

Memorandum

To: George Zambouras, Town Engineer
16 Lowell Street, Reading, MA

JOB #: REA-0316

From: William R. Bergeron, P.E., Project Engineer
Hayes Engineering, Inc.

Date: December 12, 2011

Subject: Phase II – Johnson Woods Traffic Information

General:

Based upon your request for supplemental information to clarify the potential traffic impacts to the adjacent intersections of West Street and Summer Avenue, and West Street and Willow Street, we have both agreed that the following procedure will be used.

- * The *Figure 3* "2025 Weekday AM(PM) Peak Hour Traffic Volumes with Existing Geometry" in the Greenman-Pedersen, Inc. Functional Design Report, West Street Reconstruction, Reading, Massachusetts, No. 601705, February 2006, will be used for the base calculations.
- * The TABLE 5 and 6 Intersection Level-of-Service Analysis Summary – AM & PM Peak Hour data from the GPI report is to be used for comparison.
- * The directional distribution for the traffic from the Phase II Johnson Woods Condominium Complex will be as shown on the attached *Figure 1* and is based upon the Abend Associates Technical Memorandum dated April 11, 2002 done for the Johnson Woods condominium site.

The LOS analysis provided in this supplemental information includes an analysis of the data to reproduce the original GPI results as a base. The additional traffic from Johnson Woods Phase II was then added to the appropriate turning movement locations based upon the trip distribution to determine the potential changes. The results of this analysis are shown in **TABLE I**, and the LOS calculation sheets are attached.

It is our opinion that the impacts of the additional traffic to the West Street / Willow Street, and West Street / Summer Avenue intersections will have no detrimental effect, and the LOS levels will not change.

As noted previously, this applicant has already contributed \$100,000.00 toward the improvement of this intersection as part of the Phase I approval.

Please feel free to call if you have any questions or if I can be of any further assistance on this matter.

**JOHNSON WOODS PHASE II
READING, MASSACHUSETTS**

**Supplemental Traffic Information
Table I**

Intersection Level-of-Service (LOS) Summary
Based Upon GPI Functional Design Report, Dated February 2006

Intersection (Unsignalized)	GPI 2025 - Without Improvements Report *						Johnson Woods - No Phase II 2025 **						Johnson Woods - With Phase II 2025 ***						
	AM		PM		PM		AM		PM		PM		AM		PM		PM		
	delay (secs)	LOS	delay (secs)	LOS	delay (secs)	LOS	delay (secs)	LOS	delay (secs)	LOS	delay (secs)	LOS	delay (secs)	LOS	delay (secs)	LOS	delay (secs)	LOS	
<u>West Street @ Willow Street</u>	144.1	F	19.7	C			144.5	F	19.3	C			167.7	F	20.7	C			
Willow SB Movement to West SB																			
<u>West Street @ Summer Avenue</u>																			
Summer WB Left / Right	10.5	B	11.1	B			10.1	B	10.5	B			10.2	B	10.7	B			
West SB Left / Through	3.9	A	4.4	A			7.8	A	8.0	A			7.9	A	8.1	A			
* This data from Tables 5 and 6 of GPI Functional Design Report.						** This data is from different computer programs to reproduce original GPI data.						*** This data reflects impact of full development of Johnson Woods Phase II.							

HAYES ENGINEERING, INC.

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JOB FILE #: REM-0316

NAME: Johnson Woods Phase II

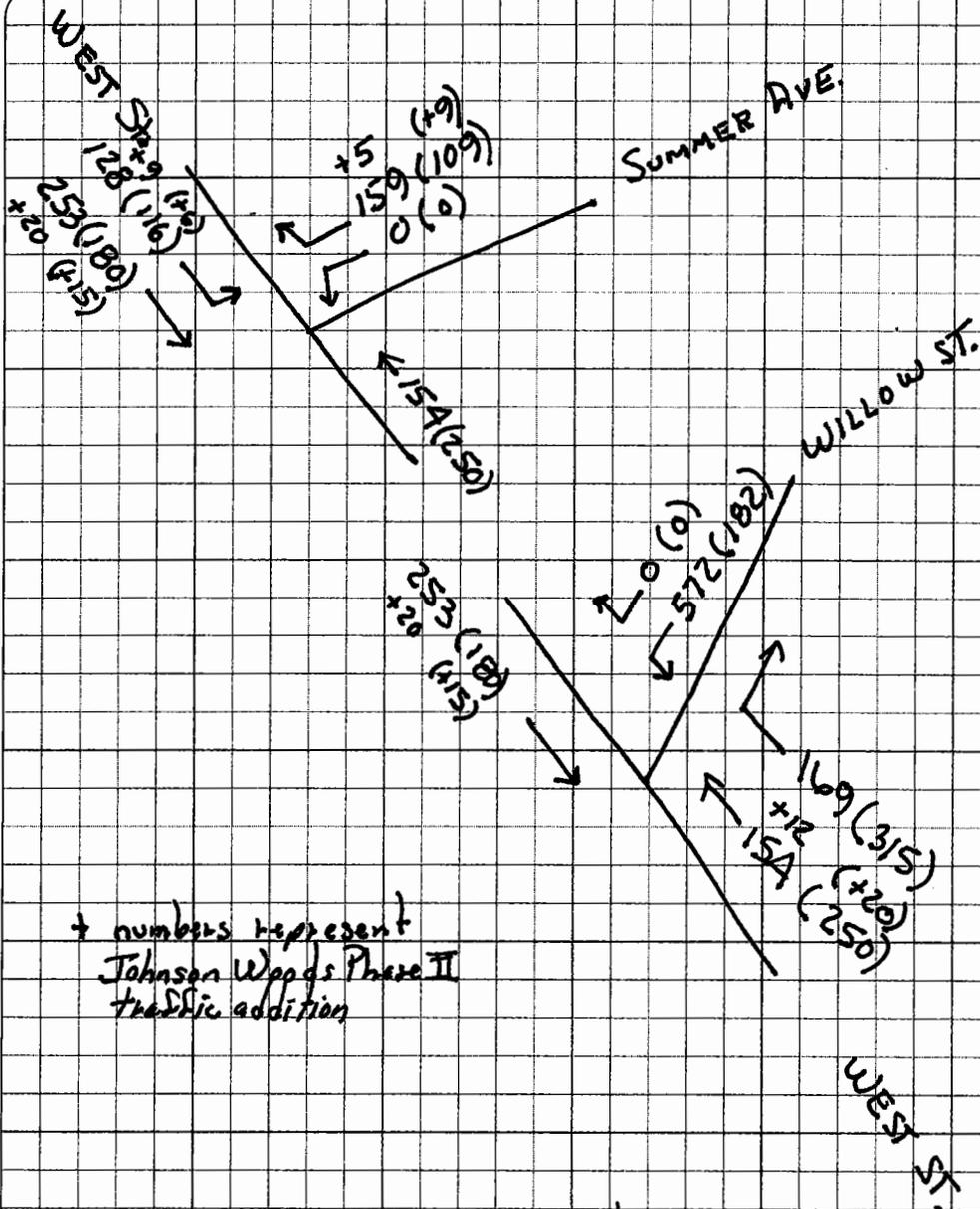
DATE: 12/12/2011

MADE BY: _____

MEMO

CALCULATION

Figure 1



+ numbers represent Johnson Woods Phase II traffic addition

Base Data from GPI Greenman-Pedersen, Inc.

Functional Design Report

West Street Reconstruction

Reading, Massachusetts No. 601765

February 2006

Figure 3 2025 Week day AM (PM)

Peak Hour Traffic Volumes

Existing Geometry

TWO-WAY STOP CONTROL SUMMARY							
General Information				Site Information			
Analyst	WRB			Intersection	West & Summer Ave		
Agency/Co.	Hayes Engineering, Inc.			Jurisdiction	Reading		
Date Performed	12/7/2011			Analysis Year	2025 from GPI Functional Desig		
Analysis Time Period	AM						
Project Description Johnson Woods Phase II No Build 2025 No IMPROVEMENTS							
East/West Street: Summer Avenue				North/South Street: West Street			
Intersection Orientation: North-South				Study Period (hrs): 0.25			
Vehicle Volumes and Adjustments							
Major Street	Northbound			Southbound			
Movement	1	2	3	4	5	6	
	L	T	R	L	T	R	
Volume (veh/h)		154		128	253		
Peak-Hour Factor, PHF	1.00	0.93	0.93	0.93	0.93	1.00	
Hourly Flow Rate, HFR (veh/h)	0	165	0	137	272	0	
Percent Heavy Vehicles	0	--	--	0	--	--	
Median Type	Undivided						
RT Channelized			0			0	
Lanes	0	1	0	0	1	0	
Configuration		T		LT			
Upstream Signal		0			0		
Minor Street	Eastbound			Westbound			
Movement	7	8	9	10	11	12	
	L	T	R	L	T	R	
Volume (veh/h)						159	
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.91	1.00	0.91	
Hourly Flow Rate, HFR (veh/h)	0	0	0	0	0	174	
Percent Heavy Vehicles	0	0	0	2	0	0	
Percent Grade (%)		0			0		
Flared Approach		N			N		
Storage		0			0		
RT Channelized			0			0	
Lanes	0	0	0	0	0	1	
Configuration						R	
Delay, Queue Length, and Level of Service							
Approach	Northbound	Southbound	Westbound			Eastbound	
Movement	1	4	7	8	9	10	11
Lane Configuration		LT			R		
v (veh/h)		137			174		
C (m) (veh/h)		1426			885		
v/c		0.10			0.20		
95% queue length		0.32			0.73		
Control Delay (s/veh)		7.8			10.1		
LOS		A			B		
Approach Delay (s/veh)	--	--	10.1				
Approach LOS	--	--	B				

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	WRB			Intersection	West & Summer Ave			
Agency/Co.	Hayes Engineering, Inc.			Jurisdiction	Reading			
Date Performed	12/7/2011			Analysis Year	2025 from GPI Functional Desig			
Analysis Time Period	AM							
Project Description Johnson Woods Phase II Build 2025 No IMPROVEMENTS				East/West Street: Summer Avenue North/South Street: West Street				
Intersection Orientation: North-South				Study Period (hrs): 0.25				
Vehicle Volumes and Adjustments								
Major Street	Northbound			Southbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)		166		137	273			
Peak-Hour Factor, PHF	1.00	0.93	0.93	0.93	0.93	1.00		
Hourly Flow Rate, HFR (veh/h)	0	178	0	147	293	0		
Percent Heavy Vehicles	0	--	--	0	--	--		
Median Type	Undivided							
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration		T		LT				
Upstream Signal		0			0			
Minor Street	Eastbound			Westbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)						164		
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.91	1.00	0.91		
Hourly Flow Rate, HFR (veh/h)	0	0	0	0	0	180		
Percent Heavy Vehicles	0	0	0	2	0	0		
Percent Grade (%)		0			0			
Flared Approach		N			N			
Storage		0			0			
RT Channelized			0			0		
Lanes	0	0	0	0	0	1		
Configuration						R		
Delay, Queue Length, and Level of Service								
Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT			R			
v (veh/h)		147			180			
C (m) (veh/h)		1410			870			
v/c		0.10			0.21			
95% queue length		0.35			0.78			
Control Delay (s/veh)		7.9			10.2			
LOS		A			B			
Approach Delay (s/veh)	--	--	10.2					
Approach LOS	--	--	B					

TWO-WAY STOP CONTROL SUMMARY								
General Information					Site Information			
Analyst	WRB				Intersection	West & Summer Ave		
Agency/Co.	Hayes Engineering, Inc.				Jurisdiction	Reading		
Date Performed	12/7/2011				Analysis Year	2025 from GPI Functional Desig		
Analysis Time Period	PM							
Project Description	Johnson Woods Phase II				No Build 2025 No Improvements			
East/West Street:	Summer Avenue				North/South Street: West Street			
Intersection Orientation:	North-South				Study Period (hrs): 0.25			
Vehicle Volumes and Adjustments								
Major Street	Northbound			Southbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)		250		116	180			
Peak-Hour Factor, PHF	1.00	0.93	0.93	0.93	0.93	1.00		
Hourly Flow Rate, HFR (veh/h)	0	268	0	124	193	0		
Percent Heavy Vehicles	0	--	--	0	--	--		
Median Type	Undivided							
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration		T		LT				
Upstream Signal		0			0			
Minor Street	Eastbound			Westbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)						109		
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.91	1.00	0.93		
Hourly Flow Rate, HFR (veh/h)	0	0	0	0	0	117		
Percent Heavy Vehicles	0	0	0	2	0	0		
Percent Grade (%)		0			0			
Flared Approach		N			N			
Storage		0			0			
RT Channelized			0			0		
Lanes	0	0	0	0	0	1		
Configuration						R		
Delay, Queue Length, and Level of Service								
Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT			R			
v (veh/h)		124			117			
C (m) (veh/h)		1307			776			
v/c		0.09			0.15			
95% queue length		0.31			0.53			
Control Delay (s/veh)		8.0			10.5			
LOS		A			B			
Approach Delay (s/veh)	--	--	10.5					
Approach LOS	--	--	B					

TWO-WAY STOP CONTROL SUMMARY							
General Information				Site Information			
Analyst	WRB			Intersection	West & Summer Ave		
Agency/Co.	Hayes Engineering, Inc.			Jurisdiction	Reading		
Date Performed	12/7/2011			Analysis Year	2025 from GPI Functional Desig		
Analysis Time Period	PM						
Project Description Johnson Woods Phase II build PM based on GPI Report				No IMPROVEMENTS			
East/West Street: Summer Avenue				North/South Street: West Street			
Intersection Orientation: North-South				Study Period (hrs): 0.25			
Vehicle Volumes and Adjustments							
Major Street	Northbound			Southbound			
Movement	1	2	3	4	5	6	
	L	T	R	L	T	R	
Volume (veh/h)		270		122	195		
Peak-Hour Factor, PHF	1.00	0.93	0.93	0.93	0.93	1.00	
Hourly Flow Rate, HFR (veh/h)	0	290	0	131	209	0	
Percent Heavy Vehicles	0	-	-	0	-	-	
Median Type	Undivided						
RT Channelized			0			0	
Lanes	0	1	0	0	1	0	
Configuration		T		LT			
Upstream Signal		0			0		
Minor Street	Eastbound			Westbound			
Movement	7	8	9	10	11	12	
	L	T	R	L	T	R	
Volume (veh/h)						118	
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.91	1.00	0.93	
Hourly Flow Rate, HFR (veh/h)	0	0	0	0	0	126	
Percent Heavy Vehicles	0	0	0	2	0	0	
Percent Grade (%)		0			0		
Flared Approach		N			N		
Storage		0			0		
RT Channelized			0			0	
Lanes	0	0	0	0	0	1	
Configuration						R	
Delay, Queue Length, and Level of Service							
Approach	Northbound	Southbound	Westbound			Eastbound	
Movement	1	4	7	8	9	10	11
Lane Configuration		LT			R		
v (veh/h)		131			126		
C (m) (veh/h)		1283			754		
v/c		0.10			0.17		
95% queue length		0.34			0.60		
Control Delay (s/veh)		8.1			10.7		
LOS		A			B		
Approach Delay (s/veh)	--	--	10.7				
Approach LOS	--	--	B				

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	WRB			Intersection	West & Willow			
Agency/Co.	Hayes Engineering, Inc.			Jurisdiction	Reading			
Date Performed	12/7/2011			Analysis Year	2025 from GPI Functional Desig			
Analysis Time Period	AM							
Project Description				Johnson Woods Phase II NO BUILD 2025 No IMPROVEMENTS				
East/West Street:				Willow Street North/South Street: West Street				
Intersection Orientation:				North-South Study Period (hrs): 0.25				
Vehicle Volumes and Adjustments								
Major Street	Northbound			Southbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)		154	169		253			
Peak-Hour Factor, PHF	1.00	0.93	0.93	1.00	0.93	1.00		
Hourly Flow Rate, HFR (veh/h)	0	165	181	0	272	0		
Percent Heavy Vehicles	0	-	-	0	-	-		
Median Type	Undivided							
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration			TR		T			
Upstream Signal		0			0			
Minor Street	Eastbound			Westbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)				572				
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.91	1.00	1.00		
Hourly Flow Rate, HFR (veh/h)	0	0	0	628	0	0		
Percent Heavy Vehicles	0	0	0	2	0	0		
Percent Grade (%)		0			0			
Flared Approach		N			N			
Storage		0			0			
RT Channelized			0			0		
Lanes	0	0	0	1	0	0		
Configuration				L				
Delay, Queue Length, and Level of Service								
Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration			L					
v (veh/h)			628					
C (m) (veh/h)			511					
v/c			1.23					
95% queue length			24.31					
Control Delay (s/veh)			144.5					
LOS			F					
Approach Delay (s/veh)	--	--	144.5					
Approach LOS	--	--	F					

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	WRB			Intersection	West & Willow			
Agency/Co.	Hayes Engineering, Inc.			Jurisdiction	Reading			
Date Performed	12/7/2011			Analysis Year	2025 from GPI Functional Desig			
Analysis Time Period	AM							
Project Description Johnson Woods Phase II BUILD 2025 NO IMPROVEMENTS								
East/West Street: Willow Street				North/South Street: West Street				
Intersection Orientation: North-South				Study Period (hrs): 0.25				
Vehicle Volumes and Adjustments								
Major Street	Northbound			Southbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)		166	169		273			
Peak-Hour Factor, PHF	1.00	0.93	0.93	1.00	0.93	1.00		
Hourly Flow Rate, HFR (veh/h)	0	178	181	0	293	0		
Percent Heavy Vehicles	0	-	-	0	-	-		
Median Type	Undivided							
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration			TR		T			
Upstream Signal		0			0			
Minor Street	Eastbound			Westbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)				572				
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.91	1.00	1.00		
Hourly Flow Rate, HFR (veh/h)	0	0	0	628	0	0		
Percent Heavy Vehicles	0	0	0	2	0	0		
Percent Grade (%)		0			0			
Flared Approach		N			N			
Storage		0			0			
RT Channelized			0			0		
Lanes	0	0	0	1	0	0		
Configuration				L				
Delay, Queue Length, and Level of Service								
Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration			L					
v (veh/h)			628					
C (m) (veh/h)			489					
v/c			1.28					
95% queue length			26.32					
Control Delay (s/veh)			167.7					
LOS			F					
Approach Delay (s/veh)	--	--	167.7					
Approach LOS	--	--	F					

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	WRB			Intersection	West & Willow			
Agency/Co.	Hayes Engineering, Inc.			Jurisdiction	Reading			
Date Performed	12/7/2011			Analysis Year	2025 from GPI Functional Desig			
Analysis Time Period	PM							
Project Description	Johnson Woods Phase II No Build In GPI Report 2025 PM No Improvements							
East/West Street:	Willow Street			North/South Street:	West Street			
Intersection Orientation:	North-South			Study Period (hrs):	0.25			
Vehicle Volumes and Adjustments								
Major Street	Northbound			Southbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)		250	315		180			
Peak-Hour Factor, PHF	1.00	0.93	0.93	1.00	0.93	1.00		
Hourly Flow Rate, HFR (veh/h)	0	268	338	0	193	0		
Percent Heavy Vehicles	0	--	--	0	--	--		
Median Type	Undivided							
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration			TR		T			
Upstream Signal		0			0			
Minor Street	Eastbound			Westbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)				182				
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	1.00		
Hourly Flow Rate, HFR (veh/h)	0	0	0	197	0	0		
Percent Heavy Vehicles	0	0	0	2	0	0		
Percent Grade (%)		0			0			
Flared Approach		N			N			
Storage		0			0			
RT Channelized			0			0		
Lanes	0	0	0	1	0	0		
Configuration				L				
Delay, Queue Length, and Level of Service								
Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration			L					
v (veh/h)			197					
C (m) (veh/h)			446					
v/c			0.44					
95% queue length			2.22					
Control Delay (s/veh)			19.3					
LOS			C					
Approach Delay (s/veh)	--	--	19.3					
Approach LOS	--	--	C					

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	WRB			Intersection	West & Willow			
Agency/Co.	Hayes Engineering, Inc.			Jurisdiction	Reading			
Date Performed	12/7/2011			Analysis Year	2025 from GPI Functional Desig			
Analysis Time Period	PM							
Project Description Johnson Woods Phase II Build from GPI Report 2025 PM <i>No Improvements</i>								
East/West Street: Willow Street				North/South Street: West Street				
Intersection Orientation: North-South				Study Period (hrs): 0.25				
Vehicle Volumes and Adjustments								
Major Street	Northbound			Southbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)		270	315		195			
Peak-Hour Factor, PHF	1.00	0.93	0.93	1.00	0.93	1.00		
Hourly Flow Rate, HFR (veh/h)	0	290	338	0	209	0		
Percent Heavy Vehicles	0	--	--	0	--	--		
Median Type	Undivided							
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration			TR		T			
Upstream Signal		0			0			
Minor Street	Eastbound			Westbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)				182				
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	1.00		
Hourly Flow Rate, HFR (veh/h)	0	0	0	197	0	0		
Percent Heavy Vehicles	0	0	0	2	0	0		
Percent Grade (%)	0			0				
Flared Approach		N			N			
Storage		0			0			
RT Channelized			0			0		
Lanes	0	0	0	1	0	0		
Configuration				L				
Delay, Queue Length, and Level of Service								
Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration			L					
v (veh/h)			197					
C (m) (veh/h)			423					
v/c			0.47					
95% queue length			2.41					
Control Delay (s/veh)			20.7					
LOS			C					
Approach Delay (s/veh)	--	--	20.7					
Approach LOS	--	--	C					