

Traffic Impact Study

Woodbury Club Development Ann Arbor, Michigan

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Table of Contents

Executive Summary	2
Introduction.....	3
Sight Distance Requirements.....	4
Data Collection.....	4
Trip Generation	5
Trip Distribution.....	5
Intersection Analysis.....	6
Intersection Analysis – Huron Parkway and Nixon Road	7
Intersection Analysis – Nixon Road and Bluett Drive.....	9
Intersection Analysis – Nixon Road and Dhu Varren / Green	11
Nixon and Dhu Varren	11
Nixon Road and Green Road.....	12
Intersection Analysis – Site Driveways	14
North Site Driveway	14
South Site Driveway.....	15
Crash Analysis.....	15
Summary of Findings and Recommendations	16
Appendix.....	17

Appendix Contents

- Volume Figures
- Turning Movement Counts
- ITE Trip Generation
- SimTraffic Results
- MDOT Traffic and Safety Notes 603 & 604
- Crash Diagrams & SEMCOG Summary Table

Executive Summary

The proposed Woodbury Club development is located along the east side of Nixon Road between M-14 and the Dhu Varren / Green Road intersection in the northeast part of the City of Ann Arbor. The site is currently undeveloped. The proposed development would consist of 234 apartment units in five (5) structures with a single Community Building which will not be occupied for residential uses.

The traffic impact area for this development includes the offset intersection of Nixon Road with Dhu Varren and Green Roads, Nixon and Bluett, and Nixon with Huron Parkway. The intersection of Nixon Road and Huron Parkway is configured as a modern roundabout intersection. Nixon Road and Dhu Varren / Green is 4-Way Stop controlled; and the 90+ feet offset between Green and Dhu Varren is the root cause of additional delay and driver confusion currently experienced at the intersection. Nixon and Bluett is a 2-Way Stop controlled intersection with Bluett and the private drive (Meade Court) stopping for Nixon traffic.

During the AM peak hour there will be a total of 118 new vehicle trips associated with the apartment development. The development will generate a total of 146 new PM peak hour vehicle trips. Although the Ann Arbor Transportation Authority has bus stops along Nixon Road and Green Road somewhat close to the development, no reduction factors were applied to the trip generation.

Traffic data was collected at Nixon with Dhu Varren/Green and Bluett on July 9th and 10th, 2013. The traffic count at Nixon and Huron Parkway was taken on February 12th, 2013. Since the July counts were taken during the summer break, a factor of 1.35 was applied to the morning counts and a factor of 1.15 was applied to the evening counts to account for school traffic and bring the volumes in line with the higher traffic volumes seen at Huron Parkway and Nixon.

Traffic simulation models were created to predict the traffic conditions with and without the development during the peak AM and PM traffic hours. A small amount of traffic was added to Nixon Road from the proposed Traverwood Apartments project as background growth in addition to the factored existing counts. These models predicted not only the current traffic service levels, but also future service levels under the assumption that the Woodbury Club apartments would be occupied in the fall of 2014.

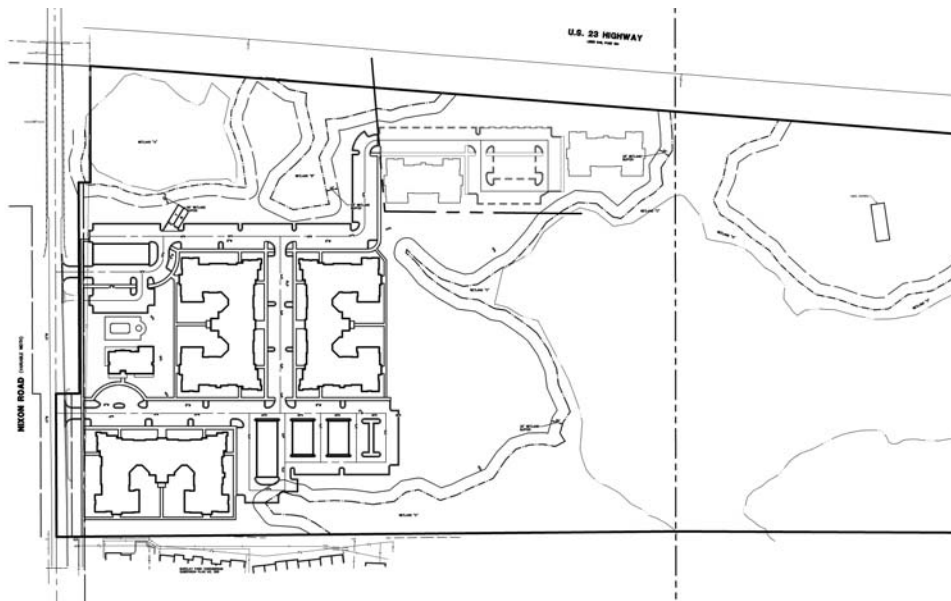
Due to the unusual offset design and 4-Way Stop control of the Nixon Road and Dhu Varren / Green Road intersection, the existing level of service at the intersection is undesirable. As expected, any additional traffic added from the proposed development further increases the congestion at this intersection.

If the Dhu Varren/Green intersection is realigned, provided a separate left-turn lane on each approach, and controlled by a traffic signal; an acceptable level of service can be achieved for both the existing and forecast traffic including the proposed development. The intersections of Bluett and Huron Parkway are not significantly impacted by the traffic from the proposed development.

Introduction

A multi-building apartment development, containing 234 apartments within 5 structures is proposed for an undeveloped site located in the City of Ann Arbor in a parcel of land on the east side of Nixon Road between M-14 and Green Road. Two driveways will provide access to the site from Nixon Road, approximately 1/3rd of a mile north of Dhu Varren.

The proposed site plan illustrates the layout of the Woodbury Club site and the locations of the two access driveways. These driveway locations were used to model ingress and egress movements from each portion of the development onto Nixon Road.



Proposed Woodbury Club Site Plan

This traffic impact study is intended to evaluate the impact that the proposed development will have on the adjacent street system. The Woodbury Club project is expected to be completed in 2014.

Sight Distance Requirements

According to the AASHTO (American Association of State Highway Transportation Officials) publication: **A Policy on Geometric Design of Highways and Streets**; the minimum sight distance required for a site driveway is derived from the following equation:

$$\text{Intersection Sight Distance (ISD)} = 1.47 \times V_{\text{major}} \times t_g$$
$$V_{\text{major}} = 35 \text{ MPH}$$

t_g = time gap for minor road vehicle to enter the major road = 7.5 seconds.

$$\text{ISD} = 386 \text{ feet (rounded to 390 feet for design)}$$

The sight distance triangle is defined by the calculated ISD (390 feet) and the typical position of a driver that is exiting the site driveway, which is set back from the edge of the major roadway by 14.5 to 18 feet. Any vegetation or signage should be either cleared from the sight distance triangle or placed in a location that does not impact the view of the driver.

Data Collection

New traffic counts on July 9th and 10th were taken at two of the study intersections: Nixon with Dhu Varren/Green Road, and Nixon with Bluett. An existing count at Nixon and Huron Parkway from February 2013 is used in this study.

Traffic counts were obtained for the peak AM and PM traffic hours (one sixty-minute period occurring between 7:00 and 9:00 AM and again between 4:00 and 6:00 PM on a Tuesday, Wednesday or Thursday). The resulting existing peak hour volumes are illustrated on Figure 1 (AM) and Figure 2 (PM) following the text of this report.

There were minor pedestrian movements at some of the intersections included in this traffic study. The low volume of pedestrian movements did not impact the analysis or conclusions.

The July counts were factored by 1.35 in the morning and 1.15 in the afternoon to account for additional school traffic and to be more in line with the February volumes observed at Huron Parkway intersection. In addition, a small amount of traffic from the proposed Traverwood apartment development was added to the existing traffic volumes along Nixon Road as background growth. The SimTraffic program also adjusts the through volumes between the intersections to balance the traffic from one intersection to the next and includes those differences even though the visual model will remove those cars as they pass the midpoint of each link. The resulting background peak hour volumes are illustrated on Figures 3 (AM) and 4 (PM) following the text of this report.

The change in level of service from the background to forecast conditions (without, and then with the proposed development's traffic) is the potential impact of the proposed Woodbury Club traffic.

Trip Generation

Trip generation was performed utilizing established trip generation rates and equations documented in the ITE Trip Generation Manual, 9th Edition for the proposed land uses on the site. Following discussions with the City it was decided that the ITE land use is considered appropriate for the proposed site is “Land Use 220 – Apartment”.

For the apartment land use, AM peak hour trips are predicted to total 118 total trips with 24 vehicles entering the site and 94 vehicles exiting the site. During the PM peak hour 146 vehicles will be generated with 95 vehicles entering the site and 51 vehicles exiting the site. These figures use the number of apartment units as the independent variable to predict the number of new trips associated with this proposed use.

The result of the trip generation process is illustrated in the following table:

Trip Generation Summary Table

ITE Land Use	AM Peak Hour			PM Peak Hour		
	Inbound	Outbound	Total Trips	Inbound	Outbound	Total Trips
220 – Apartment Building 216 Units	24	94	118	95	51	146

The appendix contains the ITE Land Use sheets used in the trip generation calculations.

Trip Distribution

Traffic generated by the development was distributed to the street system based upon discussions with the City. It is assumed that 95 percent of the ingress and egress traffic from the development would head toward and come from the south along Nixon Road. As the site traffic reaches Dhu Varren/Green 5 percent was assumed to travel to and from the west, and 30 percent was assumed to travel to and from the east. The remaining traffic would proceed south past Bluett to the Huron Parkway intersection where it would split again with 5 percent to the west, 30 percent to the south, and 25 percent to the east.

The distribution of the site generated trips are shown on Figures 5 (AM) and 6 (PM) following the text of this report.

The AM and PM peak hour trip distributions are added to the background traffic volumes to create the forecast traffic conditions. Since the construction period for Nixon Apartments is only one year, no additional background traffic growth was factored on top of those used for the summer-school season.

The projected forecast traffic volumes are show on Figures 7 (AM) and 8 (PM) following the text of this report.

Intersection Analysis

The Synchro / SimTraffic program (version 7, build 761) was utilized to model the background and forecast traffic for this traffic study. Four models were created for the AM and PM peak hours to represent the background and forecast traffic conditions.

In Synchro, each intersection is considered separately with progression factors that are applied to the calculated delays to accommodate for the influence of other nearby signalized intersections on the individual study intersections. In SimTraffic, the simulation portion of the software package, vehicles are sent through the model in real time, and travel statistics are recorded providing delays that are directly affected by storage lengths, signal timing, and intersection spacing.

Turning movements per 15-minute intervals were directly read into the traffic model during the peak hours to provide a more accurate model of traffic conditions in the area. Each scenario was run 10 times to produce an average of the delays shown in this report. Some forecast delays might be less than background conditions due to this averaging process; however this is an indication that the development traffic has minimal effect on those particular movements. In order to be compliant with the Synchro 6 version used by the City, the intersection of Nixon with Dhu Varren / Green was separated into two intersections since version 6 cannot accommodate the intersection offset. The SimTraffic results that show the delays and queues for each of the study intersections and two access driveways, and are included in the Appendix:

- Nixon and Dhu Varren
- Nixon and Green
- Nixon and Bluett
- Nixon Road and Huron Parkway
- North Site Access Driveway (Forecast Only)
- South Access Driveway (Forecast Only)

The SimTraffic results for the background traffic conditions, forecast traffic conditions, and mitigated conditions (if needed) are shown for each of the study intersections.

The table below shows the delay ranges for each level of service for signalized and unsignalized intersections. These delays are control delays which are calculated differently than the SimTraffic model. SimTraffic delays are calculated from model time minus free flow time values rather than the equations from the Highway Capacity Manual. Driver acceptance follows the same general principle of the delay ranges shown below.

Level of Service Criteria for Signalized Intersections from HCM Exhibit 16-2 in Control Delay per Vehicle (s/veh):	
LOS A	< 10
LOS B	>10 and < 20
LOS C	>20 and < 35
LOS D	>35 and < 55
LOS E	>55 and < 80
LOS F	>80

Level of Service for Signalized Intersections

Level of Service (LOS) Criteria for Unsignalized Intersections from HCM Exhibit 17-2 in Control Delay per Vehicle (sec):	
LOS A	< 10
LOS B	>10 and < 15
LOS C	>15 and < 25
LOS D	>25 and < 35
LOS E	>35 and < 50
LOS F	>50

Level of Service for Unsignalized Intersections

Intersection Analysis – Huron Parkway and Nixon Road

The intersection of Huron Parkway Street and Nixon Road is configured as a modern roundabout. As such, the Synchro and SimTraffic computer programs develop delay statistics based upon gap acceptance theory. This roundabout was designed using traffic analytical software that calculated delays based upon intersection geometry: not gap acceptance. Thus the SimTraffic output may be slightly different than that used to design the modern roundabout.

The roundabout has a single circulating lane with approach and departure flares to direct traffic on the correct path. The speed limit on Nixon Road is 30 miles per hour.

The SimTraffic model results for the intersection are below. No lane improvement changes were made to the Forecast scenario so that conditions are the same as existing, and only the additional site traffic is added to the study intersection.

SimTraffic Results - Morning Peak Hour
Intersection of Huron Parkway and Nixon Road

Background Conditions	Huron Parkway			Huron Parkway			Nixon Road			Nixon Road		
AM Peak	Eastbound			Westbound			Northbound			Southbound		
Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Volume	12	77	28	21	90	171	22	106	29	280	343	59
Delay (sec)	4.8	6.3	4.7	3.7	5.3	3.6	4.1	4.8	3.8	8.6	8.0	8.5
LOS	A	A	A	A	A	A	A	A	A	A	A	A
Queue (ft)	65'			48'			58'			154'		

Forecast Conditions	Huron Parkway			Huron Parkway			Nixon Road			Nixon Road		
AM Peak	Eastbound			Westbound			Northbound			Southbound		
Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Volume	13	77	28	21	90	178	22	113	29	303	371	64
Delay (sec)	4.1	6.4	5.2	3.8	5.3	3.8	4.0	5.0	4.2	9.2	8.6	8.7
LOS	A	A	A	A	A	A	A	A	A	A	A	A
Queue (ft)	59'			56'			62'			176'		

During the AM peak hour, all movements at the intersection of Huron Parkway and Nixon Road operate at acceptable service levels during the background conditions (without the proposed apartment development traffic). The intersection is projected to continue to operate at an acceptable level of service (LOS A for all movements) with only minor changes to delays and queue lengths during forecast traffic conditions.

SimTraffic Results - Evening Peak Hour
Intersection of Huron Parkway and Nixon Road

Background Conditions	Huron Parkway			Huron Parkway			Nixon Road			Nixon Road		
PM Peak	Eastbound			Westbound			Northbound			Southbound		
Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Volume	60	135	70	47	112	248	33	354	55	127	196	24
Delay (sec)	5.3	6.8	5.9	7.3	9.6	7.5	10.8	10.1	9.1	5.5	5.6	5.1
LOS	A	A	A	A	A	A	B	B	A	A	A	A
Queue (ft)	81'			128'			164'			82'		

Forecast Conditions	Huron Parkway			Huron Parkway			Nixon Road			Nixon Road		
PM Peak	Eastbound			Westbound			Northbound			Southbound		
Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Volume	65	135	70	47	112	272	33	382	55	140	210	27
Delay (sec)	6.7	7.5	6.4	8.9	11.2	9.1	14.6	12.4	11.1	5.6	5.7	5.5
LOS	A	A	A	A	B	A	B	B	B	A	A	A
Queue (ft)	100'			153'			223'			80'		

During the PM peak hour all movements at the intersection of Huron Parkway and Nixon Road operate at acceptable service levels during the background conditions without the proposed apartment development traffic. The intersection is projected to continue to operate at an acceptable level of service (LOS A or B for all movements) with only minor changes to delays.

The development’s largest impact will be southbound in the morning and northbound in the afternoon peak hour, but will not significantly impact the traffic conditions at the intersection of Nixon Road and Huron Parkway. No road improvements will be needed at this intersection.

Intersection Analysis – Nixon Road and Bluett Drive

The intersection of Nixon Road with Bluett Drive/Meade Court is configured as a two-way stop, with Bluett Drive/Meade Court stopping for Nixon Road traffic. The speed limit on Nixon Road is 30 miles per hour through the intersection. The southbound Nixon Road approach to Bluett Drive includes a left-turn only lane; otherwise each approach is a single shared left-through-right lane.

Meade Court serves a small apartment development on the west side of Nixon and Bluett Drive serves the residential neighborhood to the east and does not directly connect to Green Road to the east. Traffic on Bluett Drive could reach Plymouth Road via Georgetown Boulevard, however since that intersection is unsignalized; it is highly unlikely that any of the proposed development traffic would ever turn from Nixon Road to use that route and so all development traffic is only added to northbound and southbound Nixon Road through traffic volumes.

SimTraffic Results - Morning Peak Hour Intersection of Bluett and Nixon Road

Background Conditions	Meade Court			Bluett Drive			Nixon Road			Nixon Road					
	Eastbound			Westbound			Northbound			Southbound					
Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right			
Volume	2	0	18	51	1	13	0	271	18	10	564	0			
Delay (sec)	12.0	0.0	6.2	9.1	9.0	4.3	0.0	0.9	0.7	5.3	2.9	0			
LOS	B	A	A	A	A	A	A	A	A	A	A	A			
Queue (ft)		41'			55'			7'			14'			8'	

Forecast Conditions	Meade Court			Bluett Drive			Nixon Road			Nixon Road					
	Eastbound			Westbound			Northbound			Southbound					
Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right			
Volume	2	0	18	51	1	13	0	286	18	10	620	0			
Delay (sec)	11.4	0.0	6.0	9.9	10.4	4.1	0.0	0.9	0.8	5.7	2.8	0.0			
LOS	B	A	A	A	B	A	A	A	A	A	A	A			
Queue (ft)		39'			58'			7'			14'			14'	

During the morning peak hour, all turning movements operate at an acceptable level of service A or B. Development traffic adds little to no delay to the intersection.

**SimTraffic Results - Evening Peak Hour
Intersection of Bluett and Nixon Road**

Background Conditions	Private Drive			Bluett			Nixon Road			Nixon Road		
PM Peak Movement	Eastbound			Westbound			Northbound			Southbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Volume	5	1	10	35	1	18	19	598	63	14	287	1
Delay (sec)	8.9	6.2	4.9	11.2	7.4	6.0	5.4	3.0	2.4	6.3	2.0	2.0
LOS	A	A	A	B	A	A	A	A	A	A	A	A
Queue (ft)		39'			57'			43'			7'	0'

Forecast Conditions	Private Drive			Bluett			Nixon Road			Nixon Road		
PM Peak Movement	Eastbound			Westbound			Northbound			Southbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Volume	5	1	10	35	1	18	19	656	63	14	317	1
Delay (sec)	8.5	7.5	4.3	23.5	7.7	26.6	12.2	8.5	9.6	7.5	1.9	1.7
LOS	A	A	A	C	A	D	B	A	A	A	A	A
Queue (ft)		32'			87'			275'			29'	5'

During forecast afternoon peak hour, with no road improvements to the intersection of Nixon and Dhu Varren / Green, traffic on Nixon Road would occasionally back up all the way past the intersection of Bluett Drive. This backup is the primary reason behind the significant increase in westbound and northbound traffic delays.

If the intersection of Nixon Road and Dhu Varen / Green is properly mitigated, delays would be much closer to those that would be seen during background traffic conditions.

Mitigated Conditions	Private Drive			Bluett			Nixon Road			Nixon Road		
PM Peak Movement	Eastbound			Westbound			Northbound			Southbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Volume	5	1	10	35	1	18	19	656	63	14	317	1
Delay (sec)	11.3	10.9	4.7	14.2	13.2	7.1	5.0	3.3	3.0	6.9	1.8	2.4
LOS	B	B	A	B	B	A	A	A	A	A	A	A
Queue (ft)		40'			60'			37'			29'	4'

The mitigated forecast conditions at Nixon and Bluett during the evening peak hour operates an acceptable level of service, A or B. No road improvements would be necessary at the intersection of Nixon Road and Bluett Drive.

Intersection Analysis – Nixon Road and Dhu Varren / Green

The offset intersection of Nixon Road and Dhu Varren / Green is broken into two distinct intersections so that it can be analyzed in version 6 of the Synchro / SimTraffic modeling software. The intersection of Nixon with Dhu Varren is approximately 90' north of the intersection of Nixon with Green Road. In practice, this is a four-way stop controlled intersection. Left-turning northbound and southbound Nixon Road traffic is given the right of way (in theory) after the stop sign. In reality however, through traffic occasionally proceeds through the intersection between the gaps caused by the intersection spacing, causing additional delays for the north and southbound lefts.

Nixon and Dhu Varren

SimTraffic Results - Morning Peak Hour Intersection of Nixon Road and Dhu Varren

Background Conditions AM Peak	Dhu Varren Eastbound		Nixon Road Northbound		Nixon Road Southbound	
	Left	Right	Left	Thru	Thru	Right
Movement						
Volume	12	318	150	90	422	34
Delay (sec)	17.5	13.8	0.8	0.6	52.3	46.1
LOS	C	B	A	A	F	D
Queue (ft)	163'		45'		616'	

SimTraffic Results - Morning Peak Hour Intersection of Nixon Road and Dhu Varren

Forecast Conditions AM Peak	Dhu Varren Eastbound		Nixon Road Northbound		Nixon Road Southbound	
	Left	Right	Left	Thru	Thru	Right
Movement						
Volume	13	318	150	112	506	39
Delay (sec)	21.2	16.7	0.8	0.6	185.1	202.2
LOS	C	C	A	A	F	F
Queue (ft)	174'		45'		1573'	

SimTraffic Results - Evening Peak Hour Intersection of Nixon Road and Dhu Varren

Background Conditions PM Peak	Dhu Varren Eastbound		Nixon Road Northbound		Nixon Road Southbound	
	Left	Right	Left	Thru	Thru	Right
Movement						
Volume	18	215	334	444	149	18
Delay (sec)	11.8	6.0	1.4	1.8	11.3	6.0
LOS	B	A	A	A	B	A
Queue (ft)	88'		54'		82'	

SimTraffic Results - Evening Peak Hour Intersection of Nixon Road and Dhu Varren

Forecast Conditions PM Peak	Dhu Varren Eastbound		Nixon Road Northbound		Nixon Road Southbound	
	Left	Right	Left	Thru	Thru	Right
Movement						
Volume	23	215	334	530	195	21
Delay (sec)	11.9	6.4	1.4	1.9	11.9	7.4
LOS	B	A	A	A	B	A
Queue (ft)	93'		56'		101'	

Nixon Road and Green Road

SimTraffic Results - Morning Peak Hour Intersection of Nixon Road and Green Road

Background Conditions AM Peak Movement	Green Road Westbound		Nixon Road Northbound		Nixon Road Southbound	
	Left	Right	Thru	Right	Left	Thru
Volume	76	127	142	42	353	386
Delay (sec)	15.6	4.9	10.2	9.0	1.4	2.2
LOS	C	A	B	A	A	A
Queue (ft)	68'	62'	89'		61'	

SimTraffic Results - Morning Peak Hour Intersection of Nixon Road and Green Road

Forecast Conditions AM Peak Movement	Green Road Westbound		Nixon Road Northbound		Nixon Road Southbound	
	Left	Right	Thru	Left	Right	Thru
Volume	76	134	157	42	381	442
Delay (sec)	16.7	5.0	12.0	10.2	1.5	2.3
LOS	C	A	B	B	A	A
Queue (ft)	68'	62'	111'		61'	

SimTraffic Results - Evening Peak Hour Intersection of Nixon Road and Green Road

Background Conditions PM Peak Movement	Green Road Westbound		Nixon Road Northbound		Nixon Road Southbound	
	Left	Right	Thru	Right	Left	Thru
Volume	57	358	471	88	148	216
Delay (sec)	23.3	34.5	139.2	152.0	0.9	0.7
LOS	C	D	F	F	A	A
Queue (ft)	148'	385'	1667'		52'	

SimTraffic Results - Evening Peak Hour Intersection of Nixon Road and Green Road

Forecast Conditions PM Peak Movement	Green Road Westbound		Nixon Road Northbound		Nixon Road Southbound	
	Left	Right	Thru	Left	Right	Thru
Volume	57	386	528	88	163	246
Delay (sec)	24.8	33.5	247.5	271.5	0.9	0.7
LOS	C	D	F	F	A	A
Queue (ft)	152'	392'	2519'		52'	

The offset intersection of Nixon Road with Dhu Varren and Green Roads currently operates poorly (LOS F) southbound in the morning peak hour and poorly northbound (LOS F) in the afternoon peak hour. Any additional traffic from any source further exacerbates the congestion already experienced at this intersection.

If the intersection is realigned, separate left-turn lanes are provided on all four approaches to the intersection and a traffic signal is installed at the intersection, an acceptable level of service can be achieved.

The following tables show the model results with the applied mitigation for the background and forecast traffic conditions.

SimTraffic Results - Morning Peak Hour
Intersection of Dhu Varren/Green and Nixon Road

Mitigated Background	Dhu Varren			Green			Nixon Road			Nixon Road		
AM Peak	Eastbound			Westbound			Northbound			Southbound		
Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Volume	12	191	126	76	103	23	48	95	42	164	258	34
Delay (sec)	17.3	11.9	6.2	20.6	9.5	3.8	17.0	6.1	4.1	13.9	11.2	6.3
LOS	B	B	A	C	A	A	B	A	A	B	B	A
Queue (ft)	23'	118'		66'	70'		57'	71'		99'	131'	

Mitigated Forecast	Dhu Varren			Green			Nixon Road			Nixon Road		
AM Peak	Eastbound			Westbound			Northbound			Southbound		
Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Volume	13	191	126	76	103	30	48	110	42	192	315	39
Delay (sec)	19.2	13.8	8.5	23.7	10.9	5.3	19.2	6.9	5.0	15.2	11.8	7.4
LOS	B	B	A	C	B	A	B	A	A	B	B	A
Queue (ft)	27'	144'		74'	74'		54'	79'		115'	165'	

SimTraffic Results - Evening Peak Hour
Intersection of Dhu Varren/Green and Nixon Road

Mitigated Background	Dhu Varren			Green			Nixon Road			Nixon Road		
PM Peak	Eastbound			Westbound			Northbound			Southbound		
Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Volume	18	100	114	57	180	178	15	317	88	48	101	18
Delay (sec)	20.9	11.9	4.4	18.3	14.5	8.9	14.7	10.7	8.1	19.0	9.8	4.7
LOS	C	B	A	B	B	A	B	B	A	B	A	A
Queue (ft)	29'	90'		63'	165'		101'	172'		55'	79'	

Mitigated Forecast	Dhu Varren			Green			Nixon Road			Nixon Road		
PM Peak	Eastbound			Westbound			Northbound			Southbound		
Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Volume	23	100	114	57	180	206	154	374	88	63	134	21
Delay (sec)	23.7	12.2	4.8	18.7	15.7	10.6	17.1	11.9	9.1	22.9	9.8	5.2
LOS	C	B	A	B	B	B	B	B	A	C	A	A
Queue (ft)	33'	87'		59'	190'		105'	197'		67'	88'	

The additional left-turn lanes, realignment, and traffic signal improvements would allow the intersection of Nixon Road with Dhu Varren / Green to operate within acceptable levels C or better for both the background and forecast traffic conditions.

Intersection Analysis – Site Driveways

The Nixon Apartments development site includes two (2) driveway approaches. Both are controlled by stop signs for the driveway approach to Nixon Road. The following tables show the traffic analysis for the driveways assuming that mitigation at the Nixon Road and Dhu Varren / Green intersection have been implemented. Both driveways will operate at acceptable service levels (A) during all traffic conditions.

According to the guidelines within the MDOT Traffic and Safety Note 603A, and given the preponderance (95%) of site generated traffic is projected to come from and go to the south along Nixon Road, there would be no need to provide a center-left or left-turn passing lane flare at either of the site driveways to accommodate those few peak hour turns (3 southbound lefts at the north driveway and 2 southbound lefts at the south driveway).

However, according to guidelines within the MDOT Traffic and Safety Note 604A, and given the number of northbound right-turns (44 and 45), and the total northbound approach volumes during the evening peak hour, right-turn tapers are recommended for both site driveways. A copy of the MDOT Traffic and Safety notes are included in the Appendix.

North Site Driveway

SimTraffic Results - Morning Peak Hour
Intersection of Nixon Road and the North Site Driveway

Forecast Conditions	North Driveway		Nixon Road		Nixon Road	
	Westbound		Northbound		Southbound	
Movement	Left	Right	Thru	Right	Left	Thru
Volume	44	3	103	11	1	456
Delay (sec)	6.9	3.0	0.3	0.1	3.0	0.9
LOS	A	A	A	A	A	A
Queue (ft)	53'		0'		0'	

SimTraffic Results - Evening Peak Hour
Intersection of Nixon Road and the North Site Driveway

Forecast Conditions	North Driveway		Nixon Road		Nixon Road	
	Westbound		Northbound		Southbound	
Movement	Left	Right	Thru	Right	Left	Thru
Volume	24	2	463	45	3	167
Delay (sec)	7.0	5.8	0.9	0.2	2.2	0.4
LOS	A	A	A	A	A	A
Queue (ft)	44'		0'		7'	

South Site Driveway

SimTraffic Results - Morning Peak Hour Intersection of Nixon Road and the South Site Driveway

Forecast Conditions	South Driveway		Nixon Road		Nixon Road	
	Westbound		Northbound		Southbound	
Movement	Left	Right	Thru	Right	Left	Thru
Volume	45	2	113	12	0	500
Delay (sec)	7.0	2.8	2.0	1.5	0.0	0.3
LOS	A	A	A	A	A	A
Queue (ft)	49'		0'		0'	

SimTraffic Results - Evening Peak Hour Intersection of Nixon Road and the South Site Driveway

Forecast Conditions	South Driveway		Nixon Road		Nixon Road	
	Westbound		Northbound		Southbound	
Movement	Left	Right	Thru	Right	Left	Thru
Volume	24	1	507	45	2	189
Delay (sec)	7.4	0.0	3.2	2.5	3.6	0.2
LOS	A	A	A	A	A	A
Queue (ft)	41'		0'		13'	

Crash Analysis

A crash diagram has been prepared for the four study intersections of Nixon Road with Dhu Varren, Green, Bluett, and Huron Parkway. These diagrams included data from TIA (Traffic Improvement Association of Michigan) and they show the crash type, ID number, and approximate location and direction for the time frame between 1/1/2010 and 1/1/2013. The accident diagrams are included in the appendix.

The SEMCOG (Southeast Michigan Council of Governments) website contains intersection crash data statistics such as Average Accidents per Year and the intersection's accident ranking. The table below shows the available information on the study intersections.

SEMCOG Crash Data Table 2008-2012

N/S	E/W	Average Crashes per Year 2008-2012	Crash Ranking 2008-2012
Nixon Road	Dhu Varren	2	339
Nixon Road	Green Road	2	315
Nixon Road	Bluett	n/a	n/a
Nixon Road	Huron Parkway	1	433

Summary of Findings and Recommendations

The intersection of Nixon Road and Dhu Varren / Green currently experiences congestion as it is currently configured as a four-way stop offset intersection. Forecasted traffic generated by the proposed Woodbury Club development would result in continued poor levels of service at this intersection. If the intersection is re-aligned, a left-turn lane provided on all four of the approaches to the intersection, and traffic signal control is implemented; the intersection would operate at an acceptable level of service C or better both with and without the proposed development.

The improvements would also reduce queuing along Nixon Road that would otherwise backup past the Bluett Drive intersection to the south of Green Road.

Once this mitigation strategy is implemented at Dhu Varren / Green, the proposed apartments would have no significant impact to the intersections of Nixon Road with Bluett Drive and with Huron Parkway.

The guidelines contained in the MDOT Traffic and Safety Note 604A recommend a right-turn taper be installed at both driveways to the Apartment development due to the traffic volumes projected for the PM peak hour.

Left-turn passing flares would not be recommended according to the criteria within MDOT Traffic and Safety Note 603A.

Appendix

Appendix Contents

Volume Figures

Existing Morning Peak Hour Volume - Figure 1
Existing Evening Peak Hour Volume - Figure 2
Background Morning Peak Hour Volume - Figure 3
Background Evening Peak Hour Volume - Figure 4
Generated Morning Peak Hour Traffic Volumes – Figure 5
Generated Evening Peak Hour Traffic Volumes – Figure 6
Forecast Morning Peak Hour Traffic Volumes – Figure 7
Forecast Evening Peak Hour Traffic Volumes – Figure 8

Traffic Count Data

Nixon Road & Dhu Varren / Green
Nixon Road & Bluett / Meade
Nixon Road & Huron Parkway

ITE Trip Generation

Apartments - Site Code 220 – 24-Hour Volumes
Apartments - Site Code 220 – AM Peak Hour Volumes
Apartments - Site Code 220 – PM Peak Hour Volumes

SimTraffic Results

Background AM Peak Hour Conditions
Background PM Peak Hour Conditions
Forecast AM Peak Hour Conditions
Forecast PM Peak Hour Conditions

MDOT Traffic and Safety Notes

603A – Left Turn Passing
604B – Right Turn Tapers & Lanes

Crash Diagrams & SEMCOG Summary Table

Nixon & Dhu Varren
Nixon & Green
Nixon & Bluett
Nixon & Huron Parkway
SEMCOG Table