Traffic Impact Study

Hudson Valley Community College

Student Housing

City of Troy, New York

CM Project No. 113-231

Prepared For:

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May 23, 2014

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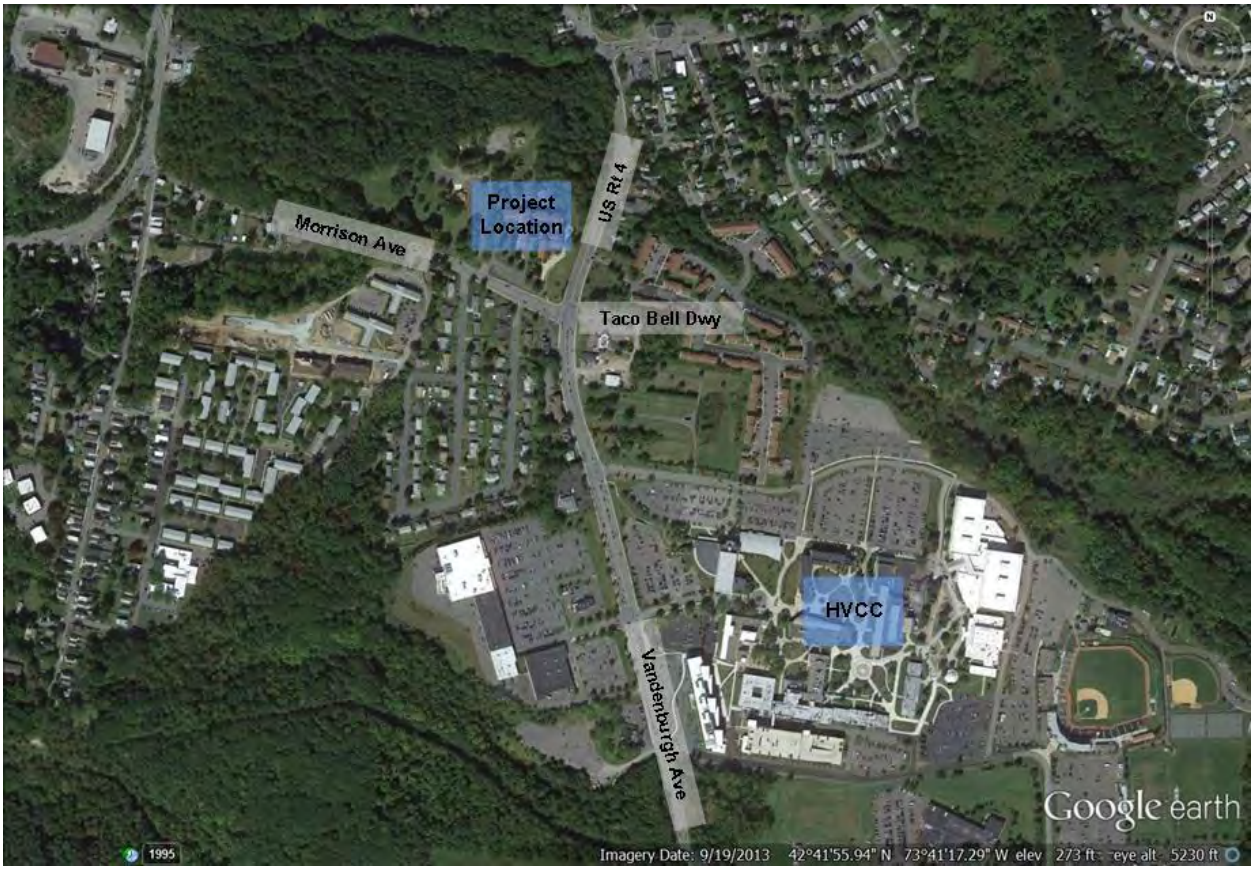
CHAPTER I
INTRODUCTION

This report summarizes the results of a Traffic Impact Study for the proposed *Student Housing* for Hudson Valley Community College (HVCC) located in the northwest quadrant of the Morrison Avenue/Vandenburgh Avenue (US Route 4) intersection in the City of Troy, Rensselaer County, New York. The site is an approximate 1.74 acre parcel as shown in the aerial image below. A copy of the proposed Site Layout and Materials Plan dated May 23, 2014 is included in Appendix A.



A. Planned Project

The proposed project includes the construction of a 330-bed student housing facility. Access to the site is proposed via the existing full access driveway intersecting Morrison Avenue and a potential right-out only driveway intersecting Vandenburgh

Avenue at the site of an existing curb cut. Archaeological constraints on the site may preclude construction of the driveway to Vandenburgh Avenue; therefore the capacity analyses contained in Chapter IV include analysis both with and without the Vandenburgh Avenue driveway. It is anticipated that the project will be open by fall 2015.

B. Study Area and Methodology

The study area for this analysis includes the Morrison Avenue/Vandenburgh Avenue intersection. A sensitivity analysis includes an evaluation of the Morrison Avenue/NY Route 378/Burden Avenue intersection. The potential traffic impact of the proposed project was determined by documenting the existing traffic conditions in the area, projecting future traffic volumes, including adding traffic associated with other developments in the area, adding the peak hour trip generation of the site, and determining the operating conditions of the study area intersections after development of the proposed project.

CHAPTER II

EXISTING CONDITIONS

A. Roadways Serving the Site

- Morrison Avenue – Morrison Avenue is a local road extending from NY Route 378 in the west to Vandenburgh Avenue (US Route 4) in the east. Adjacent to the site driveway, Morrison Avenue provides an 11-foot westbound travel lane, a 17-foot eastbound travel lane, and a 10-foot center two-way left-turn lane. The roadway is at an approximately nine percent upgrade toward Vandenburgh Avenue along the site frontage. There is no posted speed limit on Morrison Avenue therefore the 30-mph City speed limit applies. A sidewalk extends on the north side of the roadway along the site frontage to the adjacent Vandenburgh Avenue and along the south side for the entirety of Morrison Avenue. In the eastbound direction, there is a five ton weight limit for trucks. In the westbound direction there is a no truck sign.

- Vandenburgh Avenue (US Route 4) – Vandenburgh Avenue is designated US Route 4 in the study area and provides north-south travel from Campbell Avenue in the north to the Troy City Line in the south at Campus View Drive. Adjacent to the site, Vandenburgh Avenue transitions from two travel lanes in each direction near Morrison Avenue to one 15-foot northbound travel lane and two 11-foot southbound travel lanes near the north end of the site frontage. There is a five foot wide marked bike lane on the both sides of the roadway in the study area. A sidewalk is provided on the east side of the roadway along the site frontage. The posted speed limit on Vandenburgh Avenue is 30-mph.

B. Study Area Intersections

- Morrison Avenue/Vandenburgh Avenue – This is a four-leg intersection controlled by an actuated traffic signal. The northbound and southbound Vandenburgh Avenue approaches each provide a left-turn lane, a through lane, and a shared through/right-turn lane. The eastbound Morrison Avenue approach provides a shared left-turn/through lane and two right-turn lanes. The westbound Taco Bell driveway approach provides a left-turn lane and a shared through/right-turn lane. Crosswalks with pedestrian indicators, pushbuttons, and countdown timers are provided on the southbound, eastbound, and westbound intersection approaches. The crosswalks connect the sidewalk network available on both sides of Morrison Avenue, on the east side of Vandenburgh Avenue north of Morrison Avenue, and on both sides of the Vandenburgh Avenue south of Morrison Avenue.

C. Existing Conditions

Intersection turning movement counts were conducted at the study area intersection of Morrison Avenue/Vandenburgh Avenue on April 9, 2014 from 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m. Peak one hour traffic volumes were obtained from the two hour counts conducted in the morning and afternoon periods. These volumes represent the existing condition traffic volumes for the weekday AM and PM peak hours as shown on Figure 2.1 and form the basis for all traffic forecasts. The raw turning movement count data is included in Appendix B. Automatic traffic recorders (ATRs) were placed on Morrison Avenue and Vandenburgh Avenue near the site driveways for a period of several days to collect continuous traffic volume and travel speed data.

The following observations are evident based on the existing traffic volume data:

- The weekday morning peak hour occurred from 7:15 to 8:15 a.m. and the weekday afternoon peak hour occurred from 5:00 to 6:00 p.m.

- The two-way traffic volume on Morrison Avenue along the project frontage is approximately 1,670 vehicles per hour (vph) during the AM peak hour and 1,730 vph during the PM peak hour. The two-way traffic volume on Vandenburgh Avenue along the project frontage is approximately 710 vph during the AM peak hour and 940 vph during the PM peak hour.

- Heavy vehicles and buses account for a total of 2% of two-way traffic on Morrison Avenue adjacent to the project site during the AM peak hour and 1% during the PM peak hour.

- Heavy vehicles and buses account for a total of 5% of two-way traffic on Vandenburgh Avenue adjacent to the project site during the AM peak hour and 2% during the PM peak hour.

D. Vehicle Queues

Vehicle queues were documented during both the AM and PM peak hours for eastbound vehicles on Morrison Avenue and southbound vehicles on Vandenburgh Avenue at the signalized study area intersection. The following observations were noted:

- The average queue observed on the southbound Vandenburgh Avenue approach was 7 vehicles during the AM and PM peak hours. The maximum vehicle queue observed was 20 vehicles during the AM peak hour and 17 vehicles during the PM peak hour.

- The average queue observed on the eastbound Morrison Avenue approach was 3 vehicles during both the AM and PM peak hours. The maximum vehicle queue observed was 9 vehicles during the AM peak hour and 8 vehicles during the PM peak hour. The existing site driveway is located approximately 400 feet from the eastbound stop bar at the adjacent signalized intersection allowing space for approximately 16 vehicles to queue prior to blocking the driveway. The vehicle queue never blocked the site driveway during the peak hours during the periods of data collection.

E. Transit

Transit service available in the project vicinity is provided by the Capital District Transportation Authority (CDTA) on several existing bus lines. CDTA Route 85 – Waterford/Troy and CDTA Route 224 – Albany/Troy via Route 4 provide service in the study area. CDTA Route 85 provides service seven days a week. On weekdays service spans from 5:45 a.m. to 12:00 a.m. with stops approximately every twenty minutes. CDTA Route 224 provides service on weekdays from 6:00 a.m. till 7:00 p.m. with stops near the project site every 15 to 30 minutes. Bus stops are available adjacent to the proposed project on Morrison Avenue and Vandenburgh Avenue. Both routes also stop on Vandenburgh Avenue adjacent to Hudson Valley Community College.

F. Pedestrian/Bicycle Accommodations and Environment

Sidewalks are provided on both sides of Morrison Avenue along the project frontage, on the south side for the length of Morrison Avenue, on the east side of Vandenburgh Avenue north of Morrison Avenue and on both sides of Vandenburgh Avenue south of Morrison Avenue. Crosswalks, pedestrian pushbuttons, indicators, and countdown timers are provided on the southbound, eastbound, and westbound intersection approaches at the adjacent Morrison Avenue/Vandenburgh Avenue intersection. As shown on the site plan, the proposed project includes sidewalks connecting between the student housing and the existing sidewalk network. At the signalized Vandenburgh Avenue/North Drive intersection which provides direct access to the HVCC campus, pedestrian pushbuttons, indicators, and countdown timers are provided on all intersection approaches except the eastbound SEFCU driveway

approach where only a crosswalk is provided. There is also a bicycle lane on both sides of Vandenburgh Avenue through the study area.

G. Accident History

Accident data was requested from NYSDOT to determine accident trends at the Morrison Avenue/Vandenburgh Avenue intersection. Accident summaries and details were provided by the NYSDOT Safety and Information Management System for the latest three years of available data from the period between August 1, 2010 and July 31, 2013. Table 2.1 summarizes the accident history at the study area intersection.

Table 2.1 – Summary of Intersection Accidents

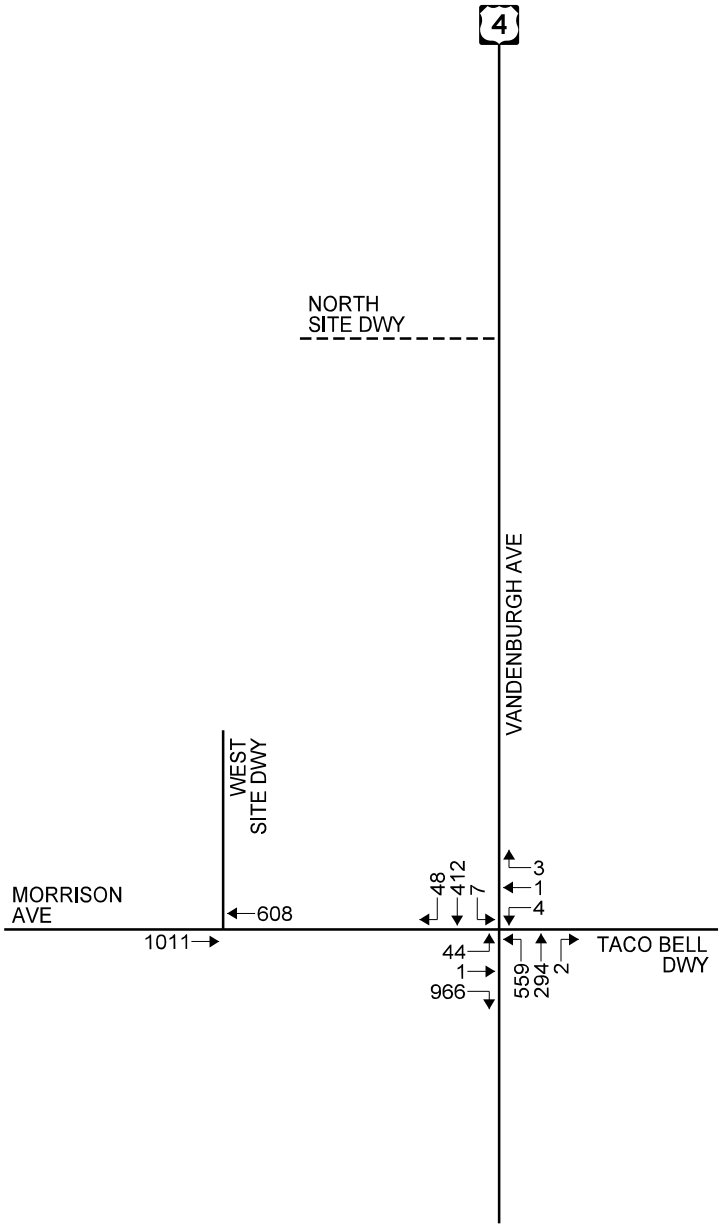
Intersection	Non-Reportable[1]	Property Damage Only	Injury	Fatality	Total
Morrison Avenue/ Vandenburgh Avenue	4	18	17	0	39

[1] A non-reportable accident indicates no personal injuries occurred and property damages totaled less than $1,000.

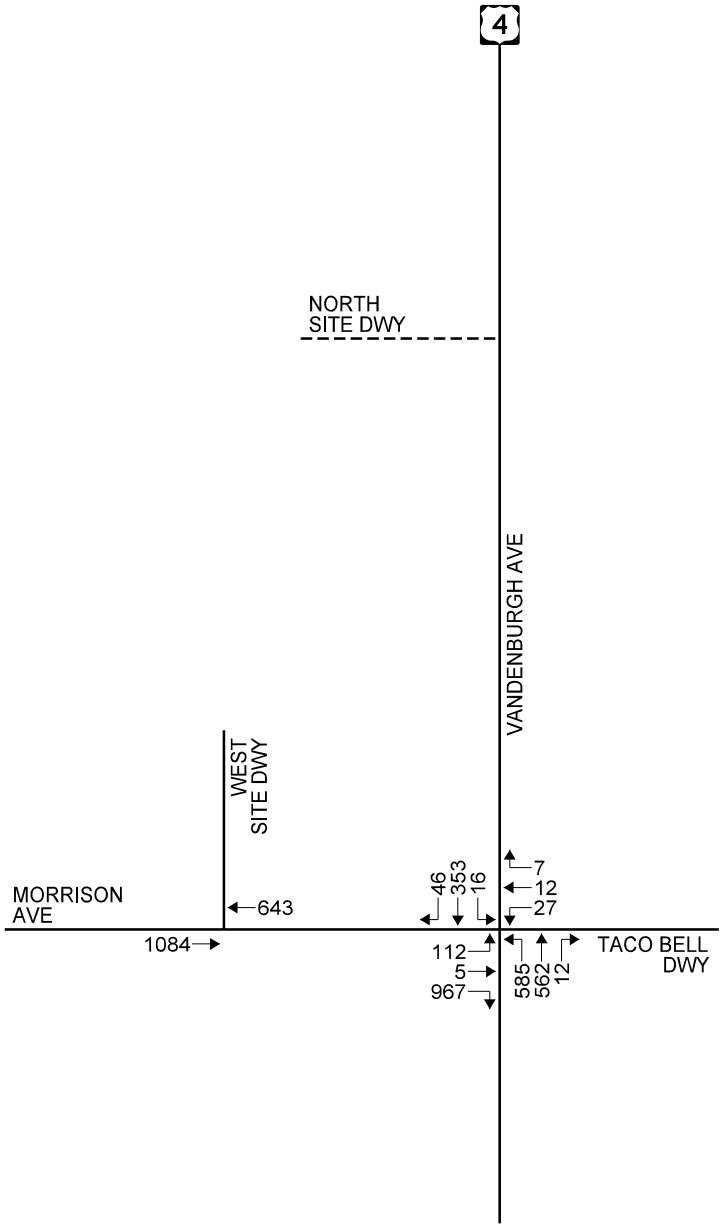
The data shows that there were 39 accidents at the study intersection. Of the 39 accidents, three were pedestrian collisions involving injury. There was one additional pedestrian injury collision located on Vandenburgh Avenue 30 meters south of Morrison Avenue due to pedestrian error/confusion. The four pedestrian accidents occurred while the pedestrian was on Vandenburgh Avenue; two were due to the drivers obstructed view and two were due to pedestrian confusion.

A majority of the vehicle accidents occurring at the study intersection involved right angle collisions due to failure to yield and disregarding the traffic control device.

AM PEAK HOUR



PM PEAK HOUR



2014 EXISTING
TRAFFIC VOLUMES

HVCC STUDENT HOUSING
TROY, NEW YORK

Creighton Manning

PROJECT: 113-231	DATE: 04/2014	FIGURE: 2.1

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CHAPTER III
TRAFFIC FORECASTS

To evaluate the impact of the proposed project, traffic projections were prepared for 2015, the expected year of site development and operation.

A. 2015 No-Build Traffic Volumes

No-Build traffic volumes include trips associated with other development projects in the study area and a background growth rate. Information provided by the City of Troy indicates that there are no other projects within the study are that will affect traffic volumes in the study are prior to project completion. Historical traffic volume data published by the New York State Department of Transportation (NYSDOT) indicates that traffic volumes in the study area are increasing by less than 1% per year; therefore, a background growth rate of 0.5% was applied to the 2014 existing traffic volumes to develop the 2015 No-Build traffic volumes. These volumes, illustrated on Figure 3.1, represent future traffic conditions in the study area *without* construction of the proposed project.

B. Trip Generation

Trip generation determines the quantity of traffic expected to travel to/from the project site. The Institute of Transportation Engineers (ITE) *Trip Generation*, 9th edition, provides trip generation data for various land uses based on studies of similar existing developments located across the country and is the industry standard for determining trip generation for proposed land uses. However, *Trip Generation* does not contain data for off campus student housing. Therefore, data collected at a similar student housing facility for Schenectady County Community College (SCCC) was utilized in this study. The SCCC data identified an AM peak hour trip generation rate of 0.093 vehicle trips per bed and a PM peak hour trip generation rate of 0.139 vehicle trips per bed. Table 3.1 summarizes the trip generation estimate for the proposed 330-bed student housing facility.

Table 3.1 – Trip Generation Summary

Land Use	Size	AM Peak Hour			PM Peak Hour		
		Enter	Exit	Total	Enter	Exit	Total
Student Housing	330 beds	14	17	31	20	26	46

Table 3.1 shows that the proposed *HVCC Student Housing* is expected to generate approximately 31 new vehicle trips during the AM peak hour and 46 new vehicle trips during the PM peak hour.

It is noted that the existing building was previously occupied by a number of uses including offices for HVCC (Finance, Registrar, Admissions, President's Office, etc.), classrooms for the Law Enforcement Academy, Respiratory Therapy/Paramedics, Communications, and Food Service Program, as well as a daycare center and church congregation. It is estimated that between 200 and 250 people worked at the existing building in its latest use by HVCC. Information published by ITE for General Office Building (land use code 710) shows that a 100,000 square foot (SF) office building with approximately 250 employees generates between 120 and 150 vehicle trips during the AM and PM peak hours. This is approximately 100 trips more than the proposed *HVCC Student Housing* facility indicating that the current proposal will result in fewer trips to and from the site during the peak hours.

In addition, the 330-bed facility will be housing students that would otherwise be commuters traveling to and from the campus daily. Although some students will opt to drive vehicles onto campus or travel to and from the site for other activities or employment, the trips per resident at student housing facilities are typically low. The proximity of the site to the school will make non-motorized travel (via foot, bicycle, or bus) an attractive means of commuting to and from campus. Overall, there will be a net reduction in trips on the study area network as students that previously drove to campus will no longer be traveling to and from outside the immediate study area and many will opt to walk or bike to campus.

C. Trip Distribution

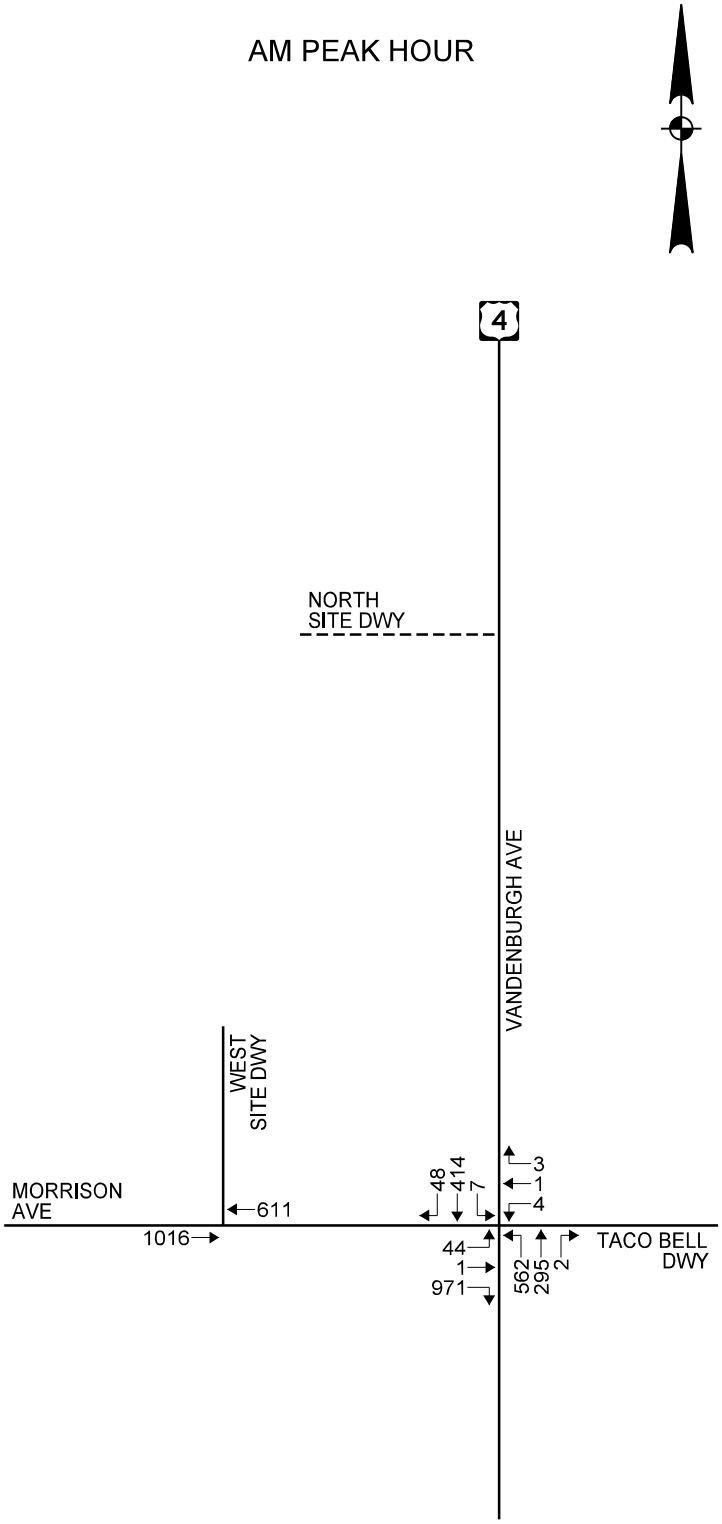
Trip distribution describes where traffic originates or where traffic is destined. Traffic generated by the proposed project was distributed based on existing travel patterns in the study area. It is expected that 85% of the site generated traffic will travel to and from the HVCC campus while the remaining 15% travels west on Morrison Avenue to access other portions of the City and Capital District. Figure 3.2 illustrates the expected distribution of trips for the proposed project.

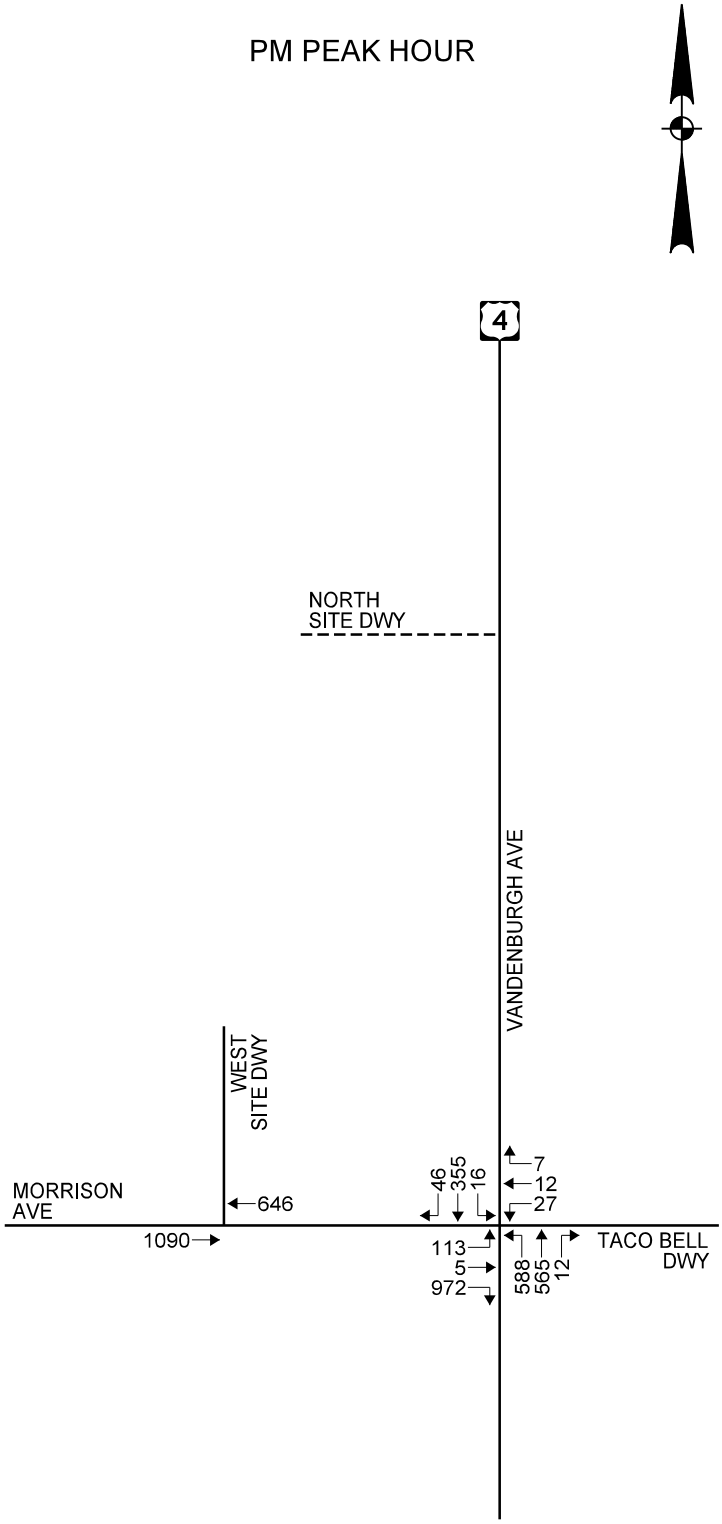
D. Trip Assignment

Trip assignment combines the results of the trip generation and trip distribution and determines the specific paths and roadways that will be used between various origin/destination pairs. Figure 3.2 shows the resulting trip assignment for the proposed *HVCC Student Housing* for the weekday AM and PM peak hours.

E. 2015 Build Traffic Volumes

The results of the site generated traffic assignment were added to the 2015 No-Build traffic volumes to develop the 2015 Build traffic volumes. The 2015 Build traffic volumes are shown on Figure 3.3.





2015 NO-BUILD
TRAFFIC VOLUMES

HVCC STUDENT HOUSING
TROY, NEW YORK

Creighton Manning

PROJECT: 113-231	DATE: 04/2014	FIGURE: 3.1

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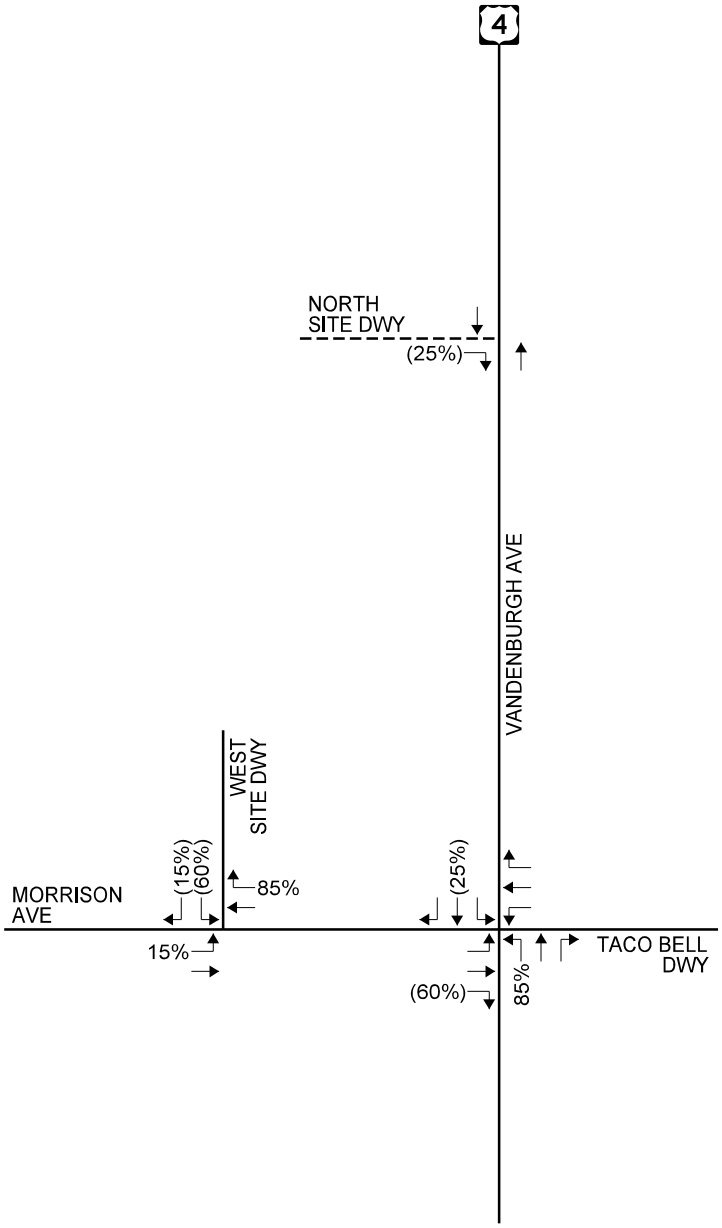
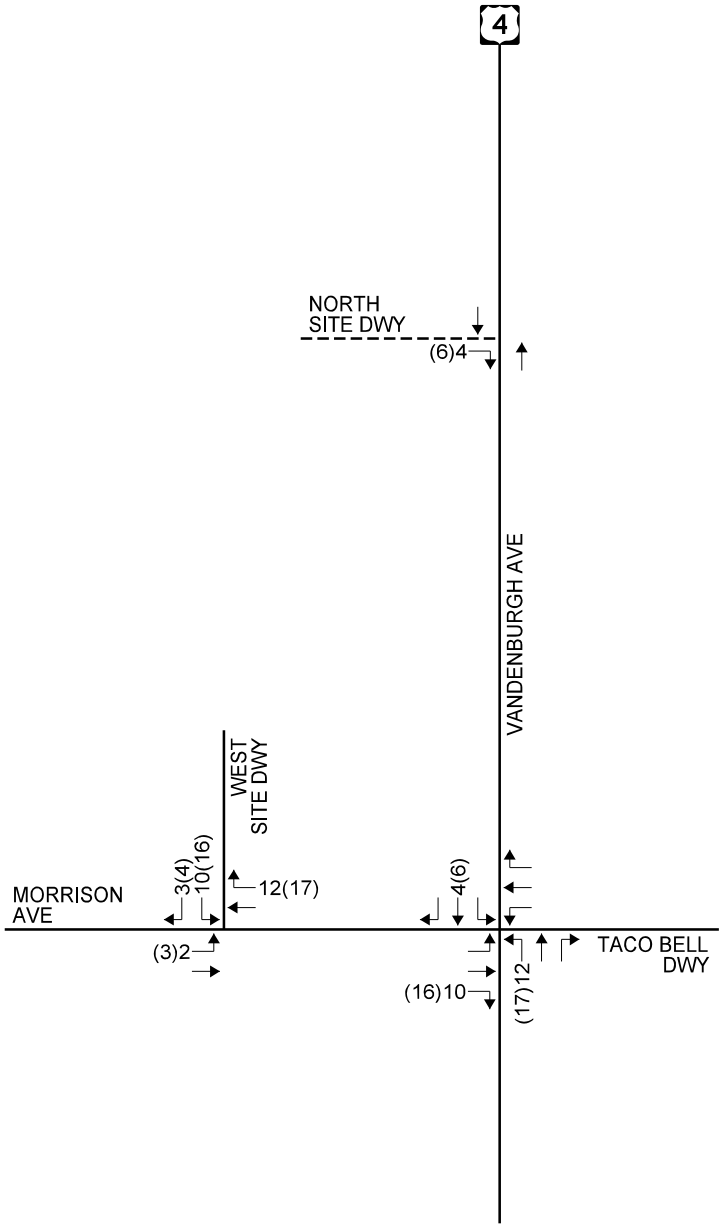
TRIP DISTRIBUTION



KEY:
XX(XX) = ENTERING (EXITING)

TRIP ASSIGNMENT



KEY:
XX(XX) = AM PEAK (PM PEAK)

TRAFFIC VOLUMES

HVCC STUDENT HOUSING
TROY, NEW YORK

Creighton Manning

PROJECT: 113-231	DATE: 04/2014	FIGURE: 3.2

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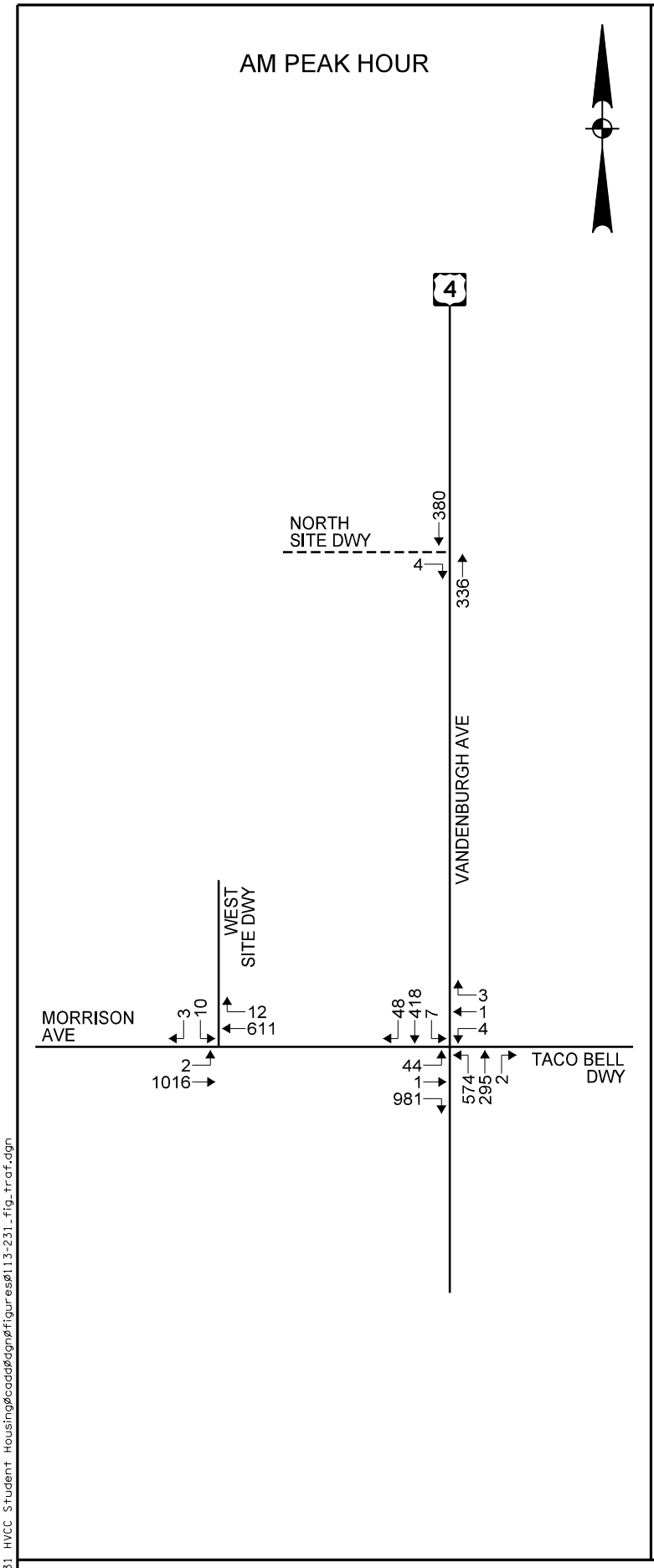

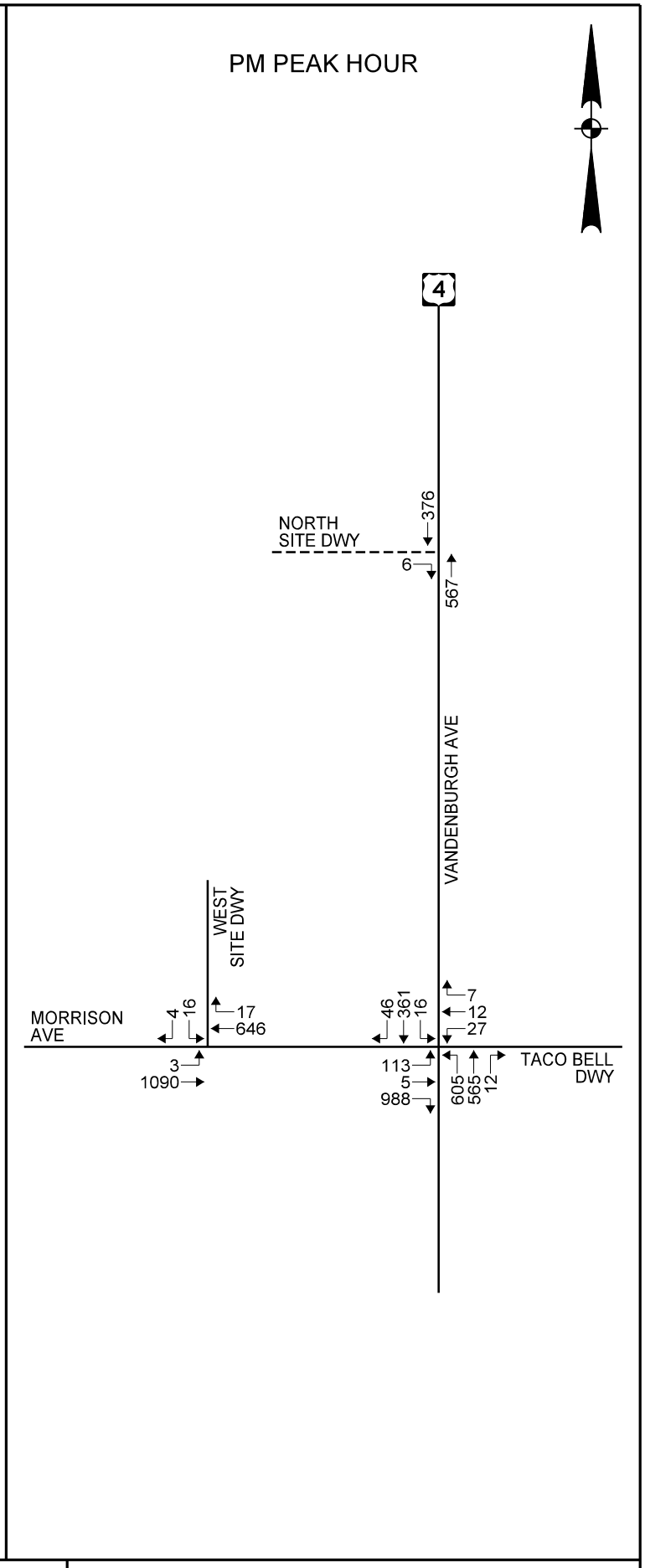

2015 BUILD
TRAFFIC VOLUMES

HVCC STUDENT HOUSING
TROY, NEW YORK

Creighton Manning

PROJECT: 113-231	DATE: 04/2014	FIGURE: 3.3

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CHAPTER IV
ANALYSIS

A. Capacity/Level of Service Analysis

Intersection Level of Service (LOS) and capacity analysis relate traffic volumes to the physical characteristics of an intersection. Intersection evaluations were made using Synchro8 software which automates the procedures contained in the *2010 Highway Capacity Manual*. Levels of service range from A to F with level of service A conditions considered excellent with very little delay while level of service F generally represents conditions with very long delays. Further detailed information about levels of service criteria is included in Appendix C. Tables 4.1 and 4.2 summarize the results of the Level of Service calculations. The *italicized* text identifies a traffic movement with an increase in average vehicle delay that results in a reduction in level of service between the No-Build and Build conditions. As noted previously, archaeological constraints may preclude construction of the Vandenburgh Avenue driveway; therefore, the tables include intersection analyses with and without construction of the right-out egress driveway.

Table 4.1 – AM Peak Hour Level of Service Summary

Intersection Approach		Control	2014 Existing	2015 No-Build	2015 Build	
					With Vandenburgh	Without Vandenburgh
Morrison Ave/Vandenburgh Ave		S				
Morrison Ave EB	LT		C (33.6)	C (34.1)	*D (35.7)*	*D (35.5)*
	R,R		B (10.3)	B (10.4)	B (10.6)	B (10.5)
Taco Bell Dwy WB	L		D (35.5)	D (36.0)	D (37.7)	D (37.5)
	TR		C (32.0)	C (32.4)	C (33.9)	C (33.8)
Vandenburgh Ave NB	L		D (35.3)	D (35.7)	D (36.6)	D (36.5)
	T,TR		E (57.5)	E (58.3)	E (60.7)	E (60.5)
Vandenburgh Ave SB	L		B (16.3)	B (16.4)	B (16.4)	B (16.4)
	T,TR		D (52.9)	D (53.6)	*E (55.7)*	*E (55.6)*
Overall			C (31.4)	C (31.8)	C (32.8)	C (32.7)
Morrison Ave/West Driveway		TW				
Morrison Ave EB	L		--	--	A (9.2)	A (9.2)
West Driveway SB	LR				C (23.3)	C (24.5)
Vandenburgh Ave/North Driveway		TW				
North Driveway EB	R		--	--	A (9.5)	--

Key: S, TW = Signalized, Two-Way Stop controlled intersection
EB, WB, NB, SB = Eastbound, Westbound, Northbound, or Southbound intersection approaches
L, T, R = Left-turn, Through, and/or Right-turn intersection movements
X (Y.Y) = Level of service (Average Delay in seconds per vehicle)
-- = Not Applicable

Table 4.2 – PM Peak Hour Level of Service Summary

Intersection Approach		Control	2014 Existing	2015 No-Build	2015 Build	
					With Vandenburgh	Without Vandenburgh
Morrison Ave/Vandenburgh Ave		S				
Morrison Ave EB	LT		C (26.6)	C (26.9)	C (28.2)	C (28.1)
	R,R		A (7.8)	A (7.8)	A (7.8)	A (7.8)
Taco Bell Dwy WB	L		C (30.9)	C (31.3)	C (32.9)	C (32.7)
	TR		C (23.9)	C (24.1)	C (25.3)	C (25.1)
Vandenburgh Ave NB	L		C (26.5)	C (26.7)	C (27.5)	C (27.4)
	T,TR		D (36.6)	D (37.0)	D (38.8)	D (38.8)
Vandenburgh Ave SB	L		B (19.3)	B (19.4)	B (19.6)	B (19.7)
	T,TR		D (40.0)	D (40.4)	D (42.3)	D (42.4)
Overall			C (24.1)	C (24.3)	C (25.2)	C (25.1)
Morrison Ave/West Driveway		TW				
Morrison Ave EB	L		--	--	A (9.4)	A (9.4)
West Driveway SB	LR				D (26.9)	D (28.8)
Vandenburgh Ave/North Driveway		TW				
North Driveway EB	R		--	--	A (9.5)	--

Key: S, TW = Signalized, Two-Way Stop controlled intersection
EB, WB, NB, SB = Eastbound, Westbound, Northbound, or Southbound intersection approaches
L, T, R = Left-turn, Through, and/or Right-turn intersection movements
X (Y.Y) = Level of service (Average Delay in seconds per vehicle)
-- = Not Applicable

The following observations are evident from the above analysis:

- Morrison Avenue/Vandenburgh Avenue/Taco Bell Driveway – The analysis shows that this intersection operates at overall level of service C during both peak hours. During the AM peak hour the southbound through movement operates at level of service D under No-Build conditions and level of service E under Build conditions with a two second increase in average vehicle delay. The eastbound shared left-turn/through movement operates at level of service C under No-Build conditions and will operate at level of service D under Build conditions with less than two seconds increase in average delay. During the PM peak hour the intersection will operate with levels of service consistent with existing conditions. The analysis shows that this intersection will operate with comparable conditions with or without construction of the Vandenburgh Avenue driveway. It is noted that no vehicles were removed from the study intersection to account for the number of students that will no longer be commuting HVCC. Therefore, the level of service evaluation represents a conservative analysis and the increases in delay are likely over stated.

  At the request of the City, an additional analysis was completed for the intersection to evaluate a potential westbound only green phase to allow vehicles exiting the Taco Bell Driveway to enter the intersection with no opposing vehicles as part of a protected phase. The analyses, contained in Appendix C, shows that providing a protected westbound phase results in levels of service that are comparable to those presented in both Build conditions in Tables 4.1 and 4.2.

- Morrison Avenue/West Site Driveway – The analysis shows that the site driveway approach to Morrison Avenue will operate at level of service C during the AM peak hour and level of service D during the PM peak hour with a single lane exiting the site and stop control. No level of service mitigation is recommended. If the Vandenburgh Avenue driveway is not constructed and all site driveway traffic utilizes the driveway, the driveway approach to Morrison Avenue will experience a less than two second increase in delay during both peak hours. No mitigation is recommended.

  The existing site driveway is located approximately 400 feet from the eastbound stop bar at the adjacent signalized intersection allowing space for approximately 16 vehicles to queue prior to blocking the driveway. During the AM and PM peak hours an average queue of three vehicles and a maximum of eight to nine vehicles was observed. Review of the queue analysis shows that the average and peak vehicle queues during the AM and PM peak hours may increase by one vehicle. Therefore, similar to existing conditions, this length queue will not block the site driveway.

- Vandenburgh Avenue/North Site Driveway – The analysis shows that the right-turn egress only site driveway approach to Vandenburgh Avenue will operate at level of service A during the AM and PM peak hours with a single

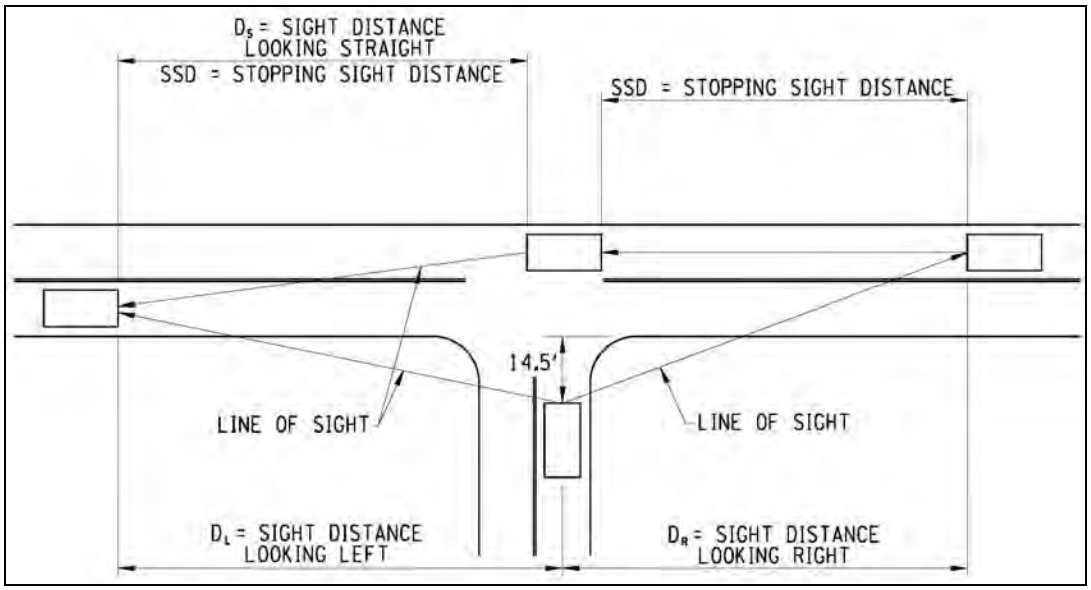
lane exiting the site and stop control. No level of service mitigation is recommended.

The potential right-turn egress driveway is located approximately 600 feet from the southbound stop bar at the adjacent signalized intersection allowing space for approximately 24 vehicles to queue prior to blocking the driveway. During the AM and PM peak hours an average queue of seven vehicles was observed. The maximum queue observed was 20 vehicles during the AM peak hour and 17 vehicles during the PM peak hour. This length of average and maximum vehicle queue does not extend to the proposed site driveway. Review of the queue analysis shows that the average and peak vehicle queues during the AM and PM peak hours may increase by one vehicle. Therefore, similar to existing conditions, the site driveway will not be blocked by the southbound vehicle queue at the adjacent intersection

B. Sight Distance Analysis

A sight distance evaluation was completed at the proposed right-out only site driveway intersecting Vandenburgh Avenue. The site access intersection with Morrison Avenue is an existing condition; therefore, no sight distance evaluation was completed for this driveway. Available *intersection* sight distance was measured from the perspective of a passenger vehicle exiting the site. The available intersection sight distance on a side street should provide drivers a sufficient view of the intersecting highway to allow vehicles to enter or exit the intersection without excessively slowing vehicles traveling at or near the operating speed on the intersecting mainline.

Stopping sight distance was also measured at the proposed site driveway. Stopping sight distance is the length of the roadway ahead that is visible to the driver. The available stopping sight distance on a roadway should be of sufficient length to enable a vehicle traveling at or near the operating speed to stop before reaching a stationary object in its path. The following diagram illustrates these sight distance measurements.



Intersection Sight Distance Measurements

The posted speed limit on Vandenburgh Avenue near the proposed driveway is 30-mph and the recorded 85th percentile travel speed in the southbound direction is 38-mph. The sight distances measured in the field were compared to the guidelines presented in the American Association of State Highway Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets* for a 40-mph operating speed on Vandenburgh Avenue. The results of the sight distance analysis are summarized in Table 4.3.

Table 4.3 – Intersection & Stopping Sight Distance Evaluation

Intersection	Right-turn from Site Dwy[1]	Northbound Stopping[2]
Vandenburgh Ave/North Site Driveway		
Available	265	610
Recommended	385	280[3]

1 Intersection sight distance is measured at 14.5 feet back from the travel way at an eye and object height of 3.5 feet.
2 Stopping sight distance measured for a 2-foot object located in the path of northbound vehicles on Vandenburgh Ave.
3 The southbound stopping sight distance was adjusted for a 6% upgrade.

The sight distance analysis indicates that the available sight distance looking left along Vandenburgh Avenue from the proposed site driveway is less than the AASHTO guideline for a 40-mph operating speed. The intersection sight distance is limited by

existing trees and vegetation as shown in Photograph 1. The northbound stopping sight distance meets the AASHTO guideline for a 40-mph operating speed. It is recommended that the Applicant clear the trees and vegetation as illustrated in Figure 4.1 to maximize sight lines looking left from the project site.

Photograph 1: Sight distance looking left (D_L) from proposed right-out egress site driveway.

C. Sensitivity Analysis

A sensitivity analysis was completed to determine the impact associated with the proposed project at the Morrison Avenue/Burden Avenue/NY Route 378 intersection. Traffic volume data collected in 2010 as part of the South Troy Industrial Park Road project (PIN 1754.59) was compared to existing traffic data. The comparison showed that the peak hour traffic volumes in 2010 and 2014 are comparable. Therefore, the 2010 data was used to represent current conditions at this intersection.

As noted previously, the proposed student housing project is expected to reduce commuter trips to and from HVCC therefore reducing the number of HVCC destined vehicle trips outside of the immediate study area intersection. A trip generation estimate was prepared using land use code 540 for Junior/Community College to determine the impact the student housing facility will have on the number of people commuting to HVCC and utilizing intersections (like Morrison Avenue/Burden Avenue/NY Route 378) exterior to the immediate study intersection. Table 4.4 summarizes the change in commuter trips for the AM and PM peak hours.

Table 4.4 – Sensitivity Trip Generation Summary

Junior/ Community College	AM Peak Hour			PM Peak Hour		
	Enter	Exit	Total	Enter	Exit	Total
330 Students	34	6	40	25	15	40

The table shows that the student housing project will result in an approximately 40 trip reduction on intersections outside of the immediate study area during the AM and PM peak hours. It is estimated that of these 40 trips, 60% utilize the Morrison Avenue/NY Route 378/Burden Avenue intersection.

Table 4.5 summarizes the results of the level of service analyses with the reduction in traffic associated with the proposed student housing facility. The detailed level of service calculations, including the traffic volumes used in the analyses, are included in Appendix D.

Table 4.5 – Sensitivity Level of Service Summary

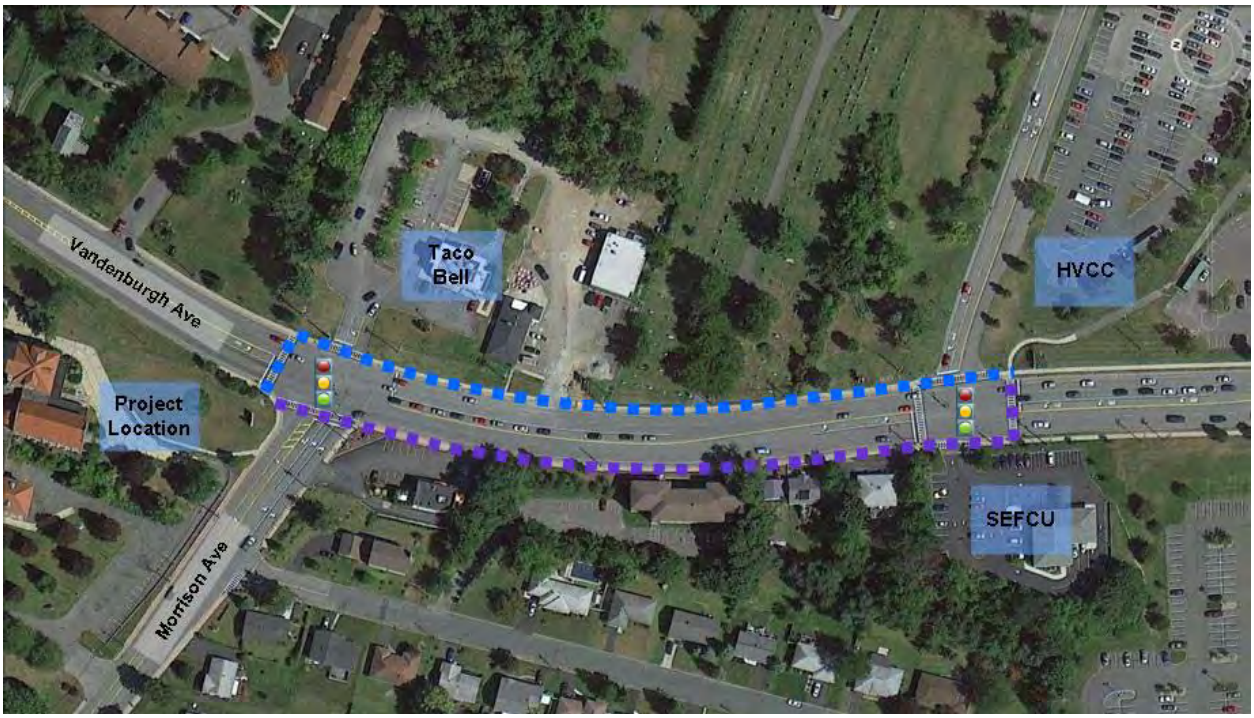
Intersection Approach		Control	AM Peak Hour		PM Peak Hour	
			2014 Existing	2015 Build	2014 Existing	2015 Build
Morrison Ave/NY Route 378		S				
Morrison Ave WB	LR		D (36.6)	D (36.3)	D (47.9)	D (47.4)
NY 378 NB	T,T		D (38.9)	D (38.9)	D (44.8)	D (44.4)
	R		D (52.1)	D (47.2)	B (19.6)	B (18.7)
Burden Ave SB	LT,T		F (164)	F (164)	D (37.5)	D (36.9)
Stowe Ave NWB	LR		F (84.5)	F (84.5)	E (76.5)	E (74.4)
	Overall		F (89.5)	F (88.3)	D (36.8)	D (36.2)

Key: S = Signal controlled intersection
WB, NB, SB, NWB = Westbound, Northbound, Southbound, or Northwestbound intersection approaches
L, T, R = Left-turn, Through, and/or Right-turn intersection movements
X (Y.Y) = Level of service (Average Delay in seconds per vehicle)

The analysis shows that the Morrison Avenue/NY Route 378/Burden Avenue intersection operates at overall level of service F during the AM peak hour and overall level of service D during the PM peak hour. With construction of the proposed project, and a reduction in peak hour traffic volumes, the intersection will maintain these overall levels of service with minor reductions in delay on the westbound and northbound approaches. No intersection mitigation is needed as a result of the proposed 330-bed student housing facility.

D. Pedestrian Circulation

Construction of the proposed project will result in increased pedestrian activity between the project location and HVCC. As noted previously, there are sidewalks and intersection crossings connecting the proposed student housing facility with the HVCC campus. However, the Vandenburgh Avenue northbound approach to the Morrison Avenue intersection does not provide a crosswalk or other pedestrian accommodations. Due to the large amount of eastbound right-turn traffic at the intersection (approximately 975 vehicles during the AM and PM peak hours) it is preferred to have pedestrians cross Vandenburgh Avenue on the southbound approach to the intersection where there are significantly fewer right-turning vehicles (less than 10 during both peak hours). The following image illustrates the preferred pedestrian routes (in blue and purple) between the student housing facility and HVCC.



It is recommended that the Applicant install pedestrian indicators, countdown timers, and pushbuttons on the SEFCU driveway approach to Vandenburgh Avenue to facilitate the preferred pedestrian routing. This accommodation will provide additional flexibility for students travelling to and from the housing and campus. It is noted that the route denoted in purple travels by the Dunkin Donuts and, south of SEFCU, continues to the Hudson Valley Plaza therefore connecting multiple desirable destinations for residents of the proposed student housing. This improvement requires coordination with the City and NYSDOT as they maintain this traffic signal.

F:øProjectsø2013ø113-231 HVCC Student Housingøcaddødgnøfiguresø113-231_site_dist_01.dgn

SIGHT DISTANCE CLEARING

HVCC STUDENT HOUSING
TROY, NEW YORK

Creighton Manning

PROJECT: 113-231	DATE: 05/2014	FIGURE: 4.1

CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

A Traffic Impact Study was completed for the proposed *HVCC Student Housing* located in the northwest quadrant of the Morrison Avenue/Vandenburgh Avenue intersection in the City of Troy. The project is expected to be completed by the fall of 2015 and generate approximately 31 new vehicle trips during the AM peak hour and 46 new trips during the PM peak hour. The project is expected to reduce traffic at intersections outside of the immediate study area by 40 vehicles trips during the AM and PM peak hours. Access to the site is proposed via the existing full access intersection with Morrison Avenue and a proposed right-out only driveway intersection with Vandenburgh Avenue at the site of an existing curb cut. Archaeological constraints may preclude the construction of the right-out driveway; therefore the intersection capacity evaluation included analysis with and without the Vandenburgh Avenue driveway. The following conclusions and recommendations are offered:

1. The level of service analysis shows that the Morrison Avenue/Vandenburgh Avenue intersection will operate at overall level of service C during the AM and PM peak hours with construction of the proposed project. During the AM peak hour two level of service drops will occur with approximately two seconds increase in average delay. The levels of service are comparable with or without construction of the Vandenburgh Avenue right-out only driveway. No intersection mitigation is recommended.

2. The site driveway approaches to Morrison Avenue and Vandenburgh Avenue will operate with acceptable levels of service under stop sign control and a single lane exiting the site. No level of service mitigation is recommended.

3. The vehicle queue evaluation shows that the eastbound and southbound vehicle queues are expected to increase by approximately one vehicle during the AM and PM peak hours under average and peak conditions. This indicates that, consistent with existing conditions, the site driveways will not be blocked by vehicle queues from the adjacent Morrison Avenue/Vandenburgh Avenue signal controlled intersection.

4. The sight distance evaluation at the proposed right-out only driveway on Vandenburgh Avenue shows that the intersection sight distance looking left from the potential site driveway approach to Vandenburgh Avenue is limited by existing vegetation and trees. The Applicant should clear the vegetation north of the site driveway as illustrated in Figure 4.1 to maximize sight lines at the intersection if the driveway is constructed.

5. The sensitivity analysis evaluated the operations at the Morrison Avenue/NY Route 378/Burden Avenue intersection associated with the reduced number of HVCC commuters at this external intersection resulting from the proposed student housing project. The analysis shows that the intersection will operate with comparable levels of service with construction of the proposed project as existing vehicles at intersections external to the immediate study intersection are reduced.

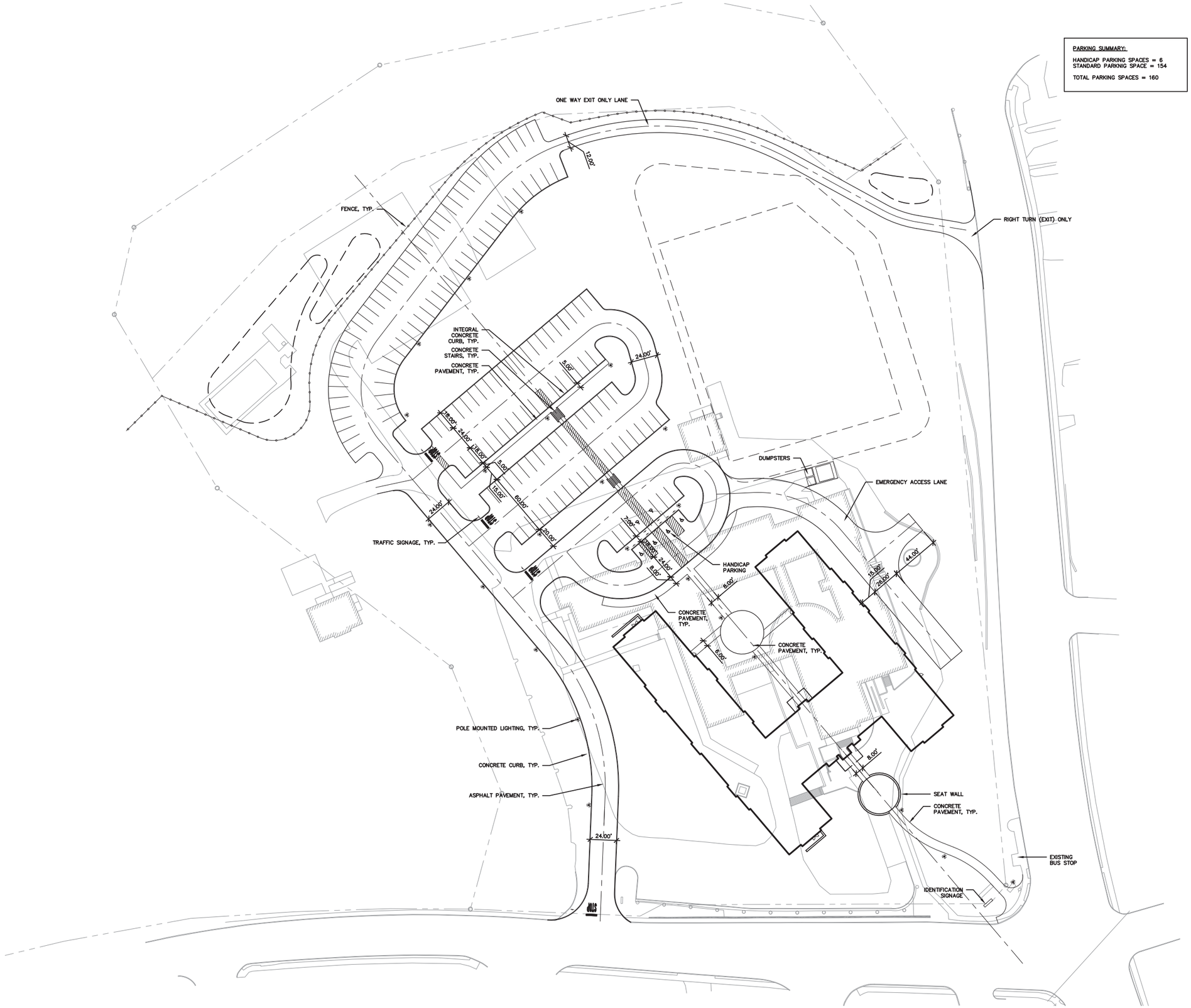
6. Full pedestrian accommodations should be provided on the eastbound SEFCU driveway approach to Vandenburgh Avenue to facilitate pedestrian travel between the proposed project and HVCC. This improvement will provide fully protected crossing between the site and HVCC along the west side of Vandenburgh Avenue where Dunkin Donuts and the Hudson Valley Plaza are located. The Applicant should coordinate with NYSDOT and the City to implement these features.

With the construction of the proposed *HVCC Student Housing* in the northwestern quadrant of the Morrison Avenue/Vandenburgh Avenue intersection, construction of implementation of full pedestrian accommodations on the SEFCU approach to Vandenburgh Avenue across from North Drive are recommended. In addition, clearing of trees and vegetation along the site frontage north of the potential site driveway intersection with Vandenburgh Avenue is recommended to maximize the sight lines at the proposed site driveway to meet AASHTO guidelines.

Appendix A

Site Layout and Materials Plan

Traffic Impact Study
HVCC Student Housing
City of Troy, New York



PARKING SUMMARY:

HANDICAP PARKING SPACES = 6
STANDARD PARKNIG SPACE = 154

TOTAL PARKING SPACES = 160

LEGEND

- STANDARD BITUMINOUS ASPHALT PAVING (X / L.XXX)
- HEAVY DUTY BITUMINOUS ASPHALT PAVING (X / L.XXX)
- SCORED CONCRETE PAVING (X / L.XXX)
- SIGNAGE (X / L.XXX)
- TRASH RECEPTACLE
- LIMIT OF WORK

LAYOUT & MATERIALS NOTES

1. ALL LINES AND DIMENSIONS ARE PARALLEL OR PERPENDICULAR TO THE LINES FROM WHICH THEY ARE MEASURED UNLESS OTHERWISE INDICATED.
2. ALL LINE AND GRADE PER DRAWINGS SHALL BE LAID OUT BY A NEW YORK STATE REGISTERED CIVIL ENGINEER OR SURVEYOR ENGAGED BY THE CONTRACTOR.
3. THE CONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS IN THE FIELD PRIOR TO CONSTRUCTION AND REPORT ANY DISCREPANCIES IN THE SITE SURVEY PRIOR TO STARTING WORK.
4. AT ALL LOCATIONS WHERE EXISTING CURBING, BITUMINOUS CONCRETE ROADWAY OR CONCRETE SIDEWALK ABUT NEW CONSTRUCTION, THE EDGE OF THE EXISTING CURB OR PAVEMENT SHALL BE SAW CUT TO A CLEAN, SMOOTH EDGE. PROVIDE PAVEMENT KEY AS DETAILED. TACK COAT EXPOSED EDGES OF EXISTING BITUMINOUS CONCRETE PRIOR TO PLACEMENT OF NEW BITUMINOUS CONCRETE PAVEMENT.
5. DIMENSIONS ON PARKING LOTS AND ROADWAYS ARE FROM FACE OR BOTTOM OF CURB TO FACE OR BOTTOM OF CURB.
6. ALL NEW WORK SHALL BE STAKED-OUT PRIOR TO CONSTRUCTION.
7. ALL EXISTING UTILITIES SHOWN IN THEIR RELATIVE POSITION. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE VERTICAL AND HORIZONTAL POSITION OF EXISTING UTILITIES PRIOR TO CONSTRUCTION.

GRAPHIC SCALE

40 0 20 40 80

1 inch = 40 feet

the LA group
Landscape Architecture and Engineering, PC
40 Long Alley
Saratoga Springs
New York 12866
P 518/587-8100
F 518/587-0180
www.thelagroup.com

Unauthorized alteration or addition to this document is a violation of Section 7209 of the New York State Education Law

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Design	DTM
Drawn	MJM
Checked	DTM

PREPARED FOR:
OMNI HOUSING DEVELOPMENT, LLC
40 BEAVER STREET
ALBANY, NEW YORK

THE IRONWORKS - STUDENT HOUSING

45 MORRISON AVENUE
TROY, NEW YORK

Title
SITE LAYOUT AND MATERIALS PLAN

Revisions

Project: 201406
Date: 05/23/2014

Drawing
L100

Plotted By: MICHAEL MARQUARDT
Plot Date: 5/23/2014 11:14:09 AM
File Name: G:\Projects\201406\dwg_PrvPC_Housing\201406SDA01-L100_DRAFT PLAN.dwg

Appendix B

Turning Movement Counts

Traffic Impact Study
HVCC Student Housing
City of Troy, New York

Project No.:113-231
Counted By:JG/DQ
Location:Troy, NY
Comments:

File Name : TM113231AM1
Site Code : 13-231-1
Start Date : 4/9/2014
Page No : 1

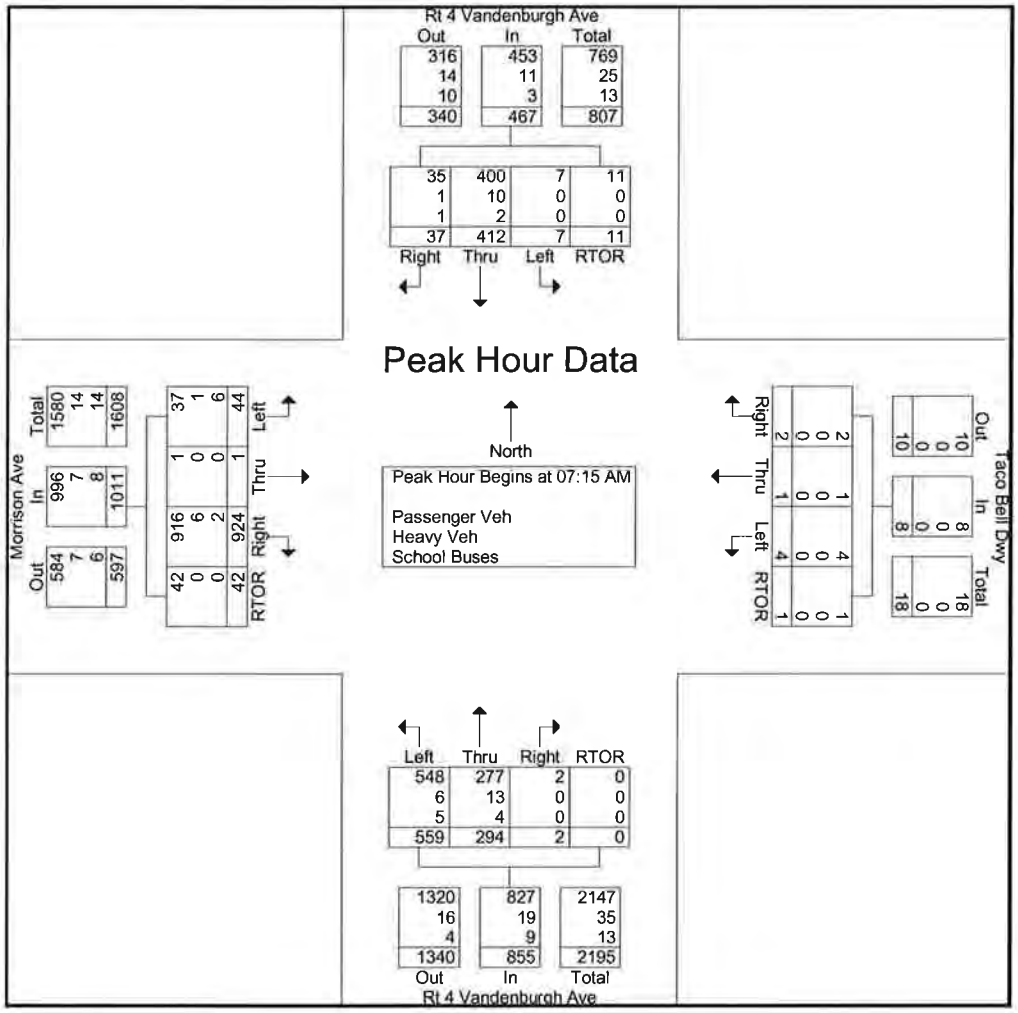
Groups Printed- Passenger Veh - Heavy Veh - School Buses

	Morrison Ave Eastbound					Rt 4 Vandenburgh Ave Northbound					Taco Bell Dwy Westbound					Rt 4 Vandenburgh Ave Southbound					
Start Time	Left	Thru	Right	RTOR	App. Total	Left	Thru	Right	RTOR	App. Total	Left	Thru	Right	RTOR	App. Total	Left	Thru	Right	RTOR	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	16	1	94	17	128	134	39	0	0	173	3	0	0	0	3	1	47	10	3	61	365
07:15 AM	12	0	158	21	191	147	57	0	0	204	2	0	0	1	3	4	55	9	7	75	473
07:30 AM	7	0	233	5	245	149	74	0	0	223	1	1	1	0	3	1	89	7	2	99	570
07:45 AM	16	0	310	6	332	129	87	1	0	217	0	0	0	0	0	2	154	11	0	167	716
Total	51	1	795	49	896	559	257	1	0	817	6	1	1	1	9	8	345	37	12	402	2124
08:00 AM	9	1	223	10	243	134	76	1	0	211	1	0	1	0	2	0	114	10	2	126	582
08:15 AM	9	3	179	13	204	94	51	1	0	146	4	0	1	1	6	1	74	9	6	90	446
08:30 AM	7	1	267	8	283	102	54	0	0	156	2	0	0	0	2	2	99	5	1	107	548
08:45 AM	6	1	293	10	310	109	71	0	0	180	1	0	0	1	2	2	145	5	0	152	644
Total	31	6	962	41	1040	439	252	2	0	693	8	0	2	2	12	5	432	29	9	475	2220
Grand Total	82	7	1757	90	1936	998	509	3	0	1510	14	1	3	3	21	13	777	66	21	877	4344
Apprch %	4.2	0.4	90.8	4.6		66.1	33.7	0.2	0		66.7	4.8	14.3	14.3		1.5	88.6	7.5	2.4		
Total %	1.9	0.2	40.4	2.1	44.6	23	11.7	0.1	0	34.8	0.3	0	0.1	0.1	0.5	0.3	17.9	1.5	0.5	20.2	
Passenger Veh	75	7	1749	90	1921	978	480	3	0	1461	14	1	3	3	21	13	743	61	21	838	4241
% Passenger Veh	91.5	100	99.5	100	99.2	98	94.3	100	0	96.8	100	100	100	100	100	100	95.6	92.4	100	95.6	97.6
Heavy Veh	1	0	6	0	7	11	23	0	0	34	0	0	0	0	0	0	29	2	0	31	72
% Heavy Veh	1.2	0	0.3	0	0.4	1.1	4.5	0	0	2.3	0	0	0	0	0	0	3.7	3	0	3.5	1.7
School Buses	6	0	2	0	8	9	6	0	0	15	0	0	0	0	0	0	5	3	0	8	31
% School Buses	7.3	0	0.1	0	0.4	0.9	1.2	0	0	1	0	0	0	0	0	0	0.6	4.5	0	0.9	0.7

Project No.:113-231
Counted By:JG/DQ
Location:Troy, NY
Comments:

File Name : TM113231AM1
Site Code : 13-231-1
Start Date : 4/9/2014
Page No : 2

	Morrison Ave Eastbound					Rt 4 Vandenburgh Ave Northbound					Taco Bell Dwy Westbound					Rt 4 Vandenburgh Ave Southbound					
Start Time	Left	Thru	Right	RTOR	App. Total	Left	Thru	Right	RTOR	App. Total	Left	Thru	Right	RTOR	App Total	Left	Thru	Right	RTOR	App Total	Int. Total
Peak Hour Analysis From 7:00:00 AM to 8:45:00 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 7:15:00 AM																					
7:15:00 AM	12	0	158	**21**	191	147	57	0	0	204	**2**	0	0	**1**	**3**	**4**	55	9	**7**	75	473
7:30:00 AM	7	0	233	5	245	**149**	74	0	0	**223**	1	**1**	**1**	0	3	1	89	7	2	99	570
7:45:00 AM	**16**	0	**310**	6	**332**	129	**87**	**1**	0	217	0	0	0	0	0	2	**154**	**11**	0	**167**	**716**
8:00:00 AM	9	**1**	223	10	243	134	76	1	0	211	1	0	1	0	2	0	114	10	2	126	582
Total Volume	44	1	924	42	1011	559	294	2	0	855	4	1	2	1	8	7	412	37	11	467	2341
% App. Total	4.4	0.1	91.4	4.2		65.4	34.4	0.2	0		50	12.5	25	12.5		1.5	88.2	7.9	2.4		
PHF	.688	.250	.745	.500	.761	.938	.845	.500	.000	.959	.500	.250	.500	.250	.667	.438	.669	.841	.393	.699	.817
Passenger Veh	37	1	916	42	996	548	277	2	0	827	4	1	2	1	8	7	400	35	11	453	2284
% Passenger Veh	84.1	100	99.1	100	98.5	98.0	94.2	100	0	96.7	100	100	100	100	100	100	97.1	94.6	100	97.0	97.6
Heavy Veh	1	0	6	0	7	6	13	0	0	19	0	0	0	0	0	0	10	1	0	11	37
% Heavy Veh	2.3	0	0.6	0	0.7	1.1	4.4	0	0	2.2	0	0	0	0	0	0	2.4	2.7	0	2.4	1.6
School Buses	6	0	2	0	8	5	4	0	0	9	0	0	0	0	0	0	2	1	0	3	20
% School Buses	13.6	0	0.2	0	0.8	0.9	1.4	0	0	1.1	0	0	0	0	0	0	0.5	2.7	0	0.6	0.9



Project No.:113-231
Counted By:JG/DQ
Location:Troy, NY
Comments:

File Name : TM113231PM1
Site Code : 13-231-1
Start Date : 4/9/2014
Page No : 1

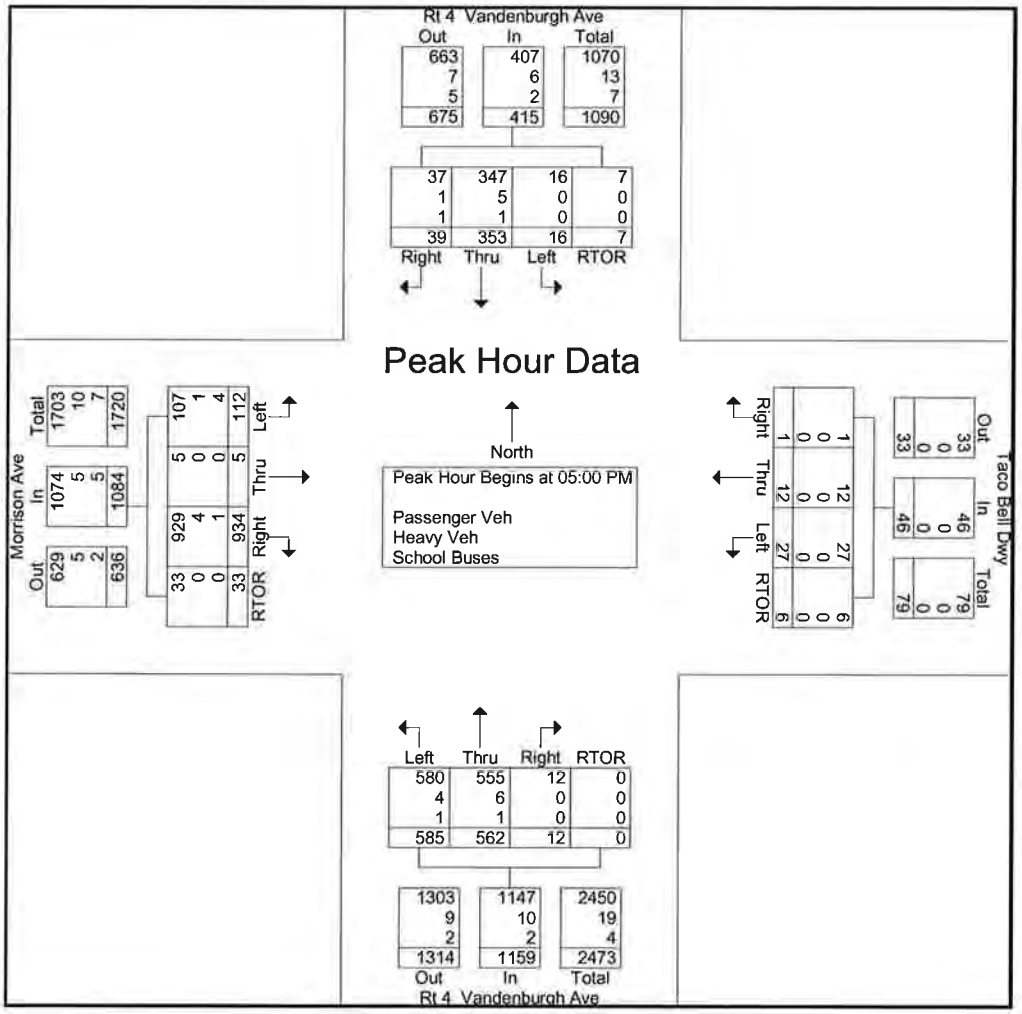
Groups Printed- Passenger Veh - Heavy Veh - School Buses

	Morrison Ave Eastbound					Rt 4 Vandenburgh Ave Northbound					Taco Bell Dwy Westbound					Rt 4 Vandenburgh Ave Southbound					
Start Time	Left	Thru	Right	RTOR	App. Total	Left	Thru	Right	RTOR	App. Total	Left	Thru	Right	RTOR	App. Total	Left	Thru	Right	RTOR	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	27	0	172	8	207	165	119	4	0	288	1	2	1	1	5	3	93	13	0	109	609
04:15 PM	33	1	203	6	243	151	101	2	0	254	6	6	2	2	16	2	67	4	0	73	586
04:30 PM	28	1	197	10	236	160	131	4	0	295	5	2	0	3	10	3	101	8	0	112	653
04:45 PM	33	0	222	3	258	135	131	3	0	269	2	1	0	6	9	2	96	7	0	105	641
Total	121	2	794	27	944	611	482	13	0	1106	14	11	3	12	40	10	357	32	0	399	2489
05:00 PM	31	1	230	12	274	161	170	3	0	334	9	5	1	0	15	4	97	6	1	108	731
05:15 PM	30	4	228	9	271	146	126	5	0	277	8	1	0	2	11	2	91	12	1	106	665
05:30 PM	30	0	236	5	271	138	126	0	0	264	4	3	0	3	10	6	90	13	3	112	657
05:45 PM	21	0	240	7	268	140	140	4	0	284	6	3	0	1	10	4	75	8	2	89	651
Total	112	5	934	33	1084	585	562	12	0	1159	27	12	1	6	46	16	353	39	7	415	2704
Grand Total	233	7	1728	60	2028	1196	1044	25	0	2265	41	23	4	18	86	26	710	71	7	814	5193
Apprch %	11.5	0.3	85.2	3		52.8	46.1	1.1	0		47.7	26.7	4.7	20.9		3.2	87.2	8.7	0.9		
Total %	4.5	0.1	33.3	1.2	39.1	23	20.1	0.5	0	43.6	0.8	0.4	0.1	0.3	1.7	0.5	13.7	1.4	0.1	15.7	
Passenger Veh	228	7	1723	60	2018	1185	1029	25	0	2239	41	23	4	18	86	26	695	68	7	796	5139
% Passenger Veh	97.9	100	99.7	100	99.5	99.1	98.6	100	0	98.9	100	100	100	100	100	100	97.9	95.8	100	97.8	99
Heavy Veh	1	0	4	0	5	8	13	0	0	21	0	0	0	0	0	0	14	1	0	15	41
% Heavy Veh	0.4	0	0.2	0	0.2	0.7	1.2	0	0	0.9	0	0	0	0	0	0	2	1.4	0	1.8	0.8
School Buses	4	0	1	0	5	3	2	0	0	5	0	0	0	0	0	0	1	2	0	3	13
% School Buses	1.7	0	0.1	0	0.2	0.3	0.2	0	0	0.2	0	0	0	0	0	0	0.1	2.8	0	0.4	0.3

Project No.:113-231
Counted By:JG/DQ
Location:Troy, NY
Comments:

File Name : TM113231PM1
Site Code : 13-231-1
Start Date : 4/9/2014
Page No : 2

	Morrison Ave Eastbound					Rt 4 Vandenburgh Ave Northbound					Taco Bell Dwy Westbound					Rt 4 Vandenburgh Ave Southbound					
Start Time	Left	Thru	Right	RTOR	App. Total	Left	Thru	Right	RTOR	App. Total	Left	Thru	Right	RTOR	App. Total	Left	Thru	Right	RTOR	App. Total	Int. Total
Peak Hour Analysis From 4:00:00 PM to 5:45:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 5:00:00 PM																					
5:00:00 PM	**31**	1	230	**12**	**274**	**161**	**170**	3	0	**334**	**9**	**5**	**1**	0	**15**	4	**97**	6	1	108	**731**
5:15:00 PM	30	**4**	228	9	271	146	126	**5**	0	277	8	1	0	2	11	2	91	12	1	106	665
5:30:00 PM	30	0	236	5	271	138	126	0	0	264	4	3	0	**3**	10	**6**	90	**13**	**3**	**112**	657
5:45:00 PM	21	0	**240**	7	268	140	140	4	0	284	6	3	0	1	10	4	75	8	2	89	651
Total Volume	112	5	934	33	1084	585	562	12	0	1159	27	12	1	6	46	16	353	39	7	415	2704
% App. Total	10.3	0.5	86.2	3		50.5	48.5	1	0		58.7	26.1	2.2	13		3.9	85.1	9.4	1.7		
PHF	.903	.313	.973	.688	.989	.908	.826	.600	.000	.868	.750	.600	.250	.500	.767	.667	.910	.750	.583	.926	.925
Passenger Veh	107	5	929	33	1074	580	555	12	0	1147	27	12	1	6	46	16	347	37	7	407	2674
% Passenger Veh	95.5	100	99.5	100	99.1	99.1	98.8	100	0	99.0	100	100	100	100	100	100	98.3	94.9	100	98.1	98.9
Heavy Veh	1	0	4	0	5	4	6	0	0	10	0	0	0	0	0	0	5	1	0	6	21
% Heavy Veh	0.9	0	0.4	0	0.5	0.7	1.1	0	0	0.9	0	0	0	0	0	0	1.4	2.6	0	1.4	0.8
School Buses	4	0	1	0	5	1	1	0	0	2	0	0	0	0	0	0	1	1	0	2	9
% School Buses	3.6	0	0.1	0	0.5	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0.3	2.6	0	0.5	0.3



Appendix C

Level of Service Analysis

Traffic Impact Study
HVCC Student Housing
City of Troy, New York

LOS Definitions

The following is an excerpt from the 2010 Highway Capacity Manual (HCM).

Level of Service for Signalized Intersections

Level of Service (LOS) can be characterized for the entire intersection, each intersection approach, and each lane group. Control delay alone is used to characterize LOS for the entire intersection or an approach. Control delay *and* volume-to-capacity ratio are used to characterize LOS for a lane group. Delay quantifies the increase in travel time due to traffic signal control. It is also a surrogate measure of driver discomfort and fuel consumption. The volume-to-capacity ratio quantifies the degree to which a phase's capacity is utilized by a lane group. The following paragraphs describe each LOS.

LOS A describes operations with a control delay of 10 s/veh or less and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is low and either progression is exceptionally favorable or the cycle length is very short. If it is due to favorable progression, most vehicles arrive during the green indication and travel through the intersection without stopping.

LOS B describes operations with control delay between 10 and 20 s/veh and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is low and either progression is highly favorable or the cycle length is short. More vehicles stop than with LOS A.

LOS C describes operations with control delay between 20 and 35 s/veh and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when progression is favorable or the cycle length is moderate. Individual *cycle failures* (i.e., one or more queued vehicles are not able to depart as a result of insufficient capacity during the cycle) may begin to appear at this level. The number of vehicles stopping is significant, although many vehicles still pass through the intersection without stopping.

LOS D describes operations with control delay between 35 and 55 s/veh and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is high and either progression is ineffective or the cycle length is long. Many vehicles stop and individual cycle failures are noticeable.

LOS E describes operations with control delay between 55 and 80 s/veh and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is high, progression is unfavorable, and the cycle length is long. Individual cycle failures are frequent.

LOS F describes operations with control delay exceeding 80 s/veh or a volume-to-capacity ratio greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is very high, progression is very poor, and the cycle length is long. Most cycles fail to clear the queue.

A lane group can incur a delay less than 80 s/veh when the volume-to-capacity ratio exceeds 1.0. This condition typically occurs when the cycle length is short, the signal progression is favorable, or both. As a result, both the delay and volume-to-capacity ratio are considered when lane group LOS is established. A ratio of 1.0 or more indicates that cycle capacity is fully utilized and represents failure from a capacity perspective (just as delay in excess of 80 s/veh represents failure from a delay perspective).

Level of Service Criteria for Unsignalized Intersections

Level of service (LOS) for a TWSC intersection is determined by the computed or measured control delay. For motor vehicles, LOS is determined for each minor-street movement (or shared movement) as well as major-street left turns by using criteria given in Exhibit 19-1. LOS is not defined for the intersection as a whole or for major-street approaches for three primary reasons: (a) major-street through vehicles are assumed to experience zero delay; *(b)* the disproportionate number of major-street through vehicles at a typical TWSC intersection skews the weighted average of all movements, resulting in a very low overall average delay for all vehicles; and (c) the resulting low delay can mask important LOS deficiencies for minor movements. LOS F is assigned to the movement if the volume-to-capacity ratio for the movement exceeds 1.0, regardless of the control delay.

The LOS criteria for TWSC intersections are somewhat different from the criteria used in Chapter 18 for signalized intersections, primarily because user perceptions differ among transportation facility types. The expectation is that a signalized intersection is designed to carry higher traffic volumes and will present greater delay than an unsignalized intersection. Unsignalized intersections are also associated with more uncertainty for users, as delays are less predictable than they are at signals, which can reduce users' delay tolerance.

The level-of-service (LOS) criteria for All-Way Stop-Controlled (AWSC) intersections are given in Exhibit 20-2. LOS F is assigned if the volume-to-capacity (v/c) ratio of a lane exceeds 1.0, regardless of the control delay. For assessment of LOS at the approach and intersection levels, LOS is based solely on control delay.

Exhibits 19-1/20-2: Level-of-Service Criteria for Stop Controlled Intersections

Control Delay (sec/veh)	LOS by Volume-to-Capacity Ratio	
	v/c ≤ 1.0	**v/c ≥ 1.0**
10.0	A	F
>10.0 and ≤ 15.0	B	F
>15.0 and ≤ 25.0	C	F
>25.0 and ≤ 35.0	D	F
>35.0 and ≤ 50.0	E	F
>50.0	F	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	44	1	966	4	1	3	559	294	2	7	412	48
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	181.4	159.5	179.7	198.6	198.6	198.6	186.3	179.3	190.0	194.8	188.9	194.8
Adj Flow Rate, veh/h	54	1	1127	5	1	3	682	359	2	9	502	46
Adj No. of Lanes	0	1	2	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Percent Heavy Veh, %	0	0	1	0	0	0	2	6	6	0	3	3
Cap, veh/h	372	6	1846	182	116	348	811	461	3	943	616	56
Arrive On Green	0.26	0.26	0.26	0.26	0.26	0.26	0.42	0.13	0.13	0.48	0.19	0.19
Sat Flow, veh/h	1178	24	2677	530	438	1313	1774	3473	19	1855	3324	304
Grp Volume(v), veh/h	55	0	1127	5	0	4	682	176	185	9	270	278
Grp Sat Flow(s),veh/h/ln	1202	0	1339	530	0	1750	1774	1703	1789	1855	1794	1833
Q Serve(g_s), s	4.1	0.0	26.8	0.9	0.0	0.2	42.5	11.8	11.8	0.0	17.1	17.2
Cycle Q Clear(g_c), s	4.3	0.0	26.8	5.2	0.0	0.2	42.5	11.8	11.8	0.0	17.1	17.2
Prop In Lane	0.98		1.00	1.00		0.75	1.00		0.01	1.00		0.17
Lane Grp Cap(c), veh/h	379	0	1846	182	0	464	811	226	238	943	332	340
V/C Ratio(X)	0.15	0.00	0.61	0.03	0.00	0.01	0.84	0.78	0.78	0.01	0.81	0.82
Avail Cap(c_a), veh/h	416	0	1930	198	0	518	1787	2089	2194	943	683	698
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	33.6	0.0	9.9	35.5	0.0	32.0	31.9	49.6	49.6	16.3	46.2	46.2
Incr Delay (d2), s/veh	0.1	0.0	0.4	0.0	0.0	0.0	3.4	7.9	7.6	0.0	6.7	6.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	2.5	0.0	15.1	0.2	0.0	0.2	29.0	10.1	10.5	0.3	14.1	14.4
LnGrp Delay(d),s/veh	33.6	0.0	10.3	35.5	0.0	32.0	35.3	57.5	57.2	16.3	52.9	53.0
LnGrp LOS	C		B	D		C	D	E	E	B	D	D
Approach Vol, veh/h		1182			9			1043			557	
Approach Delay, s/veh		11.4			34.0			42.9			52.4	
Approach LOS		B			C			D			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	55.0	26.9		36.3	61.2	20.7		36.3
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0
Max Green Setting (Gmax), s	115.0	45.0		35.0	15.0	145.0		35.0
Max Q Clear Time (g_c+I1), s	44.5	19.2		7.2	2.0	13.8		28.8
Green Ext Time (p_c), s	5.5	2.7		4.5	2.2	1.8		2.5

Intersection Summary	
HCM 2010 Ctrl Delay	31.4
HCM 2010 LOS	C

Notes

User approved changes to right turn type.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	44	1	971	4	1	3	562	295	2	7	414	48
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	181.4	159.5	179.7	198.6	198.6	198.6	186.3	179.3	190.0	194.8	188.9	194.8
Adj Flow Rate, veh/h	54	1	1133	5	1	3	685	360	2	9	505	46
Adj No. of Lanes	0	1	2	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Percent Heavy Veh, %	0	0	1	0	0	0	2	6	6	0	3	3
Cap, veh/h	371	6	1849	180	116	347	813	461	3	945	618	56
Arrive On Green	0.26	0.26	0.26	0.26	0.26	0.26	0.42	0.13	0.13	0.48	0.19	0.19
Sat Flow, veh/h	1178	24	2677	527	438	1313	1774	3473	19	1855	3326	302
Grp Volume(v), veh/h	55	0	1133	5	0	4	685	176	186	9	272	279
Grp Sat Flow(s),veh/h/ln	1202	0	1339	527	0	1750	1774	1703	1789	1855	1794	1834
Q Serve(g_s), s	4.2	0.0	27.3	0.9	0.0	0.2	43.3	12.0	12.0	0.0	17.4	17.5
Cycle Q Clear(g_c), s	4.4	0.0	27.3	5.2	0.0	0.2	43.3	12.0	12.0	0.0	17.4	17.5
Prop In Lane	0.98		1.00	1.00		0.75	1.00		0.01	1.00		0.16
Lane Grp Cap(c), veh/h	378	0	1849	180	0	463	813	226	237	945	333	340
V/C Ratio(X)	0.15	0.00	0.61	0.03	0.00	0.01	0.84	0.78	0.78	0.01	0.82	0.82
Avail Cap(c_a), veh/h	411	0	1924	195	0	512	1765	2064	2167	945	675	689
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	34.0	0.0	10.0	36.0	0.0	32.4	32.2	50.2	50.2	16.3	46.8	46.8
Incr Delay (d2), s/veh	0.1	0.0	0.4	0.0	0.0	0.0	3.5	8.1	7.7	0.0	6.8	6.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	2.5	0.0	15.2	0.2	0.0	0.2	29.4	10.2	10.6	0.3	14.2	14.5
LnGrp Delay(d),s/veh	34.1	0.0	10.4	36.0	0.0	32.4	35.7	58.3	57.9	16.4	53.6	53.7
LnGrp LOS	C		B	D		C	D	E	E	B	D	D
Approach Vol, veh/h		1188			9			1047			560	
Approach Delay, s/veh		11.5			34.4			43.4			53.0	
Approach LOS		B			C			D			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	55.8	27.2		36.7	62.1	20.9		36.7
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0
Max Green Setting (Gmax), s	115.0	45.0		35.0	15.0	145.0		35.0
Max Q Clear Time (g_c+I1), s	45.3	19.5		7.2	2.0	14.0		29.3
Green Ext Time (p_c), s	5.5	2.7		4.6	2.2	1.8		2.4

Intersection Summary	
HCM 2010 Ctrl Delay	31.8
HCM 2010 LOS	C

Notes

User approved changes to right turn type.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	44	1	981	4	1	3	574	295	2	7	418	48
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	181.4	159.5	179.7	198.6	198.6	198.6	186.3	179.3	190.0	194.8	188.9	194.8
Adj Flow Rate, veh/h	54	1	1145	5	1	3	700	360	2	9	510	46
Adj No. of Lanes	0	1	2	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Percent Heavy Veh, %	0	0	1	0	0	0	2	6	6	0	3	3
Cap, veh/h	365	6	1861	175	114	343	824	457	3	960	619	56
Arrive On Green	0.26	0.26	0.26	0.26	0.26	0.26	0.43	0.13	0.13	0.49	0.19	0.19
Sat Flow, veh/h	1178	24	2677	521	438	1313	1774	3473	19	1855	3329	299
Grp Volume(v), veh/h	55	0	1145	5	0	4	700	176	186	9	274	282
Grp Sat Flow(s),veh/h/ln	1201	0	1339	521	0	1750	1774	1703	1789	1855	1794	1834
Q Serve(g_s), s	4.3	0.0	28.5	0.9	0.0	0.2	45.9	12.5	12.5	0.0	18.2	18.4
Cycle Q Clear(g_c), s	4.5	0.0	28.5	5.5	0.0	0.2	45.9	12.5	12.5	0.0	18.2	18.4
Prop In Lane	0.98		1.00	1.00		0.75	1.00		0.01	1.00		0.16
Lane Grp Cap(c), veh/h	372	0	1861	175	0	458	824	224	235	960	333	341
V/C Ratio(X)	0.15	0.00	0.62	0.03	0.00	0.01	0.85	0.79	0.79	0.01	0.82	0.83
Avail Cap(c_a), veh/h	396	0	1915	186	0	493	1701	1989	2089	960	650	665
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.6	0.0	10.2	37.7	0.0	33.9	33.0	52.3	52.3	16.4	48.6	48.6
Incr Delay (d2), s/veh	0.1	0.0	0.4	0.0	0.0	0.0	3.6	8.5	8.1	0.0	7.1	7.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	2.7	0.0	15.8	0.2	0.0	0.2	30.9	10.6	11.0	0.3	14.8	15.2
LnGrp Delay(d),s/veh	35.7	0.0	10.6	37.7	0.0	33.9	36.6	60.7	60.4	16.4	55.7	55.7
LnGrp LOS	D		B	D		C	D	E	E	B	E	E
Approach Vol, veh/h		1200			9			1062			565	
Approach Delay, s/veh		11.8			36.0			44.8			55.1	
Approach LOS		B			D			D			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	58.6	28.1		37.5	65.4	21.3		37.5
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0
Max Green Setting (Gmax), s	115.0	45.0		35.0	15.0	145.0		35.0
Max Q Clear Time (g_c+I1), s	47.9	20.4		7.5	2.0	14.5		30.5
Green Ext Time (p_c), s	5.7	2.7		4.6	2.3	1.8		2.0

Intersection Summary	
HCM 2010 Ctrl Delay	32.8
HCM 2010 LOS	C

Notes

User approved changes to right turn type.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	44	1	985	4	1	3	574	295	2	7	414	48
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	181.4	159.5	179.7	198.6	198.6	198.6	186.3	179.3	190.0	194.8	188.9	194.8
Adj Flow Rate, veh/h	54	1	1150	5	1	3	700	360	2	9	505	46
Adj No. of Lanes	0	1	2	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Percent Heavy Veh, %	0	0	1	0	0	0	2	6	6	0	3	3
Cap, veh/h	367	6	1864	175	115	345	824	457	3	957	613	56
Arrive On Green	0.26	0.26	0.26	0.26	0.26	0.26	0.43	0.13	0.13	0.48	0.18	0.18
Sat Flow, veh/h	1178	24	2677	518	438	1313	1774	3473	19	1855	3326	302
Grp Volume(v), veh/h	55	0	1150	5	0	4	700	176	186	9	272	279
Grp Sat Flow(s),veh/h/ln	1201	0	1339	518	0	1750	1774	1703	1789	1855	1794	1834
Q Serve(g_s), s	4.3	0.0	28.5	0.9	0.0	0.2	45.8	12.4	12.4	0.0	18.0	18.1
Cycle Q Clear(g_c), s	4.5	0.0	28.5	5.5	0.0	0.2	45.8	12.4	12.4	0.0	18.0	18.1
Prop In Lane	0.98		1.00	1.00		0.75	1.00		0.01	1.00		0.16
Lane Grp Cap(c), veh/h	373	0	1864	175	0	460	824	224	235	957	331	338
V/C Ratio(X)	0.15	0.00	0.62	0.03	0.00	0.01	0.85	0.79	0.79	0.01	0.82	0.83
Avail Cap(c_a), veh/h	397	0	1917	186	0	495	1705	1994	2094	957	652	666
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.4	0.0	10.1	37.5	0.0	33.8	32.9	52.1	52.1	16.4	48.5	48.6
Incr Delay (d2), s/veh	0.1	0.0	0.4	0.0	0.0	0.0	3.6	8.4	8.1	0.0	7.1	7.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	2.6	0.0	15.8	0.2	0.0	0.2	30.9	10.5	10.9	0.3	14.6	15.1
LnGrp Delay(d),s/veh	35.5	0.0	10.5	37.5	0.0	33.8	36.5	60.5	60.2	16.4	55.6	55.7
LnGrp LOS	D		B	D		C	D	E	E	B	E	E
Approach Vol, veh/h		1205			9			1062			560	
Approach Delay, s/veh		11.7			35.8			44.6			55.0	
Approach LOS		B			D			D			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	58.5	27.8		37.5	65.1	21.3		37.5
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0
Max Green Setting (Gmax), s	115.0	45.0		35.0	15.0	145.0		35.0
Max Q Clear Time (g_c+I1), s	47.8	20.1		7.5	2.0	14.4		30.5
Green Ext Time (p_c), s	5.7	2.7		4.7	2.2	1.8		2.0

Intersection Summary	
HCM 2010 Ctrl Delay	32.7
HCM 2010 LOS	C

Notes

User approved changes to right turn type.

Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	2	1016	611	12	10	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	25	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	9	-9	-	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	0	1	2	0	0	0
Mvmt Flow	2	1239	745	15	12	4

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	760	0	-	0	1996	752
Stage 1	-	-	-	-	752	-
Stage 2	-	-	-	-	1244	-
Critical Hdwy	4.1	-	-	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	861	-	-	-	67	413
Stage 1	-	-	-	-	469	-
Stage 2	-	-	-	-	274	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	861	-	-	-	67	413
Mov Cap-2 Maneuver	-	-	-	-	185	-
Stage 1	-	-	-	-	469	-
Stage 2	-	-	-	-	273	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	23.3
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	861	-	-	-	212
HCM Lane V/C Ratio	0.003	-	-	-	0.075
HCM Control Delay (s)	9.2	-	-	-	23.3
HCM Lane LOS	A	-	-	-	C
HCM 95th %tile Q(veh)	0	-	-	-	0.2

Intersection

Int Delay, s/veh 0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	2	1016	611	12	14	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	25	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	9	-9	-	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	0	1	2	0	0	0
Mvmt Flow	2	1239	745	15	17	4

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	760	0	-	0	1996	752
Stage 1	-	-	-	-	752	-
Stage 2	-	-	-	-	1244	-
Critical Hdwy	4.1	-	-	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	861	-	-	-	67	413
Stage 1	-	-	-	-	469	-
Stage 2	-	-	-	-	274	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	861	-	-	-	67	413
Mov Cap-2 Maneuver	-	-	-	-	185	-
Stage 1	-	-	-	-	469	-
Stage 2	-	-	-	-	273	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	24.5
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	861	-	-	-	205
HCM Lane V/C Ratio	0.003	-	-	-	0.101
HCM Control Delay (s)	9.2	-	-	-	24.5
HCM Lane LOS	A	-	-	-	C
HCM 95th %tile Q(veh)	0	-	-	-	0.3

Intersection

Int Delay, s/veh 0.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	0	4	0	336	380	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	-5	-5	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	4	0	365	413	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	778	207	413	0	-	0
Stage 1	413	-	-	-	-	-
Stage 2	365	-	-	-	-	-
Critical Hdwy	6.63	6.93	4.14	-	-	-
Critical Hdwy Stg 1	5.83	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.22	-	-	-
Pot Cap-1 Maneuver	349	800	1142	-	-	-
Stage 1	637	-	-	-	-	-
Stage 2	701	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	349	800	1142	-	-	-
Mov Cap-2 Maneuver	349	-	-	-	-	-
Stage 1	637	-	-	-	-	-
Stage 2	701	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.5	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1142	-	800	-	-
HCM Lane V/C Ratio	-	-	0.005	-	-
HCM Control Delay (s)	0	-	9.5	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	112	5	967	27	12	7	585	562	12	16	353	46
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	181.4	174.7	179.7	198.6	198.6	198.6	186.3	179.5	190.0	194.8	188.9	194.8
Adj Flow Rate, veh/h	120	5	1005	29	13	2	629	604	13	17	380	41
Adj No. of Lanes	0	1	2	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	0	0	1	0	0	0	2	6	6	0	3	3
Cap, veh/h	408	15	1797	191	445	69	800	774	17	707	520	56
Arrive On Green	0.27	0.27	0.27	0.27	0.27	0.27	0.40	0.23	0.23	0.34	0.16	0.16
Sat Flow, veh/h	1237	58	2677	592	1681	259	1774	3411	73	1855	3268	350
Grp Volume(v), veh/h	125	0	1005	29	0	15	629	302	315	17	208	213
Grp Sat Flow(s),veh/h/ln	1295	0	1339	592	0	1939	1774	1705	1779	1855	1794	1824
Q Serve(g_s), s	6.7	0.0	17.4	3.7	0.0	0.5	28.6	14.6	14.6	0.0	9.6	9.8
Cycle Q Clear(g_c), s	7.2	0.0	17.4	10.9	0.0	0.5	28.6	14.6	14.6	0.0	9.6	9.8
Prop In Lane	0.96		1.00	1.00		0.13	1.00		0.04	1.00		0.19
Lane Grp Cap(c), veh/h	424	0	1797	191	0	514	800	387	404	707	286	290
V/C Ratio(X)	0.30	0.00	0.56	0.15	0.00	0.03	0.79	0.78	0.78	0.02	0.73	0.74
Avail Cap(c_a), veh/h	601	0	2157	270	0	775	2411	2821	2945	707	921	937
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	26.5	0.0	7.7	30.8	0.0	23.9	24.0	31.8	31.8	19.3	35.0	35.1
Incr Delay (d2), s/veh	0.1	0.0	0.1	0.1	0.0	0.0	2.5	4.8	4.7	0.0	5.0	5.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	4.5	0.0	10.4	1.1	0.0	0.5	20.6	11.9	12.3	0.5	8.9	9.1
LnGrp Delay(d),s/veh	26.6	0.0	7.8	30.9	0.0	23.9	26.5	36.6	36.5	19.3	40.0	40.2
LnGrp LOS	C		A	C		C	C	D	D	B	D	D
Approach Vol, veh/h		1130			44			1246			438	
Approach Delay, s/veh		9.8			28.5			31.5			39.3	
Approach LOS		A			C			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	40.5	18.9		28.2	34.5	24.9		28.2
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0
Max Green Setting (Gmax), s	115.0	45.0		35.0	15.0	145.0		35.0
Max Q Clear Time (g_c+I1), s	30.6	11.8		12.9	2.0	16.6		19.4
Green Ext Time (p_c), s	4.9	2.0		4.2	1.7	3.3		3.8

Intersection Summary

HCM 2010 Ctrl Delay	24.1
HCM 2010 LOS	C

Notes

User approved changes to right turn type.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	113	5	972	27	12	7	588	565	12	16	355	46
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	181.4	174.7	179.7	198.6	198.6	198.6	186.3	179.5	190.0	194.8	188.9	194.8
Adj Flow Rate, veh/h	122	5	1010	29	13	2	632	608	13	17	382	41
Adj No. of Lanes	0	1	2	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	0	0	1	0	0	0	2	6	6	0	3	3
Cap, veh/h	408	15	1801	188	446	69	802	777	17	707	521	56
Arrive On Green	0.27	0.27	0.27	0.27	0.27	0.27	0.41	0.23	0.23	0.34	0.16	0.16
Sat Flow, veh/h	1238	57	2677	589	1681	259	1774	3411	73	1855	3270	349
Grp Volume(v), veh/h	127	0	1010	29	0	15	632	304	317	17	209	214
Grp Sat Flow(s),veh/h/ln	1294	0	1339	589	0	1939	1774	1705	1779	1855	1794	1825
Q Serve(g_s), s	6.9	0.0	17.6	3.7	0.0	0.5	29.0	14.8	14.8	0.0	9.8	9.9
Cycle Q Clear(g_c), s	7.4	0.0	17.6	11.1	0.0	0.5	29.0	14.8	14.8	0.0	9.8	9.9
Prop In Lane	0.96		1.00	1.00		0.13	1.00		0.04	1.00		0.19
Lane Grp Cap(c), veh/h	423	0	1801	188	0	514	802	388	405	707	286	291
V/C Ratio(X)	0.30	0.00	0.56	0.15	0.00	0.03	0.79	0.78	0.78	0.02	0.73	0.74
Avail Cap(c_a), veh/h	595	0	2150	265	0	767	2388	2794	2917	707	913	928
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	26.8	0.0	7.7	31.1	0.0	24.1	24.2	32.1	32.1	19.4	35.4	35.4
Incr Delay (d2), s/veh	0.1	0.0	0.1	0.1	0.0	0.0	2.5	4.9	4.7	0.0	5.0	5.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	4.6	0.0	10.7	1.1	0.0	0.5	20.9	12.0	12.4	0.5	9.0	9.2
LnGrp Delay(d),s/veh	26.9	0.0	7.8	31.3	0.0	24.1	26.7	37.0	36.8	19.4	40.4	40.6
LnGrp LOS	C		A	C		C	C	D	D	B	D	D
Approach Vol, veh/h		1137			44			1253			440	
Approach Delay, s/veh		9.9			28.8			31.7			39.7	
Approach LOS		A			C			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	40.9	19.1		28.5	34.8	25.2		28.5
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0
Max Green Setting (Gmax), s	115.0	45.0		35.0	15.0	145.0		35.0
Max Q Clear Time (g_c+I1), s	31.0	11.9		13.1	2.0	16.8		19.6
Green Ext Time (p_c), s	4.9	2.0		4.2	1.7	3.3		3.8

Intersection Summary	
HCM 2010 Ctrl Delay	24.3
HCM 2010 LOS	C

Notes

User approved changes to right turn type.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	113	5	988	27	12	7	605	565	12	16	361	46
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	181.4	174.7	179.7	198.6	198.6	198.6	186.3	179.5	190.0	194.8	188.9	194.8
Adj Flow Rate, veh/h	122	5	1027	29	13	2	651	608	13	17	388	41
Adj No. of Lanes	0	1	2	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	0	0	1	0	0	0	2	6	6	0	3	3
Cap, veh/h	402	15	1821	182	442	68	815	770	16	725	521	55
Arrive On Green	0.26	0.26	0.26	0.26	0.26	0.26	0.42	0.23	0.23	0.35	0.16	0.16
Sat Flow, veh/h	1237	57	2677	580	1681	259	1774	3411	73	1855	3276	344
Grp Volume(v), veh/h	127	0	1027	29	0	15	651	304	317	17	212	217
Grp Sat Flow(s),veh/h/ln	1294	0	1339	580	0	1939	1774	1705	1779	1855	1794	1825
Q Serve(g_s), s	7.2	0.0	18.5	4.0	0.0	0.5	31.3	15.5	15.5	0.0	10.4	10.5
Cycle Q Clear(g_c), s	7.7	0.0	18.5	11.7	0.0	0.5	31.3	15.5	15.5	0.0	10.4	10.5
Prop In Lane	0.96		1.00	1.00		0.13	1.00		0.04	1.00		0.19
Lane Grp Cap(c), veh/h	417	0	1821	182	0	510	815	385	402	725	285	290
V/C Ratio(X)	0.30	0.00	0.56	0.16	0.00	0.03	0.80	0.79	0.79	0.02	0.74	0.75
Avail Cap(c_a), veh/h	569	0	2131	249	0	735	2287	2676	2793	725	874	889
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	28.1	0.0	7.7	32.7	0.0	25.3	24.9	33.7	33.7	19.6	37.0	37.1
Incr Delay (d2), s/veh	0.2	0.0	0.1	0.2	0.0	0.0	2.6	5.1	4.9	0.0	5.3	5.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	4.8	0.0	10.9	1.2	0.0	0.5	22.1	12.4	12.8	0.5	9.4	9.7
LnGrp Delay(d),s/veh	28.2	0.0	7.8	32.9	0.0	25.3	27.5	38.8	38.6	19.6	42.3	42.5
LnGrp LOS	C		A	C		C	C	D	D	B	D	D
Approach Vol, veh/h		1154			44			1272			446	
Approach Delay, s/veh		10.1			30.3			33.0			41.5	
Approach LOS		B			C			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	43.4	19.7		29.3	37.2	25.9		29.3
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0
Max Green Setting (Gmax), s	115.0	45.0		35.0	15.0	145.0		35.0
Max Q Clear Time (g_c+I1), s	33.3	12.5		13.7	2.0	17.5		20.5
Green Ext Time (p_c), s	5.1	2.1		4.3	1.7	3.3		3.8

Intersection Summary	
HCM 2010 Ctrl Delay	25.2
HCM 2010 LOS	C

Notes

User approved changes to right turn type.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	113	5	994	27	12	7	605	565	12	16	355	46
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	181.4	174.7	179.7	198.6	198.6	198.6	186.3	179.5	190.0	194.8	188.9	194.8
Adj Flow Rate, veh/h	122	5	1034	29	13	2	651	608	13	17	382	41
Adj No. of Lanes	0	1	2	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	0	0	1	0	0	0	2	6	6	0	3	3
Cap, veh/h	404	15	1825	182	445	68	815	770	16	721	515	55
Arrive On Green	0.26	0.26	0.26	0.26	0.26	0.26	0.42	0.23	0.23	0.35	0.16	0.16
Sat Flow, veh/h	1238	57	2677	576	1681	259	1774	3411	73	1855	3270	349
Grp Volume(v), veh/h	127	0	1034	29	0	15	651	304	317	17	209	214
Grp Sat Flow(s),veh/h/ln	1294	0	1339	576	0	1939	1774	1705	1779	1855	1794	1825
Q Serve(g_s), s	7.2	0.0	18.6	4.0	0.0	0.5	31.2	15.5	15.5	0.0	10.2	10.4
Cycle Q Clear(g_c), s	7.7	0.0	18.6	11.7	0.0	0.5	31.2	15.5	15.5	0.0	10.2	10.4
Prop In Lane	0.96		1.00	1.00		0.13	1.00		0.04	1.00		0.19
Lane Grp Cap(c), veh/h	419	0	1825	182	0	513	815	385	402	721	282	287
V/C Ratio(X)	0.30	0.00	0.57	0.16	0.00	0.03	0.80	0.79	0.79	0.02	0.74	0.75
Avail Cap(c_a), veh/h	570	0	2132	248	0	735	2289	2679	2796	721	875	890
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	27.9	0.0	7.7	32.6	0.0	25.1	24.8	33.6	33.7	19.7	37.1	37.1
Incr Delay (d2), s/veh	0.1	0.0	0.1	0.1	0.0	0.0	2.6	5.1	4.9	0.0	5.3	5.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	4.8	0.0	11.0	1.2	0.0	0.5	22.1	12.4	12.8	0.5	9.3	9.6
LnGrp Delay(d),s/veh	28.1	0.0	7.8	32.7	0.0	25.1	27.4	38.8	38.6	19.7	42.4	42.6
LnGrp LOS	C		A	C		C	C	D	D	B	D	D
Approach Vol, veh/h		1161			44			1272			440	
Approach Delay, s/veh		10.0			30.1			32.9			41.6	
Approach LOS		B			C			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	43.3	19.5		29.4	37.0	25.8		29.4
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0
Max Green Setting (Gmax), s	115.0	45.0		35.0	15.0	145.0		35.0
Max Q Clear Time (g_c+I1), s	33.2	12.4		13.7	2.0	17.5		20.6
Green Ext Time (p_c), s	5.1	2.0		4.3	1.7	3.3		3.9

Intersection Summary

HCM 2010 Ctrl Delay	25.1
HCM 2010 LOS	C

Notes

User approved changes to right turn type.

Intersection

Int Delay, s/veh 0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	3	1090	646	17	16	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	25	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	9	-9	-	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	0	1	2	0	0	0
Mvmt Flow	4	1329	788	21	20	5

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	809	0	-	0	2135	798
Stage 1	-	-	-	-	798	-
Stage 2	-	-	-	-	1337	-
Critical Hdwy	4.1	-	-	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	825	-	-	-	55	389
Stage 1	-	-	-	-	447	-
Stage 2	-	-	-	-	247	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	825	-	-	-	55	389
Mov Cap-2 Maneuver	-	-	-	-	167	-
Stage 1	-	-	-	-	447	-
Stage 2	-	-	-	-	246	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	26.9
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	825	-	-	-	189
HCM Lane V/C Ratio	0.004	-	-	-	0.129
HCM Control Delay (s)	9.4	-	-	-	26.9
HCM Lane LOS	A	-	-	-	D
HCM 95th %tile Q(veh)	0	-	-	-	0.4

Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	3	1090	646	17	22	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	25	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	9	-9	-	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	0	1	2	0	0	0
Mvmt Flow	4	1329	788	21	27	5

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	809	0	-	0	2135	798
Stage 1	-	-	-	-	798	-
Stage 2	-	-	-	-	1337	-
Critical Hdwy	4.1	-	-	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	825	-	-	-	55	389
Stage 1	-	-	-	-	447	-
Stage 2	-	-	-	-	247	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	825	-	-	-	55	389
Mov Cap-2 Maneuver	-	-	-	-	167	-
Stage 1	-	-	-	-	447	-
Stage 2	-	-	-	-	246	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	28.8
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	825	-	-	-	183
HCM Lane V/C Ratio	0.004	-	-	-	0.173
HCM Control Delay (s)	9.4	-	-	-	28.8
HCM Lane LOS	A	-	-	-	D
HCM 95th %tile Q(veh)	0	-	-	-	0.6

Intersection	
Int Delay, s/veh	0.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	0	6	0	567	376	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Stop	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	-5	-5	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	7	0	616	409	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1025	204	409	0	-	0
Stage 1	409	-	-	-	-	-
Stage 2	616	-	-	-	-	-
Critical Hdwy	6.63	6.93	4.14	-	-	-
Critical Hdwy Stg 1	5.83	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.22	-	-	-
Pot Cap-1 Maneuver	245	803	1146	-	-	-
Stage 1	640	-	-	-	-	-
Stage 2	538	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	245	803	1146	-	-	-
Mov Cap-2 Maneuver	245	-	-	-	-	-
Stage 1	640	-	-	-	-	-
Stage 2	538	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.5	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1146	-	803	-	-
HCM Lane V/C Ratio	-	-	0.008	-	-
HCM Control Delay (s)	0	-	9.5	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

1: Vandenburgh & Morrison/Taco Bell Dwy

2015 Build (wb protected) AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	44	1	981	4	1	3	574	295	2	7	418	48
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	181.4	159.5	179.7	198.6	198.6	198.6	186.3	179.3	190.0	194.8	188.9	194.8
Adj Flow Rate, veh/h	54	1	1145	5	1	3	700	360	2	9	510	46
Adj No. of Lanes	0	1	2	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Percent Heavy Veh, %	0	0	1	0	0	0	2	6	6	0	3	3
Cap, veh/h	300	5	1711	147	110	330	831	463	3	967	625	56
Arrive On Green	0.20	0.20	0.20	0.01	0.25	0.25	0.43	0.13	0.13	0.49	0.19	0.19
Sat Flow, veh/h	1175	24	2674	1891	438	1313	1774	3473	19	1855	3329	299
Grp Volume(v), veh/h	55	0	1145	5	0	4	700	176	186	9	274	282
Grp Sat Flow(s),veh/h/ln	1199	0	1337	1891	0	1750	1774	1703	1789	1855	1794	1834
Q Serve(g_s), s	4.4	0.0	20.3	0.0	0.0	0.2	43.4	11.8	11.8	0.0	17.3	17.4
Cycle Q Clear(g_c), s	4.6	0.0	20.3	0.0	0.0	0.2	43.4	11.8	11.8	0.0	17.3	17.4
Prop In Lane	0.98		1.00	1.00		0.75	1.00		0.01	1.00		0.16
Lane Grp Cap(c), veh/h	305	0	1711	147	0	440	831	227	238	967	337	344
V/C Ratio(X)	0.18	0.00	0.67	0.03	0.00	0.01	0.84	0.78	0.78	0.01	0.81	0.82
Avail Cap(c_a), veh/h	325	0	1756	202	0	520	1791	2095	2200	967	685	700
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	39.3	0.0	5.7	42.8	0.0	33.1	31.1	49.4	49.4	15.4	45.9	46.0
Incr Delay (d2), s/veh	0.1	0.0	0.8	0.1	0.0	0.0	3.4	7.9	7.6	0.0	6.7	6.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	2.7	0.0	12.0	0.3	0.0	0.2	29.4	10.1	10.4	0.3	14.1	14.5
LnGrp Delay(d),s/veh	39.4	0.0	6.5	42.8	0.0	33.1	34.5	57.3	57.0	15.4	52.6	52.7
LnGrp LOS	D		A	D		C	C	E	E	B	D	D
Approach Vol, veh/h		1200			9			1062			565	
Approach Delay, s/veh		8.0			38.5			42.2			52.0	
Approach LOS		A			D			D			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6	7	8
Phs Duration (G+Y+Rc), s	56.2	27.1		34.6	62.6	20.7	5.6	29.0
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	115.0	45.0		35.0	15.0	145.0	4.0	26.0
Max Q Clear Time (g_c+I1), s	45.4	19.4		2.2	2.0	13.8	2.0	22.3
Green Ext Time (p_c), s	5.7	2.7		0.0	2.3	1.8	0.0	1.7

Intersection Summary	
HCM 2010 Ctrl Delay	29.7
HCM 2010 LOS	C

Notes

User approved changes to right turn type.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	113	5	987	27	12	7	605	565	12	16	361	46
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	181.4	174.7	179.7	198.6	198.6	198.6	186.3	179.5	190.0	194.8	188.9	194.8
Adj Flow Rate, veh/h	122	5	1026	29	13	2	651	608	13	17	388	41
Adj No. of Lanes	0	1	2	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	0	0	1	0	0	0	2	6	6	0	3	3
Cap, veh/h	308	11	1621	164	446	69	813	769	16	723	520	55
Arrive On Green	0.19	0.19	0.19	0.02	0.27	0.27	0.41	0.23	0.23	0.35	0.16	0.16
Sat Flow, veh/h	1226	58	2673	1891	1681	259	1774	3411	73	1855	3276	344
Grp Volume(v), veh/h	127	0	1026	29	0	15	651	304	317	17	212	217
Grp Sat Flow(s),veh/h/ln	1284	0	1337	1891	0	1939	1774	1705	1779	1855	1794	1825
Q Serve(g_s), s	8.0	0.0	12.3	0.0	0.0	0.5	31.6	15.7	15.7	0.0	10.5	10.6
Cycle Q Clear(g_c), s	8.5	0.0	12.3	0.0	0.0	0.5	31.6	15.7	15.7	0.0	10.5	10.6
Prop In Lane	0.96		1.00	1.00		0.13	1.00		0.04	1.00		0.19
Lane Grp Cap(c), veh/h	319	0	1621	164	0	515	813	384	401	723	285	290
V/C Ratio(X)	0.40	0.00	0.63	0.18	0.00	0.03	0.80	0.79	0.79	0.02	0.74	0.75
Avail Cap(c_a), veh/h	437	0	1861	203	0	728	2266	2652	2768	723	866	881
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	34.3	0.0	3.8	39.8	0.0	25.3	25.1	34.0	34.0	19.8	37.4	37.5
Incr Delay (d2), s/veh	0.3	0.0	0.3	0.5	0.0	0.0	2.7	5.2	5.0	0.0	5.4	5.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	5.4	0.0	7.9	1.3	0.0	0.5	22.3	12.5	12.9	0.5	9.5	9.7
LnGrp Delay(d),s/veh	34.6	0.0	4.2	40.4	0.0	25.3	27.8	39.2	39.0	19.8	42.8	42.9
LnGrp LOS	C		A	D		C	C	D	D	B	D	D
Approach Vol, veh/h		1153			44			1272			446	
Approach Delay, s/veh		7.5			35.2			33.3			42.0	
Approach LOS		A			D			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6	7	8
Phs Duration (G+Y+Rc), s	43.7	19.8		29.8	37.5	26.0	7.1	22.6
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	115.0	45.0		35.0	15.0	145.0	4.0	26.0
Max Q Clear Time (g_c+I1), s	33.6	12.6		2.5	2.0	17.7	2.0	14.3
Green Ext Time (p_c), s	5.1	2.1		0.1	1.7	3.3	0.0	3.3

Intersection Summary

HCM 2010 Ctrl Delay	24.5
HCM 2010 LOS	C

Notes

User approved changes to right turn type.

Appendix D

Sensitivity Analysis

Traffic Impact Study
HVCC Student Housing
City of Troy, New York

HCM Signalized Intersection Capacity Analysis 23: NY 378/Burden Ave & Stowe Ave & Morrison Ave
South Troy Industrial Road

2014 Existing AM Peak

Movement	WBL2	WBL	WBR	NBT	NBR	NBR2	SBL2	SBL	SBT	NWL	NWR	NWR2
Lane Configurations												
Volume (vph)	1	546	11	478	1070	23	16	15	1258	113	39	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	13	13	13	12	12	12	11	11	11	12	12	12
Total Lost time (s)		5.0		5.0	5.0				5.0	5.0		
Lane Util. Factor		1.00		0.95	1.00				0.95	1.00		
Frt		1.00		1.00	0.85				1.00	0.96		
Flt Protected		0.95		1.00	1.00				1.00	0.96		
Satd. Flow (prot)		1849		3374	1596				3342	1511		
Flt Permitted		0.95		1.00	1.00				0.93	0.96		
Satd. Flow (perm)		1849		3374	1596				3127	1511		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1	546	11	478	1070	23	16	15	1258	113	39	1
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	558	0	478	1093	0	0	0	1289	153	0	0
Heavy Vehicles (%)	0%	1%	0%	7%	1%	9%	13%	20%	4%	2%	15%	0%
Parking (#/hr)										0	0	0
Turn Type	D.Pm	Prot		NA	pt+ov		D.P+P	Prot	NA	Prot		
Protected Phases		4		2	2 4!		1	1	1 2	3		
Permitted Phases	4!						2					
Actuated Green, G (s)		43.0		27.0	75.0				36.0	13.0		
Effective Green, g (s)		43.0		27.0	75.0				36.0	13.0		
Actuated g/C Ratio		0.38		0.24	0.67				0.32	0.12		
Clearance Time (s)		5.0		5.0						5.0		
Vehicle Extension (s)		4.0		4.0						4.0		
Lane Grp Cap (vph)		709		813	1068				1022	175		
v/s Ratio Prot				0.14	c0.68				c0.10	c0.10		
v/s Ratio Perm		0.30							c0.30			
v/c Ratio		0.79		0.59	1.02				1.26	0.87		
Uniform Delay, d1		30.5		37.6	18.5				38.0	48.7		
Progression Factor		1.00		1.00	1.00				1.00	1.00		
Incremental Delay, d2		6.1		1.3	33.6				125.5	35.8		
Delay (s)		36.6		38.9	52.1				163.5	84.5		
Level of Service		D		D	D				F	F		
Approach Delay (s)		36.6		48.1					163.5	84.5		
Approach LOS		D		D					F	F		

Intersection Summary

HCM 2000 Control Delay	89.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	112.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	111.7%	ICU Level of Service	H
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group

Movement	WBL2	WBL	WBR	NBT	NBR	NBR2	SBL2	SBL	SBT	NWL	NWR	NWR2
Lane Configurations												
Volume (vph)	1	542	11	478	1050	23	16	15	1258	113	39	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	13	13	13	12	12	12	11	11	11	12	12	12
Total Lost time (s)		5.0		5.0	5.0				5.0	5.0		
Lane Util. Factor		1.00		0.95	1.00				0.95	1.00		
Frt		1.00		1.00	0.85				1.00	0.96		
Flt Protected		0.95		1.00	1.00				1.00	0.96		
Satd. Flow (prot)		1849		3374	1596				3342	1511		
Flt Permitted		0.95		1.00	1.00				0.93	0.96		
Satd. Flow (perm)		1849		3374	1596				3127	1511		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1	542	11	478	1050	23	16	15	1258	113	39	1
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	554	0	478	1073	0	0	0	1289	153	0	0
Heavy Vehicles (%)	0%	1%	0%	7%	1%	9%	13%	20%	4%	2%	15%	0%
Parking (#/hr)										0	0	0
Turn Type	D.Pm	Prot		NA	pt+ov		D.P+P	Prot	NA	Prot		
Protected Phases		4		2	2 4!		1	1	1 2	3		
Permitted Phases	4!						2					
Actuated Green, G (s)		43.0		27.0	75.0				36.0	13.0		
Effective Green, g (s)		43.0		27.0	75.0				36.0	13.0		
Actuated g/C Ratio		0.38		0.24	0.67				0.32	0.12		
Clearance Time (s)		5.0		5.0						5.0		
Vehicle Extension (s)		4.0		4.0						4.0		
Lane Grp Cap (vph)		709		813	1068				1022	175		
v/s Ratio Prot				0.14	c0.67				c0.10	c0.10		
v/s Ratio Perm		0.30							c0.30			
v/c Ratio		0.78		0.59	1.00				1.26	0.87		
Uniform Delay, d1		30.4		37.6	18.5				38.0	48.7		
Progression Factor		1.00		1.00	1.00				1.00	1.00		
Incremental Delay, d2		5.9		1.3	28.7				125.5	35.8		
Delay (s)		36.3		38.9	47.2				163.5	84.5		
Level of Service		D		D	D				F	F		
Approach Delay (s)		36.3		44.6					163.5	84.5		
Approach LOS		D		D					F	F		

Intersection Summary

HCM 2000 Control Delay	88.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	112.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	110.4%	ICU Level of Service	H
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

Movement	WBL2	WBL	WBR	NBT	NBR	NBR2	SBL2	SBL	SBT	NWL	NWR	NWR2
Lane Configurations												
Volume (vph)	1	540	12	1021	945	85	43	21	698	56	17	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	13	13	13	12	12	12	11	11	11	12	12	12
Total Lost time (s)		5.0		5.0	5.0				5.0	5.0		
Lane Util. Factor		1.00		0.95	1.00				0.95	1.00		
Frt		1.00		1.00	0.85				1.00	0.97		
Flt Protected		0.95		1.00	1.00				1.00	0.96		
Satd. Flow (prot)		1866		3574	1615				3395	1571		
Flt Permitted		0.95		1.00	1.00				0.59	0.96		
Satd. Flow (perm)		1866		3574	1615				2017	1571		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1	540	12	1021	945	85	43	21	698	56	17	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	553	0	1021	1030	0	0	0	762	75	0	0
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%	0%	19%	2%	0%	6%	0%
Parking (#/hr)										0	0	0
Turn Type	D.Pm	Prot		NA	pt+ov		D.P+P	Prot	NA	Prot		
Protected Phases		4		2	2 4!		1	1	1 2	3		
Permitted Phases	4!						2		2			
Actuated Green, G (s)		46.5		44.8	96.3				55.0	9.3		
Effective Green, g (s)		46.5		44.8	96.3				55.0	9.3		
Actuated g/C Ratio		0.36		0.34	0.74				0.42	0.07		
Clearance Time (s)		5.0		5.0						5.0		
Vehicle Extension (s)		4.0		4.0						4.0		
Lane Grp Cap (vph)		663		1224	1189				955	111		
v/s Ratio Prot				0.29	c0.64				c0.06	c0.05		
v/s Ratio Perm		0.30							0.27			
v/c Ratio		0.83		0.83	0.87				0.80	0.68		
Uniform Delay, d1		38.6		39.6	12.6				33.1	59.3		
Progression Factor		1.00		1.00	1.00				1.00	1.00		
Incremental Delay, d2		9.3		5.3	7.1				4.4	16.3		
Delay (s)		47.9		44.8	19.6				37.5	75.6		
Level of Service		D		D	B				D	E		
Approach Delay (s)		47.9		32.2					37.5	75.6		
Approach LOS		D		C					D	E		

Intersection Summary

HCM 2000 Control Delay	36.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	130.8	Sum of lost time (s)	20.0
Intersection Capacity Utilization	105.1%	ICU Level of Service	G
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis 23: NY 378/Burden Ave & Stowe Ave & Morrison Ave
South Troy Industrial Road

2015 Build PM Peak

Movement	WBL2	WBL	WBR	NBT	NBR	NBR2	SBL2	SBL	SBT	NWL	NWR	NWR2
Lane Configurations												
Volume (vph)	1	531	12	1021	930	85	43	21	698	56	17	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	13	13	13	12	12	12	11	11	11	12	12	12
Total Lost time (s)		5.0		5.0	5.0				5.0	5.0		
Lane Util. Factor		1.00		0.95	1.00				0.95	1.00		
Frt		1.00		1.00	0.85				1.00	0.97		
Flt Protected		0.95		1.00	1.00				1.00	0.96		
Satd. Flow (prot)		1866		3574	1615				3395	1571		
Flt Permitted		0.95		1.00	1.00				0.59	0.96		
Satd. Flow (perm)		1866		3574	1615				2025	1571		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1	531	12	1021	930	85	43	21	698	56	17	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	544	0	1021	1015	0	0	0	762	75	0	0
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%	0%	19%	2%	0%	6%	0%
Parking (#/hr)										0	0	0
Turn Type	D.Pm	Prot		NA	pt+ov		D.P+P	Prot	NA	Prot		
Protected Phases		4		2	2 4!		1	1	1 2	3		
Permitted Phases	4!						2		2			
Actuated Green, G (s)		45.9		44.8	95.7				55.0	9.3		
Effective Green, g (s)		45.9		44.8	95.7				55.0	9.3		
Actuated g/C Ratio		0.35		0.34	0.74				0.42	0.07		
Clearance Time (s)		5.0		5.0						5.0		
Vehicle Extension (s)		4.0		4.0						4.0		
Lane Grp Cap (vph)		657		1229	1187				962	112		
v/s Ratio Prot				0.29	c0.63				c0.06	c0.05		
v/s Ratio Perm		0.29							0.27			
v/c Ratio		0.83		0.83	0.86				0.79	0.67		
Uniform Delay, d1		38.5		39.2	12.3				32.6	59.0		
Progression Factor		1.00		1.00	1.00				1.00	1.00		
Incremental Delay, d2		8.9		5.1	6.4				4.2	15.5		
Delay (s)		47.4		44.4	18.7				36.9	74.4		
Level of Service		D		D	B				D	E		
Approach Delay (s)		47.4		31.6					36.9	74.4		
Approach LOS		D		C					D	E		

Intersection Summary

HCM 2000 Control Delay	36.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	130.2	Sum of lost time (s)	20.0
Intersection Capacity Utilization	104.6%	ICU Level of Service	G
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group