
l - First Stage		
licting Flows		
ial Capacity		
rian Impedance Factor		
dj. factor due to Impeding mvmnt		
nt Capacity		
- Second Stage		
cting Flows		
ial Capacity		
rian Impedance Factor		
dj. factor due to Impeding mvmnt		
nt Capacity		
- Single Stage		
ting Flows		1171
al Capacity		211
ian Impedance Factor	1.00	1.00
Min T Impedance factor	0.96	
Min T Adj. Imp Factor.	0.97	
j. factor due to Impeding mvmnt	0.92	0.98
t Capacity		206
for Two-stage process:		
		206

t 8-Shared Lane Calculations

	7 L	8 T	9 R	10 L	11 T	12 R
vph)				17	0	31
Capacity (vph)				206	183	594
ne Capacity (vph)					356	

sheet 9-Computation of Effect of Flared Minor Street Approaches

nent	7	8	9	10	11	12
	L	T	R	L	T	R
ɔ				206	183	594
ne				17	0	31
/						
ɔ						
ɔ +1						
l (Qsep +1)						
:						
					356	
sep						

ıeet 10-Delay, Queue Length, and Level of Service

ɜnt	1	4	7	8	9	10	11	12
:onfig	LT						LTR	
.)	26						48	
vph)	1084						356	
	0.02						0.13	
eue length	0.07						0.46	
l Delay	8.4						16.7	
	A						C	
:h Delay							16.7	
:h LOS							C	

ɜet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
	0.98	1.00
Volume for stream 2 or 5	653	
Volume for stream 3 or 6	0	
Saturation flow rate for stream 2 or 5	1800	
Saturation flow rate for stream 3 or 6	1800	
	0.96	
. Delay for stream 1 or 4	8.4	
ɜr of major street through lanes	1	
.) Delay for stream 2 or 5	0.3	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

yst: TR
cy/Co.: McMillen Engineering
Performed: 109/2005
ysis Time Period: Saturday Peak Base
rsection: Route 40/Smith School Hse Road
sdiction:
s: U. S. Customary
/sis Year: 2016
ct ID: Route 40 and Smith School House Road Intersection
West Street: Route 40
/South Street: Dinner Bell Road
section Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
e	15	554			442	11
lour Factor, PHF	0.50	0.87			0.87	0.50
Flow Rate, HFR	30	636			508	22
it Heavy Vehicles	3	--	--		--	--
Type/Storage	Undivided			/		
nnelized?						
	0	1			1	0
uration	LT					TR
am Signal?		No			No	

Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
				9	0	13
ur Factor, PHF				0.40	0.38	0.60
Flow Rate, HFR				22	0	21
Heavy Vehicles				3	3	3
Grade (%)					10	
Approach: Exists?/Storage				/		No /
				0	1	0
ration					LTR	

Delay, Queue Length, and Level of Service

	EB	WB	Northbound			Southbound		
	1	4	7	8	9	10	11	12
fig	LT						LTR	
	30						43	
h)	1032						282	
	0.03						0.15	
e length	0.09						0.53	
Delay	8.6						20.0	
	A						C	
Delay							20.0	
LOS							C	

HCS2000: Unsignalized Intersections Release 4.1d

e: Fax:
il:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

/st: TR
:y/Co.: McMillen Engineering
Performed: 109/2005
sis Time Period: Saturday Peak Base
section: Route 40/Smith School Hse Road
diction:
: U. S. Customary
sis Year: 2016
ct ID: Route 40 and Smith School House Road Intersection
West Street: Route 40
/South Street: Dinner Bell Road
section Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
	15	554			442	11
our Factor, PHF	0.50	0.87			0.87	0.50
5 Minute Volume	8	159			127	6
Flow Rate, HFR	30	636			508	22
t Heavy Vehicles	3	--	--		--	--
Type/Storage	Undivided			/		
nnelized?						
	0	1			1	0
uration	LT					TR
am Signal?		No			No	

Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
				9	0	13
ur Factor, PHF				0.40	0.38	0.60
Minute Volume				6	0	5
Flow Rate, HFR				22	0	21
Heavy Vehicles				3	3	3
Grade (%)					10	
Approach: Exists?/Storage				/		No /
nelized?						
				0	1	0
cation					LTR	

Pedestrian Volumes and Adjustments

s	13	14	15	16
d/hr)	0	0	0	0

Width (ft)	12.0	12.0	12.0	12.0
ing Speed (ft/sec)	4.0	4.0	4.0	4.0
ent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
Left-Turn							
Through							
Left-Turn							
Through							

heet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
d ln volume, major th vehicles:	636	
d ln volume, major rt vehicles:	0	
low rate, major th vehicles:	1800	
low rate, major rt vehicles:	1800	
r of major street through lanes:	1	

heet 4-Critical Gap and Follow-up Time Calculation

cal Gap Calculation

ent	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
ase)	4.1					7.1	6.5	6.2
r)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	3					3	3	3
			0.20	0.20	0.10	0.20	0.20	0.10
100						0.10	0.10	0.10
)	0.00					0.70	0.00	0.00
: 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
1-stage	4.1					6.4	6.6	6.2
2-stage								

-Up Time Calculations

nt	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
se)	2.20					3.50	4.00	3.30
	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	3					3	3	3
	2.2					3.5	4.0	3.3

et 5-Effect of Upstream Signals

tion 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)

l Saturation Flow Rate, s (vph)
val Type
ctive Green, g (sec)
e Length, C (sec)
from Exhibit 16-11)
ortion vehicles arriving on green P
)
)

utation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
a				
el time, t(a) (sec)				
thing Factor, F				
ortion of conflicting flow, f				
platooned flow, V(c,max)				
platooned flow, V(c,min)				
tion of blocked period, t(p)				
ortion time blocked, p	0.000		0.000	

tation 3-Platoon Event Periods	Result
	0.000
	0.000
)	
o)	
rained or unconstrained?	

rtion cked inor ents, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II

ation 4 and 5
-Stage Process

nt	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
	530					1215	1215	519

x

, x

age Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
x)								
						1500		1500
u,x)								
x)								
at,x)								

sheet 6-Impedance and Capacity Equations

1: RT from Minor St.	9	12
licting Flows		519
ntial Capacity		554
strian Impedance Factor	1.00	1.00
nent Capacity		554
ability of Queue free St.	1.00	0.96
2: LT from Major St.	4	1
licting Flows		530
ntial Capacity		1032
strian Impedance Factor	1.00	1.00
nent Capacity		1032
ability of Queue free St.	1.00	0.97
-Shared Prob Q free St.		0.96
3: TH from Minor St.	8	11
icting Flows		1215
tial Capacity		179
trian Impedance Factor	1.00	1.00
Adj. factor due to Impeding mvmnt	0.96	0.96
ent Capacity		171
bility of Queue free St.	1.00	1.00
4: LT from Minor St.	7	10
icting Flows		1215
tial Capacity		198
trian Impedance Factor	1.00	1.00
L, Min T Impedance factor	0.96	
L, Min T Adj. Imp Factor.	0.97	
Adj. factor due to Impeding mvmnt	0.93	0.97
ent Capacity		192

heet 7-Computation of the Effect of Two-stage Gap Acceptance

: TH from Minor St.	8	11
- First Stage		
cting Flows		
ial Capacity		
rian Impedance Factor		
dj. factor due to Impeding mvmnt		
nt Capacity		
ility of Queue free St.		

2 - Second Stage		
licting Flows		
ntial Capacity		
strian Impedance Factor		
Adj. factor due to Impeding mvmnt		
ment Capacity		
3 - Single Stage		
licting Flows		1215
ntial Capacity		179
strian Impedance Factor	1.00	1.00
Adj. factor due to Impeding mvmnt	0.96	0.96
nent Capacity		171
lt for 2 stage process:		
		171
ibility of Queue free St.	1.00	1.00
4: LT from Minor St.	7	10
1 - First Stage		
icting Flows		
tial Capacity		
trian Impedance Factor		
Adj. factor due to Impeding mvmnt		
ent Capacity		
2 - Second Stage		
icting Flows		
:ial Capacity		
:rian Impedance Factor		
ıdj. factor due to Impeding mvmnt		
:nt Capacity		
- Single Stage		
cting Flows		1215
ial Capacity		198
rian Impedance Factor	1.00	1.00
, Min T Impedance factor	0.96	
, Min T Adj. Imp Factor.	0.97	
dj. factor due to Impeding mvmnt	0.93	0.97
nt Capacity		192
s for Two-stage process:		
		192

:et 8-Shared Lane Calculations

t	7	8	9	10	11	12
	L	T	R	L	T	R
(vph)				22	0	21
t Capacity (vph)				192	171	554
Lane Capacity (vph)					282	

sheet 9-Computation of Effect of Flared Minor Street Approaches

ment	7	8	9	10	11	12
	L	T	R	L	T	R
)				192	171	554
ne				22	0	21
/						
)						
) +1						
1 (Qsep +1)						
:						
					282	
: sep						
:						

heet 10-Delay, Queue Length, and Level of Service

ent	1	4	7	8	9	10	11	12
Config	LT						LTR	
h)	30						43	
(vph)	1032						282	
	0.03						0.15	
ueue length	0.09						0.53	
ol Delay	8.6						20.0	
	A						C	
ch Delay							20.0	
ch LOS							C	

eet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
	0.97	1.00
Volume for stream 2 or 5	636	
Volume for stream 3 or 6	0	
Saturation flow rate for stream 2 or 5	1800	
Saturation flow rate for stream 3 or 6	1800	
	0.96	
, Delay for stream 1 or 4	8.6	
ber of major street through lanes	1	
1) Delay for stream 2 or 5	0.4	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

yst:	TR
cy/Co.:	McMillen Engineering
Performed:	10/9/2005
ysis Time Period:	Weekday PM Base
rsection:	Route 40/ Dinner Bell Road
sdiction:	
s: U. S. Customary	
ysis Year:	2016
ect ID: Route 40 and Dinner Bell Road Intersection	
/West Street:	Route 40
/South Street:	Dinner Bell Road
rsection Orientation: EW	Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Street:	Approach	Eastbound			Westbound		
	Movement	1	2	3	4	5	6
		L	T	R	L	T	R
e		29	559	52	15	396	42
Hour Factor, PHF		0.81	0.94	0.78	0.58	0.94	0.79
y Flow Rate, HFR		35	594	66	25	421	53
nt Heavy Vehicles		3	--	--	3	--	--
n Type/Storage		Undivided			/		
annelized?							
		0	1	0	0	1	0
guration			LTR			LTR	
eam Signal?			No			No	

Street:	Approach	Northbound			Southbound		
	Movement	7	8	9	10	11	12
		L	T	R	L	T	R
		29	8	18	40	3	17
Hour Factor, PHF		0.81	0.58	0.67	0.75	0.38	0.63
Flow Rate, HFR		35	13	26	53	7	26
it Heavy Vehicles		3	3	3	3	3	3
it Grade (%)			-4			3	
Approach:	Exists?/Storage			No /			No /
		0	1	0	0	1	0
uration			LTR			LTR	

Delay, Queue Length, and Level of Service

ch	EB	WB	Northbound			Southbound		
nt	1	4	7	8	9	10	11	12
onfig	LTR	LTR		LTR			LTR	
)	35	25		74			86	
/ph)	1083	923		191			174	
	0.03	0.03		0.39			0.49	
eue length	0.10	0.08		1.70			2.41	
. Delay	8.4	9.0		35.3			44.4	
	A	A		E			E	
h Delay				35.3			44.4	
h LOS				E			E	