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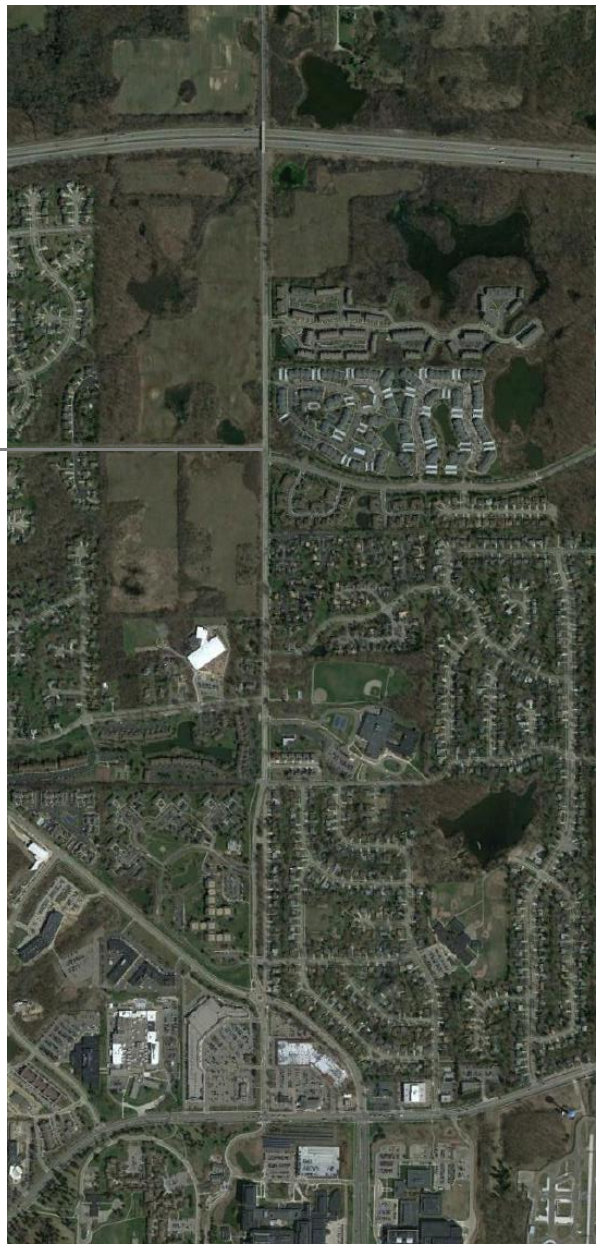

Nixon Road Corridor Study

City of Ann Arbor, Michigan

May 2017

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EXECUTIVE SUMMARY

This corridor study focuses on the portion of Nixon Road between Barclay Way and Huron Parkway in northeast Ann Arbor, as well as the intersections of Plymouth Road at Huron Parkway and Plymouth Road at Nixon Road. The surrounding land-use north of Huron Parkway is primarily residential with detached single-family dwellings, attached row houses and apartments, while commercial properties dominate south of Huron Parkway. Previous traffic studies determined the need to construct a roundabout at the intersection of Nixon Road at Green Road/Dhu Varren Road due to various planned developments in the immediate vicinity. Resident feedback gained from public outreach efforts determined the need to extend the scope of improvements along the greater corridor with a responsibility to serve motorists and non-motorized travelers alike. The primary key focus areas on Nixon Road as determined from three public meetings held by OHM are as follows:

- Non-Motorized transportation
    1. Unsafe intersections and mid-block crossings
    2. Lack of bus stops
    3. Disconnected non-motorized network
- Motorized vehicles
    1. Unacceptable levels of delay and safety at the intersection of Nixon Road and Green Road/Dhu Varren Road presently operating under all-way STOP-control
    2. Inadequate access to Nixon Road from minor side-street approaches

Existing pedestrian, bicycle and traffic data was obtained at 10 key intersections within the study area on two different occasions in early-to-mid 2016. The vehicle traffic data was forecasted out to the build year of the roundabout at Nixon Road and Green Road/Dhu Varren Road (2017) as well as the 2035 horizon year. Traffic forecasts include generated trips from the aforementioned planned developments.

A crash analysis was performed for the three-year period from January 1, 2013 to December 31, 2015. In total, 149 collisions occurred during the analysis period within the study area. No fatal or incapacitating (A-level) injury crashes were recorded and four crashes involved a bicyclist or pedestrian. The observed crash rate exceeded a regional norm called the spot critical crash rate at the intersections of Plymouth Road at Huron Parkway, Plymouth Road at Nixon Road, Nixon Road at Huron Parkway, and Nixon Road at Green Road/Dhu Varren Road.

Both non-motorized and motorized level of service (LOS) were evaluated against at least three alternative improvement options. The non-motorized evaluation focused on the perception of roadway or nearby roadside attributes as they relate to quality of service, rather than a pure analysis of capacity. The Florida Department of Transportation's Multimodal Quality/Level of Service (Q/LOS) model best fit this type of analysis and was thus utilized in the present study. For vehicle operations, traffic microsimulation software PTV VISSIM 9 was used due to its industry recognized ability to model complex weaving and merging behaviors (as at a roundabout), enhanced flexibility and detailed user-control compared to other traffic simulation packages, as well as the ability to model multi-modal interactions.

The three alternatives under analysis included 1) “Minor Work”, 2) “Continuous Three Lane Section”, and 3) “String of Roundabouts at Key Intersections”. The evaluation determined that Alternatives Two and Three improve vehicle operations compared to the Do Nothing choice. Alternative Three outperforms Alternative Two in the AM peak period as a result of improved minor-street access while Alternative Two outperforms Alternative Three in the PM due to better northbound throughput. Alternative Two generally improves travel time on the Nixon Road corridor, particularly in the southbound direction in the PM due to a reduction in queue length at the roundabout at Nixon Road and Huron Parkway. Alternative Three tends to increase corridor travel time due to the traffic calming effect of vehicles needing to slow and possibly wait at roundabouts. VISSIM analysis also indicated that a bypass lane may be required at the proposed roundabout at Nixon Road at Green Road/Dhu Varren Road in the eastbound and westbound directions by 2035. The proposed roundabout was designed to be able to seamlessly incorporate the bypass lanes if needed in the future.

The operations analysis concluded that Alternative Three, the roundabout corridor option, best suits the community’s needs and concerns with respect to both non-motorized and motorized travel modes. Improved non-motorized LOS is accomplished by connecting gaps in the network, increasing buffer distances between pedestrians/cyclists and motor vehicles, and adding or enhancing numerous pedestrian crossings. Motor vehicle safety is improved by constructing roundabouts at five key intersections and thus reducing the number and potential severity of conflict points between turning maneuvers. Additionally, average vehicle delay at minor side-street approaches is reduced due to gap creation resulting from vehicles navigating the roundabouts.

CORRIDOR STUDY

1. INTRODUCTION

The City of Ann Arbor commissioned a study to explore improvement options for the intersection of Nixon Road at Dhu Varren and Green Roads. Conducted by Opus International, the report evaluated a series of alternatives, and the City subsequently decided on a roundabout as the preferred option.

When the study alternatives were presented to the area residents in a meeting held in December 2014, it became evident that many thought that a broader review of the entire Nixon Road corridor was needed. From the dialog noted in the public meeting, there were a variety of issues and concerns held by the area residents.

For example, there appeared to be safety concerns related to a special subset of pedestrians and bicyclists – the students attending Logan Elementary School and Clague Middle School.

Another set of concerns voiced involved the increasing difficulty of residents commuting to work leaving their neighborhood by way of Argonne Drive at Nixon Road. The relative lack of gaps is compounded by the limited sight distance to southbound traffic due to a crest vertical curve north of this intersection.

Figure 1: Study Area

It is abundantly clear that the City residents want potential improvements along the corridor to further the City's policy goal of 'complete streets'; multi-modal facilities to allow and encourage non-vehicle mobility for the area residents. However, this does not mean that vehicle-related problems are to be ignored, but rather that they be balanced with the concerns for other users.

2. EXISTING CONDITIONS

Physical Features

The transportation network in northeast Ann Arbor is dominated by the US-23 freeway and the principal arterial of Plymouth Road. Nixon Road, the subject of this corridor study, is a north/south orientated collector road beginning at Plymouth Road and extending northwards past the city's corporate limits up to Pontiac Trail Road in Ann Arbor Township. Green Road, Dhu Varren Road and Huron Parkway are other collector roads serving the study area.

There are various commercial and office properties along Plymouth Road, but the majority of northeast Ann Arbor is residential. There is a mix of detached single family dwellings, attached row houses and apartments. The area is served by three public schools: Logan Elementary, Thurston Elementary and Clague Middle. The land is gently rolling, and generally falls to the south towards the Huron River.

Nixon Road has one travel lane in each direction, with sporadic turn lanes at select locations. The posted speed limit is 30 mph. The entire corridor is marked as a no passing zone. There is a crest vertical curve located north of Argonne Drive that limits intersection sight distance for Argonne looking to the north and Westbury looking to the south. Portions of Nixon Road have paved shoulders that are marked and function as on-street bike lanes. The primary gap in bike facilities is between Aurora Drive and Bluett Drive, due to a lack of paved shoulder. There is a continuous pedestrian sidewalk along the east side of Nixon Road, but the west side has gaps. The missing sidewalk piece is from Traver Boulevard northwards to the City limit. The Nixon Farms residential developments and the planned roundabout improvement at Green/Dhu Varren Roads will result in some of the west-side sidewalk deficiencies being met, but there will still be a gap.

Beyond the sidewalk gaps directly along Nixon Rd, there are also gaps that, if filled, would tie the pedestrian network together with the neighboring streets. The prominent piece missing is the north side of Traver Blvd from Nixon to the Logan Elementary School. There are also three private streets, Mead, Westbury and Haverhill, that do not have sidewalks and so constitute breaks in the pedestrian facility system.

Pedestrian and Bicycle Volumes

Data collection for pedestrian and bicycle volumes was done by way of video recording by Traffic Data Collection, Inc. using MioVision cameras. These users were surveyed twice for this study, at seven locations in the study area. They were:

- Nixon Road at Dhu Varren/Green Roads
- Nixon Road at Traver Boulevard
- Nixon Road at Bluett Drive/Meade Court
- Nixon Road at Aurora Street/Sandalwood Circle
- Nixon Road at Huron Parkway
- Nixon Road at Plymouth Road
- Huron Parkway at Plymouth Road

The first instance was on Tuesday, February 23, 2016. The data collection was done for an entire 24-hour period this day. Both the Ann Arbor Public Schools and University of

Michigan were in session that day. While the day was clear and dry with high temperatures in the 40's, it was anticipated that pedestrian and bicycle usage would be limited due to the winter season. Therefore, a second set of data was collected at the same locations on Tuesday, May 24, 2016. Ann Arbor Public Schools were in session during this count and the University of Michigan was in session for the Spring/Summer Term. The second data collection interval was just 12 hours, from 7:30 a.m. to 7:30 p.m. This day was also clear and dry, with high temperatures in the 80's.

Table 1: Summary of Pedestrian and Bicycle Data 5/24/2016

Locations	Pedestrians		Bicycles On Road		Bicycles In Crossings	
	Peak Volume (Time)	12-Hr. Volume	Peak Volume (Time)	12-Hr. Volume	Peak Volume (Time)	12-Hr. Volume
Nixon at Dhu Varren/Green	22 (6:00-7:00 p.m.)	182	7 (4:00 -5:00 p.m.)	32	11 (6:00-7:00 p.m.)	43
Nixon at Traver	32 (6:30-7:30 p.m.)	152	9 (5:00-6:00 p.m.)	46	9 (5:45-6:45 p.m.)	36
Nixon at Bluett / Meade	75 (9:45-10:45 a.m.)	476	9 (6:30-7:30 p.m.)	40	16 (5:30-6:30 p.m.)	67
Nixon at Aurora / Sandalwood	71 (3:45-4:45 p.m.)	365	9 (6:30-7:30 p.m.)	23	10 (3:15-4:15 p.m.)	47
Nixon at Huron	88 (6:30-7:30 p.m.)	674	12 (4:45-5:45 p.m.)	29	21 (6:30-7:30 p.m.)	149
Nixon at Plymouth	72 (11:30 a.m. – 12:30 p.m.)	524	5 (4:30-5:30 p.m.)	26	23 (3:15-4:15 p.m.)	115
Huron at Plymouth	70 (12:30-1:30 p.m.)	355	5 (1:30-2:30 p.m.)	21	24 (5:30-6:30 p.m.)	154

The data was classified in three categories: pedestrians, bicycles on the road, and bicycles using the crosswalk/sidewalk. The 12-hour data is summarized in Table 1, and the complete data can be found in Appendix A.

Vehicle Volumes

Motorized vehicle volumes were also collected by video recording, concurrent with the data capture for pedestrians and bicyclists. While the entire 24-hour period of Feb. 23rd was recorded, only the peak a.m. and p.m. periods were summarized in the format of turning movement counts at the study intersections. This format of data is the key to operational analysis for vehicles. Since the February volume data was used for evaluating operations in the study corridor and to validate the design assumption for developing roundabout plans for the intersection of Nixon Road at Dhu Varren/Green Roads, summarizing vehicle data from the May 24th video logs was not deemed necessary.

The average daily traffic (ADT) of Nixon Road ranged from 4,576 vehicles north of Green Road to 8,658 vehicles at the intersection with Plymouth Road. The morning peak occurs between 7:45 a.m. and 8:45 a.m., and the afternoon peak occurs between 4:45 p.m. and 5:45 p.m. The afternoon peak associated with school dismissal times was reviewed due to the presence of Logan Elementary School on Traver Boulevard and Clague Middle School;

however, the volumes associated with school dismissal were not indicative of the corridor-wide PM peak.

The vehicle data was classified in four categories: cars, busses, single-unit trucks and articulated trucks. The total peak hour turning movement data is summarized in the following table, and the complete data can be found in Appendix B.

Table 2: Existing Turning Volumes for 2/23/2016

A.M. Peak	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Nixon at Barclays	-	-	-	93	-	7	-	81	19	2	306	-
Nixon at Dhu Varren/Green	13	149	148	87	62	26	59	61	47	131	256	12
Nixon at Haverhill	-	-	-	15	-	3	-	164	3	1	491	-
Nixon at Traver	46	-	130	-	-	-	125	176	-	-	435	83
Nixon at Clague	-	-	-	33	-	72	-	221	73	87	470	-
Nixon at Meade/Bluett	2	1	16	112	0	23	3	273	40	26	477	0
Nixon at Sandalwood/Aurora	1	0	30	33	0	2	22	303	17	10	608	2
Nixon at Huron Pkwy	6	69	29	24	48	222	12	119	33	285	343	46
Nixon at Plymouth	83	610	104	44	654	88	10	9	5	125	78	157
Huron Pkwy at Plymouth	2	572	132	359	730	108	145	185	152	118	289	14

P.M. Peak	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Nixon at Barclays	-	-	-	46	-	2	-	341	92	4	93	-
Nixon at Dhu Varren/Green	21	85	98	53	159	158	127	254	92	39	84	16
Nixon at Haverhill	-	-	-	7	-	1	-	472	11	6	235	-
Nixon at Traver	28	-	64	-	-	-	84	501	-	-	204	39
Nixon at Clague	-	-	-	34	-	26	-	563	13	12	256	-
Nixon at Meade/Bluett	1	1	3	46	1	18	15	559	77	23	269	1
Nixon at Sandalwood/Aurora	0	0	41	30	1	20	28	644	43	9	320	3
Nixon at Huron Pkwy	71	68	40	58	71	280	25	362	61	126	239	26
Nixon at Plymouth	181	745	15	11	915	112	96	64	38	218	26	158
Huron Pkwy at Plymouth	6	820	177	186	912	115	207	296	283	119	158	17

3. NON-MOTORIZED AND TRAFFIC FORECASTS

As demonstrated by the low volumes of pedestrians and bicycles shown in Table 1, this area of Ann Arbor does not have much by way of intensity of pedestrian or bicycle usage. As such, only the absence of appropriate facilities would limit the future growth of these classes of users. Even a substantial increase would not represent a quantitative approach to the capacity of sidewalks or on-street bike lanes within the corridor. Therefore, we did not attempt to project an increase to pedestrians or cyclists out to the horizon year of 2035. Rather, as will be explained in a subsequent section of the study, these user needs were considered in a qualitative manner.

By contrast, vehicle traffic in the corridor already is problematic for some locations. In order to analyze future impacts, vehicle traffic data was projected to 2035. This involved assuming an overall growth rate, as well as factoring in the anticipated traffic from several specific developments currently being evaluated. The developments are:

- Nixon Farms (North and South) – 473 units of Luxury Condominium/ Townhouse (ITE Land Use Code 233).
- Westbury Club – 216 units of Apartment Building (Code 220).
- North Sky – 149 units of Single-Family Detached Housing (Code 210)
- Barton Green – 224 units of Residential Condominium/Townhouse (Code 230)
- Brewer – 420 units of Single-Family Detached Housing (Code 210)

Traffic growth rates were based on WATS projections, which consider local and regional factors such as population, household, and employment. The WATS annual growth projections within the study area ranged from just under 0.2% south of Green Road to just over 0.6% north of Green Road. These growth projections were compared with growth factors used in previous corridor and traffic impact studies completed by Opus, Midwestern Consulting and Traffic Engineering Consultants. In order to account for the general impacts of traffic growth, a growth factor of 0.7% per year was used, compounded to the projected year of 2035. The selected growth rate is in line with the WATS recommendations and is the same order of magnitude used in previous studies.

In addition to the background growth, traffic generated by individual developments near the study area is anticipated. These include the Nixon Farms and Woodbury developments proposed along Nixon Road. In addition to these approved developments, the Opus study included three additional potential developments located further west.

Table 3: Background Growth Adjusted Turning Volumes

AM Peak	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Nixon at Barclays	-	-	-	107	-	8	-	93	22	2	352	-
Nixon at Dhu Varren/Green	15	171	170	100	71	30	68	70	54	151	294	14
Nixon at Haverhill	-	-	-	17	-	3	-	189	3	1	565	0
Nixon at Traver	53	-	149	-	-	-	144	202	-	-	500	95
Nixon at Clague	-	-	-	38	-	83	-	254	84	100	540	-
Nixon at Meade/Bluett	2	1	18	129	0	26	3	314	46	30	548	0
Nixon at Sandalwood/Aurora	1	0	34	38	0	2	25	348	20	11	699	2
Nixon at Huron Pkwy	7	79	33	28	55	255	14	137	38	328	394	53
Nixon at Plymouth	95	701	120	51	752	101	11	10	6	144	90	181
Huron Pkwy at Plymouth	2	658	152	413	839	124	167	213	175	136	332	16
PM Peak	**EB**			**WB**			**NB**			**SB**		
	L	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**
Nixon at Barclays	-	-	-	53	-	2	-	392	106	5	107	-
Nixon at Dhu Varren/Green	24	98	113	61	183	182	146	292	106	45	97	18
Nixon at Haverhill	-	-	-	8	-	1	-	543	13	7	270	-
Nixon at Traver	32	-	74	-	-	-	97	576	-	-	235	45
Nixon at Clague	-	-	-	39	-	30	-	647	15	14	294	-
Nixon at Meade/Bluett	1	1	3	53	1	21	17	643	89	26	309	1
Nixon at Sandalwood/Aurora	0	0	47	34	1	23	32	740	49	10	368	3
Nixon at Huron Pkwy	82	78	46	67	82	322	29	416	70	145	275	30
Nixon at Plymouth	208	857	17	13	1052	129	110	74	44	251	30	182
Huron Pkwy at Plymouth	7	943	203	214	1049	132	238	340	325	137	182	20

Nixon Farms

A Traffic Impact Study for the proposed Nixon Farms property was completed in 2014 by Traffic Engineering Consultants. In accordance with standard industry practice, the study used the ITE Trip Generation Manual with the 9th edition data set to generate traffic. Trips were generated using the Luxury Condominium/ Townhouse land use (233). This land use generates a higher number of trips during the peak hours than the more common Residential Condominium/ Townhouse land use (230). The Impact Study anticipates the proposed development will generate 265 trips during the AM Peak Hour and 260 trips during the PM Peak Hour. Trips were distributed using existing traffic patterns.

Table 4: Nixon Farms Generated Traffic Volumes

AM Peak	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Nixon at Barclays	7	0	61	0	0	0	18	13	0	0	4	2
Nixon at Dhu Varren/Green	9	17	37	5	5	5	20	17	17	17	36	12
Nixon at Haverhill	34	0	34	0	0	0	11	20	0	0	68	10
Nixon at Traver	0	-	0	-	-	-	0	31	-	-	102	0
Nixon at Clague	-	-	-	0	-	0	-	31	0	0	102	-
Nixon at Meade/Bluett	0	0	0	0	0	3	0	28	0	6	96	0
Nixon at Sandalwood/Aurora	0	0	0	0	0	0	0	28	0	0	96	0
Nixon at Huron Pkwy	2	0	0	0	0	14	0	12	0	44	45	7
Nixon at Plymouth	10	0	0	0	0	0	0	2	0	0	12	33
Huron Pkwy at Plymouth	0	0	0	0	0	6	0	8	0	21	23	0
PM Peak	**EB**			**WB**			**NB**			**SB**		
	L	T	R	L	T	R	L	T	R	L	T	R
Nixon at Barclays	3	0	28	0	0	0	49	7	0	0	10	6
Nixon at Dhu Varren/Green	15	10	23	16	17	16	28	25	10	9	18	11
Nixon at Haverhill	19	0	13	0	0	0	22	44	0	0	25	32
Nixon at Traver	0	-	0	-	-	-	0	66	-	-	38	0
Nixon at Clague	-	-	-	0	-	0	-	66	0	0	38	-
Nixon at Meade/Bluett	0	0	0	0	0	2	0	64	0	2	36	0
Nixon at Sandalwood/Aurora	0	0	0	0	0	0	0	64	0	0	36	0
Nixon at Huron Pkwy	7	0	0	0	0	25	0	32	0	13	21	2
Nixon at Plymouth	25	0	0	0	0	0	0	7	0	0	2	19
Huron Pkwy at Plymouth	0	0	0	0	0	8	0	17	0	7	6	0

Woodbury Club

A Traffic Impact Study for the proposed Woodbury Club property was completed in 2014 by Midwestern Consulting. In accordance with standard industry practice, the study used the ITE Trip Generation Manual with the 9th edition data set to generate traffic. Trips were generated using the Apartment Building land use (216). The Impact Study anticipates the proposed development will generate 118 trips during the AM Peak Hour and 146 trips during the PM Peak Hour. Trips were distributed using existing traffic patterns.

Table 5: Woodbury Club Generated Traffic Volumes

AM Peak	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Nixon at Barclays	0	0	0	0	0	0	0	23	0	0	84	0
Nixon at Dhu Varren/Green	1	0	0	0	0	7	0	15	0	28	56	5
Nixon at Haverhill	0	0	0	0	0	0	0	15	0	0	56	0
Nixon at Traver	0	0	0	-	-	-	0	15	-	-	56	0
Nixon at Clague	-	-	-	0	0	0	-	15	0	0	56	-
Nixon at Meade/Bluett	0	0	0	0	0	0	0	15	0	0	56	0
Nixon at Sandalwood/Aurora	0	0	0	0	0	0	0	15	0	0	56	0
Nixon at Huron Pkwy	1	0	0	0	0	7	0	7	0	23	28	5
Nixon at Plymouth	6	0	0	0	0	0	0	1	0	0	9	19
Huron Pkwy at Plymouth	0	0	0	0	0	3	0	4	0	4	19	0
PM Peak	**EB**			**WB**			**NB**			**SB**		
	L	T	R	L	T	R	L	T	R	L	T	R
Nixon at Barclays	0	0	0	0	0	0	0	45	0	0	90	0
Nixon at Dhu Varren/Green	5	0	0	0	0	28	0	57	0	15	30	3
Nixon at Haverhill	0	0	0	0	0	0	0	57	0	0	30	0
Nixon at Traver	0	0	0	-	-	-	0	57	-	-	30	0
Nixon at Clague	-	-	-	0	0	0	-	57	0	0	30	-
Nixon at Meade/Bluett	0	0	0	0	0	0	0	57	0	0	30	0
Nixon at Sandalwood/Aurora	0	0	0	0	0	0	0	57	0	0	30	0
Nixon at Huron Pkwy	5	0	0	0	0	24	0	28	0	13	14	3
Nixon at Plymouth	21	0	0	0	0	0	0	7	0	0	2	12
Huron Pkwy at Plymouth	0	0	0	0	0	7	0	17	0	6	7	0

Pontiac Trail Developments

An Intersection Improvement Study for the Nixon Road at Dhu Varren and Green Roads intersection was completed in 2015 by Opus. In addition to the proposed developments listed above, the study included three potential residential developments located in the adjacent Pontiac Trail Corridor. The North Sky, Barton Green and Brewer developments total 123 Acres. In accordance with standard industry practice, the study used the ITE Trip Generation Manual with the 9th edition data set to generate traffic. Trips were generated using codes for Single Family Residential (149), Multi-Family Residential (224) and Residential (420) land uses. Trips were distributed using existing traffic patterns. Once distributed the study anticipates that of the trips generated by these developments, only 33 trips during the AM Peak Hour and 73 trips during the PM Peak Hour will impact the Nixon Road corridor.

Table 6: Pontiac Trail Development Generated Traffic Volumes

AM Peak	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Nixon at Barclays	0	0	0	0	0	0	0	1	0	0	1	0
Nixon at Dhu Varren/Green	1	7	8	0	6	0	10	0	0	0	0	1
Nixon at Haverhill	0	0	0	0	0	0	0	10	0	0	8	0
Nixon at Traver	0	0	0	-	-	-	0	10	-	-	8	0
Nixon at Clague	-	-	-	0	0	0	-	10	0	0	8	-
Nixon at Meade/Bluett	0	0	0	0	0	0	0	10	0	0	8	0
Nixon at Sandalwood/Aurora	0	0	0	0	0	0	0	10	0	0	8	0
Nixon at Huron Pkwy	1	0	0	0	0	6	0	3	0	3	4	1
Nixon at Plymouth	3	0	0	0	0	0	0	0	0	0	1	3
Huron Pkwy at Plymouth	0	0	0	0	0	2	0	4	0	1	2	0
PM Peak	**EB**			**WB**			**NB**			**SB**		
	L	T	R	L	T	R	L	T	R	L	T	R
Nixon at Barclays	0	0	0	0	0	0	0	1	0	0	3	0
Nixon at Dhu Varren/Green	1	10	9	0	28	0	22	0	0	0	0	3
Nixon at Haverhill	0	0	0	0	0	0	0	22	0	0	9	0
Nixon at Traver	0	0	0	-	-	-	0	22	-	-	9	0
Nixon at Clague	-	-	-	0	0	0	-	22	0	0	9	-
Nixon at Meade/Bluett	0	0	0	0	0	0	0	22	0	0	9	0
Nixon at Sandalwood/Aurora	0	0	0	0	0	0	0	22	0	0	9	0
Nixon at Huron Pkwy	2	0	0	0	0	9	0	11	0	3	6	0
Nixon at Plymouth	8	0	0	0	0	0	0	3	0	0	1	5
Huron Pkwy at Plymouth	0	0	0	0	0	3	0	6	0	1	2	0

Projected Vehicle Volumes

The development-generated trips were added to the background adjusted traffic volumes to determine the 2035 Volumes used in this study. These volumes were compared with the future year volumes used in the Opus intersection improvement Study. The volumes used in the two studies are of similar magnitude. Slight differences in the numbers can be attributed to the normal daily fluctuations in traffic patterns in the baseline traffic counts, and are not cause for concern.

Table 7: Projected 2035 Traffic Volumes

AM Peak	EB			WB			NB			SB		
	L	T	R	L	T	R	L	T	R	L	T	R
Nixon at Barclays	7	0	61	107	0	8	18	130	22	2	441	2
Nixon at Dhu Varren/Green	26	195	215	105	82	42	98	102	71	196	386	32
Nixon at Haverhill	34	0	34	17	0	3	11	234	3	1	697	10
Nixon at Traver	53	-	149	-	-	-	144	258	-	-	666	95
Nixon at Clague	-	-	-	38	-	83	-	310	84	100	706	-
Nixon at Meade/Bluett	2	1	18	129	0	29	3	367	46	36	708	0
Nixon at Sandalwood/Aurora	1	0	34	38	0	2	25	401	20	11	859	2
Nixon at Huron Pkwy	11	79	33	28	55	282	14	159	38	398	471	66
Nixon at Plymouth	114	701	120	51	752	101	11	13	6	144	112	236
Huron Pkwy at Plymouth	2	658	152	413	839	135	167	229	175	162	376	16
PM Peak	**EB**			**WB**			**NB**			**SB**		
	L	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**
Nixon at Barclays	3	0	28	53	0	2	49	445	106	5	210	6
Nixon at Dhu Varren/Green	45	118	145	77	228	226	196	374	116	69	145	35
Nixon at Haverhill	19	0	13	8	0	1	22	666	13	7	334	32
Nixon at Traver	32	-	74	-	-	-	97	721	-	-	312	45
Nixon at Clague	-	-	-	39	-	30	-	792	15	14	371	-
Nixon at Meade/Bluett	1	1	3	53	1	23	17	786	89	28	384	1
Nixon at Sandalwood/Aurora	0	0	47	34	1	23	32	883	49	10	443	3
Nixon at Huron Pkwy	96	78	46	67	82	380	29	487	70	174	316	35
Nixon at Plymouth	262	857	17	13	1052	129	110	91	44	251	35	218
Huron Pkwy at Plymouth	7	943	203	214	1049	150	238	380	325	151	197	20

4. COMMUNITY VALUES AND PLANS

Planning for improvements in the Nixon Road corridor is informed by several City-wide policies and planning documents, as well as resident input received. Regarding the institutional planning guidance, the key ones are:

- Ann Arbor Master Plan:
  - Land Use Element, 2009
  - Transportation Plan, 2009
  - Non-motorized Plan, 2013
- Ann Arbor Sustainability Framework, 2013
- The Connector Alternatives Analysis, February 2016

For resident input, we looked first to the information generated at the December 11, 2014 public meeting on the Nixon Road at Dhu Varren/Green Roads Intersection project. This included reviewing the recording of the meeting and various letters and emails subsequently sent to the City. While technically related to just the project to improve the intersection, the meeting participants called for a study of the corridor and provided information on some of the issues that concerned them.

Further resident comments and concerns were identified in two public meetings expressively held for this corridor study, on June 8th and July 13th of 2016. This information is summarized and provided in Appendix D.

5. SAFETY ANALYSIS

To understand the safety performance of the corridor, a crash analysis was performed. Collision data was obtained for a three-year period, encompassing 2013 through 2015. Evaluated were approximately 1.5 miles of Nixon Rd from Plymouth Rd northwards, a 0.25-mile portion of Huron Pkwy from Nixon Rd to Plymouth Rd, and a 0.15-mile portion of Plymouth Rd from Nixon Rd to Huron Pkwy. Appendix C holds the full crash analysis, as well as the raw crash data. This information is summarized in Table 8.

Note that crash rates for intersections are expressed in terms of crashes per million entering vehicles to the intersection. For roadway segments, the numbers are crashes per hundred million vehicle miles of travel. The spot critical crash rate represents a calculated crash rate using an average crash rate determined by four characteristics which include area type, functional class, number of lanes and traffic control. The average crash rates are determined by SEMCOG using crash data for Southeast Michigan from 2009 – 2011. If the observed crash rate exceeds the spot critical crash rate, the location is identified as a high-crash location.

Of the 149 collisions that have occurred in the past three years, there were no fatalities or incapacitating (A-level) injuries. One crash involved a bicycle and three crashes were with pedestrians. The bike-related crash occurred on Oct. 19, 2013 in the 7 p.m. hour. A vehicle turning left out of Haverhill Court struck a northbound cyclist on Nixon Road, who received a non-incapacitating (B-level) injury. All three pedestrian crashes were located along Plymouth Road. The first was on Jan. 4, 2013 in the 4 p.m. hour. A westbound vehicle turning right onto Huron Parkway struck a pedestrian crossing the north leg of the intersection, who had a complaint of injury (C-level). The second was on Feb. 23, 2014 in the 5 p.m. hour. A pedestrian crossing Plymouth Road mid-block east of Nixon Road was hit by an eastbound vehicle and received a B-level injury. The last was on Dec. 22, 2015 in the 5 p.m. hour. A pedestrian crossing Plymouth Road against the traffic signal at Nixon Road was struck by a westbound vehicle and received B-level injuries. The balance of the crashes involved property damage only (PDO).

Table 8: Nixon Road Corridor Crash Summary

Analysis Area	Crash Type							Injuries					Crash Rate	Spot Critical Crash Rate
	Single	Head-On Left-Turn	Sideswipe	Rear End	Angle	Backing	TOTAL	Fatal	A	B	C	PDO		
Intersection: Plymouth & Huron	2	4	11	41	11	1	70	0	0	1	11	58	**1.776**	**0.674**
Intersection: Plymouth & Nixon	2	1	5	31	12	1	52	0	0	4	4	44	**1.779**	**0.853**
Intersection: Nixon & Huron	3	0	4	3	7	0	17	0	0	0	1	16	**1.078**	**0.475**
Intersection: Nixon & Aurora/ Sandalwood	0	0	0	0	1	0	1	0	0	0	1	0	**0.081**	**0.510**
Intersection: Nixon & Bluett/ Meade	1	0	0	0	0	0	1	0	0	0	0	1	**0.092**	**1.583**
Intersection: Nixon & Clague	0	0	0	0	0	0	0	0	0	0	0	0	**0.000**	**0.554**
Intersection: Nixon & Traver	0	0	0	1	1	0	2	0	0	0	0	2	**0.210**	**1.623**
Intersection: Nixon & Dhu Varren/ Green	1	5	0	6	5	0	17	0	0	2	3	12	**1.493**	**0.523**
Sub-Total	**9**	**10**	**20**	**82**	**37**	**2**	**160**	**0**	**0**	**7**	**20**	**133**		
Sub-Total %	**6%**	**6%**	**13%**	**51%**	**23%**	**1%**	**100%**	**0%**	**0%**	**4%**	**13%**	**83%**		
Segment: Huron - Plymouth to Nixon	0	0	0	0	0	0	0	0	0	0	0	0	**0.0**	**733.9**
Segment: Plymouth - Nixon to Huron	0	0	1	3	0	0	4	0	0	0	0	4	**108.7**	**313.9**
Segment: Nixon - Plymouth to Huron	0	0	1	0	3	0	4	0	0	0	0	4	**253.7**	**855.6**
Segment: Nixon - Aurora to Bluett	1	0	0	0	1	0	2	0	0	1	0	1	**67.9**	**760.5**
Segment: Nixon - Traver to Green	2	0	0	4	0	0	6	0	0	1	0	5	**217.4**	**768.8**
Segment: Nixon - Dhu Varren to M-14	0	0	0	1	1	0	2	0	0	0	0	2	**88.2**	**796.2**
Sub-Total	**3**	**0**	**2**	**8**	**5**	**0**	**18**	**0**	**0**	**2**	**0**	**16**		
Sub-Total %	**17%**	**0%**	**11%**	**44%**	**28%**	**0%**	**100%**	**0%**	**0%**	**11%**	**0%**	**89%**		
Grand Total	**12**	**10**	**22**	**90**	**42**	**2**	**178**	**0**	**0**	**9**	**20**	**149**		
Grand Total %	**7%**	**6%**	**12%**	**51%**	**24%**	**1%**	**100%**	**0%**	**0%**	**5%**	**11%**	**84%**		

6. EVALUATION METHODOLOGY

Non-Motorized Evaluation

Analyzing the pedestrian experience can be summarized by two primary types of analysis: individual delay and facility attributes. Delay related to crowded walkways and at intersections can be easily quantified and analyzed using the calculation methodology of the Highway Capacity Manual (HCM). However, the context of the Nixon Road area is such that pedestrian flow levels are not a reasonable measure of effectiveness for the facilities being studied. The factors that describe a facility and therefore contribute to the overall walking experience are less easily quantified, including safety, security, lighting, grades, surface conditions, and even street activity levels. Automobile and heavy vehicle traffic volumes, and the extent to which pedestrians are separated from vehicular traffic, also influence pedestrians' perception of quality of service while using a sidewalk.

Unfortunately, there is not any one evaluation methodology that is widely accepted for accounting for all the potential factors that would influence the quality of the walking experience. Indeed, the most promising models tend to focus on walking facilities for city central business districts and highly commercial areas, not residential areas that are the subject of this study. Similar to the pedestrian experience, bicycling can be summarized by delay encountered at intersections or the attributes of the facility itself. These attributes include the volume and speed of adjacent vehicles, heavy vehicle presence, the presence of on-street parking, and pavement quality. Because of the severe deterioration of perceived service quality at flow levels well below the theoretical capacity of a bike path, the concept of capacity has little utility in the design and analysis of bicycle paths.

With these limitations in mind, we focused on using the Florida Department of Transportation's Multimodal Quality/Level of Service (Q/LOS) Model. This is essentially the same LOS model as the one developed by Bruce Landis, PE, AICP of Sprinkle Consulting, Inc. The Landis model was used in the development of the City of Ann Arbor Non-Motorized Transportation Plan Update of 2013. The only differences between the two models are located in the constant term and the variable coefficients of the equations.

The Florida Q/LOS Handbook focuses on the users' perceptions of the roadway or nearby roadside attributes when determining pedestrian and bicycle LOS. Pedestrian LOS is based on four variables with relative importance ordered in the following list:

1. Existence of a sidewalk
2. Lateral separation of pedestrians from motorized vehicles, including physical barriers such as parked vehicles.
3. Motorized vehicle volumes
4. Motorized vehicle speeds

Similarly, bicycle LOS also is related to variables noted below in order of importance:

1. Presence of a bike lane or paved shoulder
2. Average effective width of the outside through lane
3. Motorized vehicle volumes
4. Motorized vehicle speeds
5. Heavy vehicle (truck) volumes

6. Pavement condition
7. Presence and amount of on-street parking

A numerical LOS score, generally ranging from 0.5 to 6.5, is determined along with the corresponding LOS letter grade of A through F. Similar to LOS for motor vehicles, LOS 'A' represents the best conditions while LOS 'F' represents the worst conditions for all travel modes. LOS D is widely accepted among transportation professionals to represent an acceptable condition for vehicles in an urban/suburban setting. However, LOS D may not be considered acceptable for pedestrian/bike LOS, as the thresholds were determined by members of the general public and are thus prone to a higher degree of subjectivity.

Vehicle Evaluation

The intersections within the study area were analyzed according to the methodologies published in the Highway Capacity Manual, 2010 edition. For this project, the VISSIM 9 traffic microsimulation software package was used to conduct the analysis. The existing conditions models were built utilizing Bing Maps aerial images to lay out the road network.

Once the road network was laid out, adjusted traffic volumes, lane geometry, intersection controls, signal timings, etc. were entered into the models. The existing signal timing plans at the signalized intersections of Plymouth Road and Nixon Road and Plymouth Road and Huron Road utilized a 144-second cycle length during the AM and PM peak periods under investigation. The existing condition VISSIM models used the observed turning movement volumes at all intersections. Given that VISSIM is a microscopic traffic simulation software, individual vehicle and driver behavior parameters are also specified by peak period (some factors, such as vehicle composition, vary according to AM or PM peak period).

For the present study, the vehicle fleet mix was adjusted to mimic the vehicle composition observed by the MioVision camera installed at the Nixon Road and Huron Parkway roundabout. The vehicle types included cars (which includes vans, light pickup trucks, vans and SUVs), busses, single unit trucks, articulated trucks, bicycles and pedestrians. Default acceleration/deceleration, weight, power and length values were used for all vehicle types. The proportion of each vehicle type at the various input sources (north and south ends of Nixon Road, east and west ends of Plymouth Road, and all cross streets) were coded to match the proportions observed in the turning movement vehicle counts according to peak period.

Driver behavior in VISSIM is determined by car following and lane changing models. Each link is assigned a specific driver behavior. In the study network, driver behavior did not vary by vehicle type. The default Wiedemann74 car-following model for urban drivers was utilized. Similarly, lane change parameters were not adjusted from the default free lane selection rule (vehicles may overtake on each lane).

Right-of-way at unsignalized intersections is determined using either conflict areas or priority rules. Conflict areas assign right-of-way to one of two overlapping links according to user judgement. The scope of the conflict area cannot by adjusted. Priority rules can be used in place of conflict areas to grant the modeler greater control over right-of-way by defining acceptable gap times and headway distances at user-defined spots. Initially, right-of-way was assigned at all unsignalized intersections using conflict areas due to ease of use and various reported states' DOT guidances.

The final step of this stage was to calibrate and validate the VISSIM models, to ensure they represented the actual existing field conditions. This involved the comparison of existing traffic volumes with the model volume outputs from VISSIM simulation runs. Five different random seeds were used and the average traffic volumes of the five simulation runs was compared against the observed traffic volumes. The model is considered validated when the difference between the existing and the VISSIM volume outputs are within the range of either ± 10% (or ± 20 vehicles for low flow conditions) of the existing volumes. Based on the model validation for both peak periods, the difference between the actual volume and the average of the volumes from all five VISSIM simulation runs fall within the acceptable range as discussed above. Appendix B contains the model validation results.

The software package computes average vehicle delay as the difference between the actual vehicle travel time and its desired travel time through a user-defined travel-time measurement section, called a "node". The desired travel time is the travel time which would be expected by a specific vehicle if there were no other vehicles and/or no signal controls or any other impedance to traffic flow. This value is an average across the entire peak hour, vehicles arriving during the busiest portion of the peak hour or arriving in a clustered group of vehicles instead of in a random pattern could experience longer delays. On the other hand, vehicles arriving during a lighter portion of the peak hour could experience a shorter delay. The average delay is used to determine the corresponding level of service (LOS) values for each intersection movement as well as the intersection as a whole.

LOS is expressed as a letter grade, in a range from A through F. In this context, 'A' represents the best conditions, with very little or no average delay to vehicles. LOS 'F' is the worst of conditions, equated with very large average delays and few gaps of acceptable length. The tables on the following page identify level of service criteria for signalized and unsignalized intersections.

Table 9: Level of Service Criteria For Signalized Intersections

Level of Service	Average Delay/Vehicle (seconds)	Description
A	Less than or equal to 10	Most vehicles do not stop at all. Most arrive during the green phase. Little or no delay.
B	> 10 to 20	More vehicles stop than for LOS A. Still good progression through lights. Short traffic delays.
C	> 20 to 35	Significant numbers of vehicles stop, although many pass through without stopping.
D	> 35 to 55	Many vehicles stop. Individual signal cycle failures are noticeable. Progression is intermittent.
E	> 55 to 80	Considered to be the limit of acceptable delay. Individual cycle failures are frequent and progression is poor.
F	>80	Extreme and unacceptable traffic delays.

SOURCE: Transportation Research Board, Highway Capacity Manual 2010.

Table 10: Level of Service Criteria For Unsignalized Intersections (Including Roundabouts)

Level of Service	Average Delay/Vehicle (seconds)	Description
A	0 to 10	Little or no delay, very low main street traffic
B	> 10 to 15	Short traffic delays, many acceptable gaps
C	> 15 to 25	Average traffic delays, frequent gaps still occur
D	> 25 to 35	Longer traffic delays, limited number of acceptable gaps
E	> 35 to 50	Very long traffic delays, very small number of acceptable gaps
F	>50	Extreme traffic delays, virtually no acceptable gaps in traffic

SOURCE: Transportation Research Board, Highway Capacity Manual 2010.

An intersection LOS 'D' is considered by many traffic safety professionals to be the minimum acceptable condition in an urban/suburban area. For rural areas, most highway agencies consider LOS 'C' the minimum. Given the location of the study intersections, LOS 'D' was utilized as the study goal.

7. EXISTING OPERATIONS

Non-Motorized Operations

There are a few glaring omissions in non-motorized facilities in the corridor. There is no sidewalk along the west side from Traver Boulevard northward. There are no on-street bike lanes on either side of Nixon Road from Aurora Street to Bluett Drive. These shortcomings impact the operations for pedestrians and bicyclists for those segments. The characteristics of the facilities and related road attributes are summarized in Table 11, which also holds the Q/LOS results for pedestrians and bicyclists.

Table 11: Non-Motorist Attributes and Q/LOS By Segment

Barclay to Dhu Varren/Green	SB	NB
Peak Directional Volume (vph)	399 (a.m.)	433 (p.m.)
Heavy Vehicle Percent	< 1%	< 1%
Bike Lane Average Width (ft)	4’	5’
Sidewalk Average Width (ft)	N/A	8’
Avg. Lateral Separation Sidewalk to Traveled Way	N/A	21’
Bicycle LOS & Score	D (3.74)	D (3.71)
Pedestrian LOS & Score	C (3.42)	C (2.99)
Dhu Varren/Green to Haverhill	SB	NB
Peak Directional Volume (vph)	492 (a.m.)	473 (p.m.)
Heavy Vehicle Percent	1%	1%
Bike Lane Average Width (ft)	4’	5’
Sidewalk Average Width (ft)	N/A	8’
Avg. Lateral Separation Sidewalk to Traveled Way	N/A	22’
Bicycle LOS & Score	C (3.49)	C (3.45)
Pedestrian LOS & Score	C (3.47)	C (3.00)
Haverhill to Westbury	SB	NB
Peak Directional Volume (vph)	506 (a.m.)	483 (p.m.)
Heavy Vehicle Percent	1%	1%
Bike Lane Average Width (ft)	4’	6’
Sidewalk Average Width (ft)	N/A	5’
Avg. Lateral Separation Sidewalk to Traveled Way	N/A	20’
Bicycle LOS & Score	C (3.49)	C (3.44)
Pedestrian LOS & Score	C (3.47)	C (3.00)
Westbury to Traver	SB	NB
Peak Directional Volume (vph)	518 (a.m.)	529 (p.m.)
Heavy Vehicle Percent	1%	1%
Bike Lane Average Width (ft)	4’	6’
Sidewalk Average Width (ft)	N/A	5’
Avg. Lateral Separation Sidewalk to Traveled Way	N/A	12’
Bicycle LOS & Score	D (3.77)	D (3.72)
Pedestrian LOS & Score	D (3.50)	D(3.06)

Traver to Clague	SB	NB
Peak Directional Volume (vph)	557 (a.m.)	585 (p.m.)
Heavy Vehicle Percent	1%	1%
Bike Lane Average Width (ft)	4’	6’
Sidewalk Average Width (ft)	6’	4’
Avg. Lateral Separation Sidewalk to Traveled Way	17’	9’
Bicycle LOS & Score	C (3.43)	C (3.39)
Pedestrian LOS & Score	C (3.00)	C (3.05)
Clague to Bluett	SB	NB
Peak Directional Volume (vph)	503 (a.m.)	576 (p.m.)
Heavy Vehicle Percent	1%	1%
Bike Lane Average Width (ft)	4’	5’
Sidewalk Average Width (ft)	6’	5’
Avg. Lateral Separation Sidewalk to Traveled Way	18’	26’
Bicycle LOS & Score	C (3.49)	C (3.46)
Pedestrian LOS & Score	C (3.02)	C (3.07)
Bluett to Aurora	SB	NB
Peak Directional Volume (vph)	620 (a.m.)	651 (p.m.)
Heavy Vehicle Percent	1%	1%
Bike Lane Average Width (ft)	N/A	N/A
Sidewalk Average Width (ft)	6’	5’
Avg. Lateral Separation Sidewalk to Traveled Way	27’	95’
Bicycle LOS & Score	D (4.05)	D (4.06)
Pedestrian LOS & Score	C (3.19)	C (3.14)
Aurora to Huron	SB	NB
Peak Directional Volume (vph)	674 (a.m.)	715 (p.m.)
Heavy Vehicle Percent	1%	1%
Bike Lane Average Width (ft)	5’	5’
Sidewalk Average Width (ft)	5’	5’
Avg. Lateral Separation Sidewalk to Traveled Way	23’	80’
Bicycle LOS & Score	C (3.41)	C (3.41)
Pedestrian LOS & Score	C (3.11)	C (3.08)
Huron to Plymouth	SB	NB
Peak Directional Volume (vph)	360 (a.m.)	448 (p.m.)
Heavy Vehicle Percent	3%	3%
Bike Lane Average Width (ft)	4’	5’
Sidewalk Average Width (ft)	5’	5’
Avg. Lateral Separation Sidewalk to Traveled Way	14’	14’
Bicycle LOS & Score	D (3.73)	D (3.71)
Pedestrian LOS & Score	C (2.94)	C (3.00)

Vehicle Operations

Tables 13 and 14 on the following pages show the turning movement and intersection LOS and corresponding delays for the existing conditions in 2016, opening year of the proposed roundabout at Nixon Road and Green Road/Dhu Varren Road (2017), and the horizon year (2035). Average simulation evaluation results from the VISSIM models for the existing conditions are provided in Appendix B. It should be noted that for both the existing and proposed conditions VISSIM models, the reported delay associated with low turning movement volumes (less than five vehicles) is highly variable and subject to randomness given the microscopic nature of the model. Additionally, any "NA" cells in Table 13 or similar tables represent either turning movements with no vehicles or turning movements that do not exist due to geometric or operational constraints. The existing AM and PM peak period LOS of the intersections under analysis are summarized below:

Table 12: Intersection Level-of-Service - Existing Conditions

Intersection Level-of-Service - Existing Conditions 2016		
Intersection	**AM LOS**	**PM LOS**
Nixon Road and Barclay Way	B	A
Nixon Road and Dhu Varren Road/Green Road	F	E
Nixon Road and Haverhill Court	A	D
Nixon Road and Traver Boulevard	A	A
Nixon Road and the Clague Middle School driveway	A	A
Nixon Road and Meade Court/Bluett Drive	A	A
Nixon Road and Sandalwood Circle/Aurora Street	A	A
Nixon Road and Huron Parkway	A	B
Plymouth Road and Nixon Road	C	C
Plymouth Road and Huron Parkway	D	D

As mentioned earlier, existing conditions or "Do Nothing" models were also analyzed for the 2017 opening year of the proposed roundabout at Nixon Road and Green Road/Dhu Varren Road as well as the 2035 horizon year. Thus, the delay and corresponding LOS values reported in Table 13 and Table 14 for 2017 depict the expected average intersection delay at each study intersection on the existing corridor under no changes except for the roundabout at Nixon Road and Green Road/Dhu Varren Road. The effects of the roundabout on average intersection delay are felt at adjacent intersections(s) both north and south of Green Road/Dhu Varren Road. Additionally, preliminary RODEL analysis determined that a right-turn bypass lane may be needed on the eastbound approach to the roundabout by 2035, thus the 2035 existing conditions LOS values reflect this change.

Table 13: HCM 2010 Level of Service – Nixon Road Corridor – Existing Conditions - AM

VISSIM Analysis by Intersection and Year		Year	LOS (Avg. Delay in sec/veh)												
			NB			SB			EB			WB			INT
			L	T	R	L	T	R	L	T	R	L	T	R	
No Build/"Do Nothing"[1]	Nixon Road and Barclay Way	Existing	NA	A (0.12)	A (0.61)	A (1.65)	B (14.31)	NA	NA	NA	NA	C (24.40)	NA	B (11.93)	B (13.30)
		2017	A (3.88)	A (1.08)	C (18.04)	B (14.65)	A (2.52)	A (1.45)	A (8.85)	NA	A (8.22)	B (12.21)	NA	A (9.61)	A (4.60)
		2035	A (4.73)	A (0.80)	A (8.18)	A (2.97)	A (0.96)	A (1.82)	A (7.92)	NA	A (8.41)	B (11.61)	NA	B (10.37)	A (3.85)
	Nixon Road and Dhu Varren Road/Green Road	Existing	C (16.70)	B (11.62)	A (8.82)	F (117.97)	F (118.42)	F (114.89)	C (15.15)	B (13.13)	B (12.66)	A (8.44)	B (12.26)	A (7.04)	F (51.52)
		2017	A (7.56)	A (7.07)	A (5.10)	B (10.76)	B (10.18)	B (12.56)	E (35.59)	D (32.30)	D (32.46)	A (5.98)	A (5.88)	A (4.86)	C (15.70)
		2035	A (8.65)	A (6.84)	A (6.09)	C (17.44)	C (17.65)	C (17.18)	C (22.51)	C (20.41)	B (13.39)	A (6.30)	A (5.58)	A (4.91)	B (13.98)[2]
	Nixon Road and Haverhill Court	Existing	NA	A (0.24)	A (0.57)	A (0.48)	A (0.17)	NA	NA	NA	NA	A (7.85)	NA	A (5.57)	A (0.38)
		2017	A (3.00)	A (0.41)	A (6.61)	A (3.04)	A (0.52)	A (0.82)	A (4.82)	NA	A (4.45)	B (10.12)	NA	A (5.98)	A (1.06)
		2035	A (3.79)	A (0.41)	A (0.77)	A (0.51)	A (0.28)	A (0.42)	A (5.98)	NA	A (4.22)	A (9.73)	NA	A (0.17)	A (0.84)
	Nixon Road and Traver Boulevard	Existing	A (3.53)	A (0.41)	NA	NA	A (3.84)	A (1.24)	A (9.91)	NA	B (10.80)	NA	NA	NA	A (4.40)
		2017	A (6.00)	A (0.80)	NA	NA	A (4.71)	A (1.69)	C (15.11)	NA	C (19.09)	NA	NA	NA	A (6.47)
		2035	A (9.61)	A (1.40)	NA	NA	A (7.35)	A (3.73)	D (34.49)	NA	F (59.26)	NA	NA	NA	B (13.66)
	Nixon Road and Clague Middle School driveway	Existing	NA	A (2.24)	A (1.02)	A (2.60)	A (0.44)	NA	NA	NA	NA	B (12.10)	NA	B (12.15)	A (2.48)
		2017	NA	A (2.74)	A (1.06)	A (3.91)	A (0.52)	NA	NA	NA	NA	C (18.46)	NA	B (13.47)	A (2.64)
		2035	NA	A (4.83)	A (1.78)	A (3.81)	A (4.33)	NA	NA	NA	NA	D (30.24)	NA	C (24.61)	A (6.82)
		Existing	A (5.12)	A (1.15)	A (1.38)	A (2.62)	A (0.52)	NA	A (8.41)	A (3.05)	A (7.57)	B (14.64)	B (11.47)	B (11.25)	A (2.92)

[1] "Do Nothing" implies no changes to the existing study network except the roundabout at Green Road/Dhu Varren Road in 2017 and inclusion of a right-turn bypass lane to the EB approach to the roundabout in 2035. Also applies to Table 14.

[2] Overall intersection LOS improves at Nixon Road and Dhu Varren Road/Green Road from 2017 to 2035 due to the inclusion of the EB right-turn bypass lane, as reflected by the substantial decrease in delay for the EB right-turn movement. The EB right-turn movement is the second highest turning movement at the intersection (second to the SB through movement) and is forecasted to rise to 215 vehicles in the AM peak period by 2035. Also applies to Table 14.

	Nixon Road and Meade Court/Bluett Drive	2017	A (4.36)	A (1.20)	A (1.43)	A (3.74)	A (0.76)	NA	B (13.90)	A (3.67)	A (7.92)	C (18.00)	B (11.68)	C (16.40)	A (3.42)
		2035	A (8.57)	A (2.22)	A (1.90)	A (4.08)	C (20.58)	NA	C (15.04)	A (1.59)	D (27.12)	F (113.09)	E (39.15)	F (88.12)	C (24.79)
	Nixon Road and Sandalwood Circle/Aurora Street	Existing	A (8.79)	A (1.26)	A (0.85)	A (2.87)	A (5.71)	A (3.50)	C (18.20)	NA	B (12.92)	C (18.49)	NA	A (6.35)	A (4.91)
		2017	C (21.74)	A (1.80)	A (1.74)	B (11.79)	B (15.91)	A (5.57)	C (16.18)	NA	C (19.35)	E (37.38)	NA	B (13.81)	B (12.28)
		2035	C (19.97)	A (1.80)	A (1.22)	F (55.39)	F (70.07)	F (84.18)	NA	NA	D (31.41)	F (108.26)	NA	F (154.24)	E (47.07)
	Nixon Road and Huron Parkway	Existing	B (10.53)	A (8.77)	A (8.6)	A (3.77)	A (3.86)	A (2.88)	B (10.84)	B (13.67)	C (15.41)	A (7.83)	A (7.90)	A (8.52)	A (6.43)
		2017	C (16.45)	B (13.68)	A (7.89)	A (4.65)	A (6.71)	A (4.33)	C (23.74)	D (26.87)	D (26.61)	A (7.85)	A (6.86)	A (7.64)	A (8.50)
		2035	C (19.12)	B (14.63)	A (9.18)	A (6.98)	C (20.92)	A (6.05)	F (64.88)	F (65.63)	F (85.89)	C (20.98)	A (9.71)	A (9.68)	C (17.68)
	Plymouth Road and Nixon Road	Existing	F (80.87)	E (59.20)	E (60.83)	E (65.74)	E (58.60)	E (61.08)	E (65.75)	B (14.68)	B (13.42)	F (99.42)	B (14.06)	B (14.77)	C (28.00)
		2017	E (63.23)	E (60.29)	D (52.82)	F (80.01)	F (84.23)	F (81.91)	E (64.00)	B (14.66)	B (14.90)	F (91.97)	B (15.17)	B (13.59)	C (34.34)
		2035	E (73.55)	D (52.83)	E (59.00)	F (127.57)	F (126.44)	F (121.57)	E (65.95)	B (16.49)	B (14.97)	F (86.03)	B (17.54)	B (17.44)	D (43.92)
	Plymouth Road and Huron Parkway	Existing	F (90.25)	E (57.71)	E (61.95)	E (79.63)	D (52.70)	D (49.46)	E (67.99)	D (38.72)	D (41.05)	E (56.26)	B (17.90)	B (18.02)	D (43.19)
		2017	F (95.90)	E (57.22)	E (55.74)	F (81.74)	D (54.17)	E (58.74)	D (42.36)	D (37.26)	D (37.31)	E (56.55)	B (15.47)	B (16.07)	D (42.92)
		2035	F (113.95)	E (59.28)	E (59.61)	F (81.82)	D (54.03)	E (58.84)	D (52.76)	D (37.43)	D (38.21)	F (81.91)	B (18.85)	B (19.84)	D (48.38)

Table 14: HCM 2010 Level of Service – Nixon Road Corridor – Existing Conditions - PM

VISSIM Analysis by Intersection and Year		Year	LOS (Avg. Delay in sec/veh)												
			NB			SB			EB			WB			INT
			L	T	R	L	T	R	L	T	R	L	T	R	
No Build/"Do Nothing"	Nixon Road and Barclay Way	Existing	NA	A (0.15)	A (0.80)	A (2.97)	A (0.19)	NA	NA	NA	NA	A (7.27)	NA	A (6.87)	A (0.87)
		2017	A (1.72)	A (0.74)	A (0.86)	A (4.32)	A (0.59)	A (0.70)	B (10.69)	NA	A (6.61)	A (9.27)	NA	A (8.05)	A (1.50)
		2035	A (1.78)	A (0.78)	A (0.98)	A (5.14)	A (0.69)	A (0.81)	A (7.01)	NA	A (6.81)	A (9.66)	NA	A (9.25)	A (1.60)
		Existing	F (79.53)	F (77.49)	F (74.54)	D (25.21)	C (16.02)	A (8.81)	B (12.02)	B (12.50)	A (9.14)	B (11.57)	E (36.45)	D (32.45)	E (44.55)

Nixon Road and Dhu Varren Road/Green Road	2017	A (8.71)	A (7.96)	A (6.66)	A (9.61)	A (9.69)	B (11.72)	A (6.27)	A (4.03)	A (3.34)	D (25.39)	D (26.81)	D (26.39)	B (13.27)
	2035	A (8.80)	A (7.93)	A (7.77)	B (12.63)	B (12.47)	B (13.79)	A (5.45)	A (3.90)	A (3.27)	F (83.98)	F (82.50)	F (81.40)	D (30.68)
Nixon Road and Haverhill Court	Existing	NA	E (40.50)	C (20.19)	A (1.36)	A (0.11)	NA	NA	NA	NA	B (10.42)	NA	F (95.38)	D (26.78)
	2017	A (1.35)	A (0.96)	A (0.80)	A (6.95)	A (0.39)	A (0.55)	A (5.05)	NA	A (1.79)	B (10.57)	NA	A (8.85)	A (1.01)
	2035	A (1.75)	A (1.06)	A (0.95)	A (5.09)	A (0.60)	A (0.58)	A (6.77)	NA	A (1.95)	A (8.53)	NA	A (9.96)	A (1.23)
Nixon Road and Traver Boulevard	Existing	A (0.98)	A (5.70)	NA	NA	A (2.53)	A (0.66)	B (13.23)	NA	A (6.47)	NA	NA	NA	A (4.63)
	2017	A (1.61)	A (0.64)	NA	NA	A (2.93)	A (0.73)	A (9.54)	NA	A (7.62)	NA	NA	NA	A (1.97)
	2035	A (1.70)	A (0.65)	NA	NA	A (3.02)	A (0.88)	B (13.59)	NA	A (7.29)	NA	NA	NA	A (2.12)
Nixon Road and Clague Middle School driveway	Existing	NA	A (1.64)	A (0.69)	A (5.46)	A (0.39)	NA	NA	NA	NA	B (10.58)	NA	C (16.99)	A (2.08)
	2017	NA	A (1.67)	A (0.67)	A (7.19)	A (0.44)	NA	NA	NA	NA	B (10.87)	NA	B (12.55)	A (1.93)
	2035	NA	A (1.69)	A (0.66)	A (9.68)	A (0.45)	NA	NA	NA	NA	B (13.20)	NA	B (13.66)	A (2.10)
Nixon Road and Meade Court/Bluett Drive	Existing	A (4.26)	A (1.52)	A (1.67)	A (6.19)	A (0.34)	A (0.42)	NA	A (9.54)	A (8.34)	B (13.18)	C (17.58)	A (9.24)	A (2.11)
	2017	A (5.05)	A (1.79)	A (1.54)	A (7.11)	A (0.44)	A (0.47)	B (10.16)	A (9.54)	A (8.19)	B (12.65)	A (7.50)	A (9.30)	A (2.13)
	2035	A (5.88)	A (1.96)	A (1.73)	A (7.81)	A (3.52)	A (0.58)	C (15.52)	A (9.09)	C (15.75)	C (19.02)	C (22.37)	B (12.51)	A (3.56)
Nixon Road and Sandalwood Circle/Aurora Street	Existing	A (2.41)	A (1.21)	A (1.04)	A (5.44)	A (3.29)	A (1.06)	NA	A (5.08)	A (7.05)	C (19.76)	B (13.68)	B (10.20)	A (2.73)
	2017	A (6.05)	A (1.31)	A (0.79)	B (11.91)	A (7.66)	A (1.79)	NA	A (6.02)	B (10.12)	B (11.69)	A (6.22)	D (25.79)	A (4.45)
	2035	A (8.81)	A (1.48)	A (0.96)	E (41.93)	E (39.71)	A (7.51)	NA	C (18.03)	C (18.07)	F (114.86)	F (180.65)	F (64.62)	C (19.08)
Nixon Road and Huron Parkway	Existing	B (10.09)	A (8.72)	B (11.29)	A (4.93)	A (4.29)	A (3.37)	B (11.15)	B (10.62)	B (10.64)	C (19.55)	C (21.34)	C (19.20)	B (11.29)
	2017	C (15.21)	B (14.43)	B (11.43)	A (5.92)	A (7.91)	A (5.57)	C (15.50)	C (16.65)	C (15.70)	C (21.99)	C (20.79)	C (19.76)	B (14.01)
	2035	D (27.09)	C (24.81)	C (20.27)	B (11.84)	C (18.99)	A (7.84)	D (34.60)	D (33.63)	E (40.56)	E (48.41)	E (35.57)	E (36.48)	D (27.21)
Plymouth Road and Nixon Road	Existing	E (75.03)	E (57.39)	D (53.64)	E (61.93)	E (60.98)	D (48.17)	E (67.46)	B (18.43)	B (15.82)	F (226.92)	C (22.05)	C (21.71)	C (33.88)
	2017	E (73.41)	E (59.43)	E (56.15)	F (89.65)	F (83.73)	E (74.22)	F (81.32)	C (20.19)	B (18.09)	F (199.13)	C (21.89)	C (20.89)	D (40.07)
	2035	E (71.42)	E (65.20)	E (60.05)	F (114.46)	F (90.90)	F (89.20)	F (105.95)	C (26.89)	C (20.28)	F (192.01)	C (25.27)	C (28.28)	D (48.01)
Plymouth Road and	Existing	F (82.93)	E (57.43)	F (85.70)	E (66.20)	E (56.37)	D (51.85)	E (73.32)	C (22.08)	C (24.06)	E (75.76)	C (21.73)	C (23.34)	D (41.25)
	2017	F (116.03)	E (56.15)	E (72.34)	E (76.15)	E (55.13)	D (45.41)	F (84.49)	C (23.40)	C (22.84)	F (87.76)	B (18.61)	B (17.89)	D (42.37)

	Huron Parkway	2035	F (141.39)	E (67.55)	F (125.59)	F (82.18)	D (53.81)	E (55.65)	F (90.45)	C (25.67)	C (26.71)	F (97.60)	C (22.05)	C (24.44)	D (52.33)

Table 15: Average Corridor Travel Time from North of Huron Parkway to South of M-14 – Existing Conditions

Peak Period	Travel Direction	Existing		2017		2035	
		Vehicles[3]	Average Travel Time (sec/veh)	Vehicles	Average Travel Time (sec/veh)	Vehicles	Average Travel Time (sec/veh)
AM	NB	25	163.06	37	169.70	41	171.89
	SB	129	291.74	176	187.94	197	273.37
PM	NB	157	346.61	198	168.84	210	169.72
	SB	34	171.15	78	171.97	92	210.51

[3] The 'Vehicles' variable represents the total number of vehicles who traveled the entire length of Nixon Road from north of Huron Parkway to South of M-14 without performing a turning maneuver to a minor side-street.

8. POTENTIAL NON-MOTORIZED IMPROVEMENTS

Proposed Options

The Florida Q/LOS Handbook was used to determine the operational impacts of three different pedestrian-focused and two different bicyclist-focused improvement options. These options are not intended to act as standalone "alternatives", but instead could and should be implemented concurrently to realize the full benefits of implementation. As mentioned earlier in the report, non-motorized volumes were not forecasted out to the 2017 Opening Year or 2035 Horizon Year due the qualitative, as oppose to quantitative, nature of the non-motorized LOS analysis. The five options are described below:

Pedestrian Option One: Construct Sidewalk on West Side of Nixon Road

The first pedestrian option proposes constructing a sidewalk on the west side of Nixon Road between US-23/M-14 and Traver Boulevard, as indicated by the orange line in Figure 2 on the next page. The frontage sidewalk of Nixon Farms is to be completed by the developer. This option will fill the existing gap in pedestrian connectivity and improve safety by providing a buffer between vehicles and pedestrians. The City of Ann Arbor plans to fill this sidewalk gap in Fiscal Year (FY) 2020 under Project ID TR-AT-18-10 in its Capital Improvement Plan (CIP).

Pedestrian Option Two: Add Mid-Block Pedestrian Crossings

Pedestrian option two consists of adding high visibility mid-block pedestrian crossings at various locations, as indicated by the parallel yellow bars in Figure 2 on the next page. The locations were determined according to the most desirable places for pedestrians to cross Nixon Road. Marked mid-block pedestrian crossings provide a safe and legal means for pedestrians to cross the road.

Pedestrian Option Three: Relocate Portion of the Sidewalk

The final pedestrian option seeks to increase the separation of pedestrians from the roadway by relocating portions of the sidewalk on the east side of Nixon Road between the Clague Middle School driveway and Westbury Court. Presently, there are locations with less than 3 feet of separation between the sidewalk and the road in this area. Increasing the green space will reduce the likelihood of potentially severe vehicle versus pedestrian interactions, and improve the quality of the walking experience for pedestrians.

Bicyclist Option One: Widen Nixon Road between Huron Parkway and Bluett Drive

Given that currently there are on-street bike lanes in both directions on Nixon Road from Bluett Drive up to and past Barclay Way, the first bicyclist option seeks to improve connectivity by adding bike lanes from Huron Parkway up to Bluett Drive. Separating vehicle and cyclist traffic will reduce the risk of vehicle versus cyclist crashes.

Bicyclist Option Two: Provide Buffered Bike Lanes Throughout Corridor

When more extensive corridor roadway improvements are made, include buffered bike lanes throughout the Nixon Road corridor (5' lane to face of curb and 4' flush buffer from vehicle lane). Buffered bike lanes are an enhanced form of the on-street bike lane that provides an additional buffer zone between the vehicle travel lane and the bicycle travel lane.

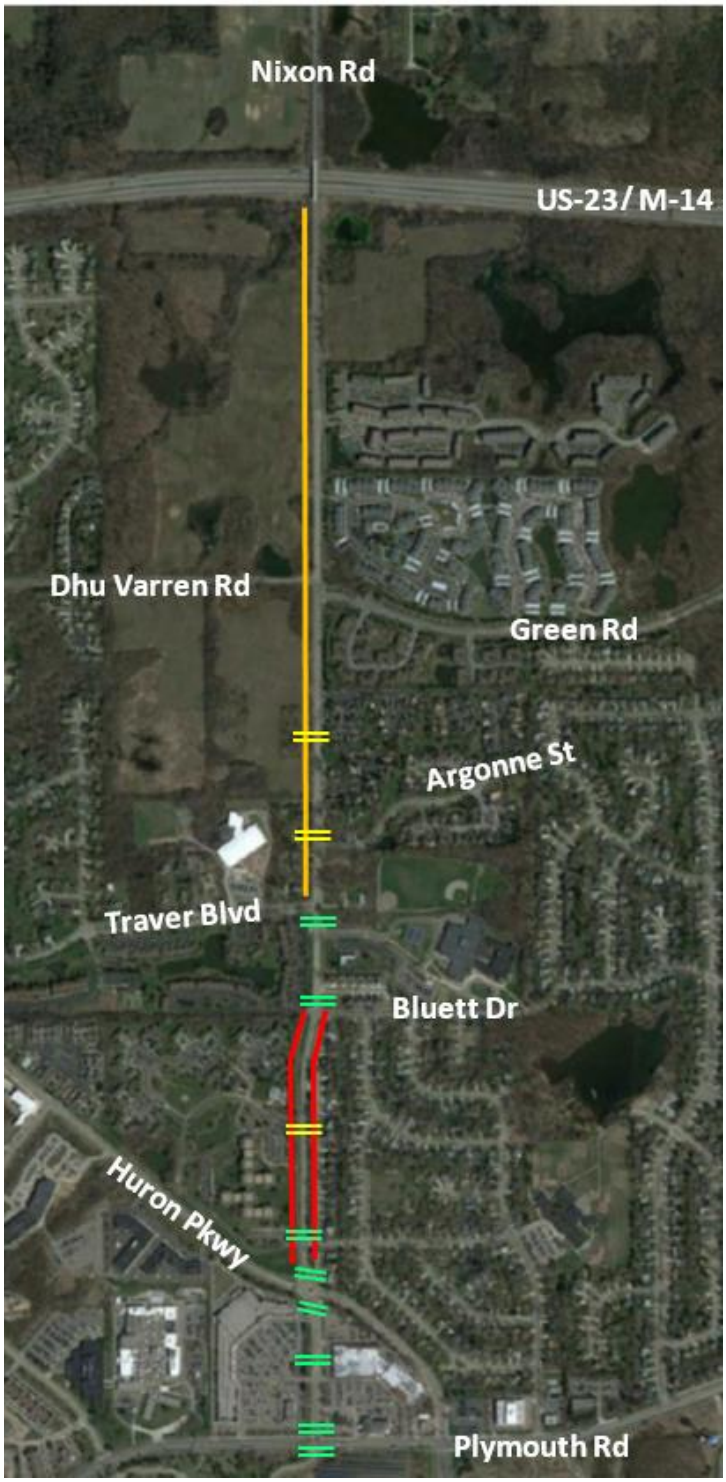

Figure 2: Pedestrian and Bicyclist Improvement Options

Maintaining/Improving Bus Stops

As part of the proposed roundabout design at Nixon Road and Green Road/Dhu Varren Road, Ann Arbor Area Transportation Authority (TheRide) bus stop locations were moved and/or enhanced as follows:

1. The existing bus stop along the south side of Dhu Varren Road near the "STOP" sign at Nixon Road lacked pedestrian connectivity and had no features other than a bus stop sign. To improve this bus stop, paved bus pads are proposed south of the proposed roundabout on the west side of Nixon Road and west of the proposed roundabout on the north side of Dhu Varren Road.
2. The existing bus stop on the east side of Nixon Road south of Green Road was relocated to a paved bus pad connected to the sidewalk along the south side of Green Road east of the proposed roundabout.

Additionally, in all Nixon Road corridor improvement alternatives, concrete bus pads are proposed, which bookend the existing and proposed pedestrian crossings indicated in Figure 2. The proposed pedestrian crossing locations were strategically chosen to coincide with attractive or desirable bus stop locations, as voiced by residents during public meetings. Bus pads will be constructed at existing crossing locations where currently missing.

9. POTENTIAL VEHICLE IMPROVEMENTS

2017 and 2035 Proposed Operations Analysis

VISSIM 9 traffic microsimulation software was used to determine the operational impacts of three different roadway improvement options. The operations analyses for the 2017 Opening Year and 2035 Horizon Year investigate the same proposed corridor changes, while using respective forecast volumes. Based on 2035 horizon year forecasts, only one travel lane is needed in each direction. This eliminates all multi-lane options (i.e. 4-lanes, 5-lanes, 4-lane boulevards) from consideration.

Proposed Alternatives

Each alternative includes the proposed roundabout at Nixon Road and Green Road/Dhu Varren Road in the analysis as the roundabout has an expected completion year of 2017. In the 2035 models for each alternative, the roundabout has an eastbound right-turn bypass lane added, which is expected to be necessary by 2035 according to a supplementary Rodel roundabout analysis. The three alternatives are described below and the results are provided in Appendix B:

Alternative One: Minor Work

The first alternative falls under the descriptions of "minor work" as it preserves the existing 2-lane and 3-lane mix in the corridor, while prescribing minor fixes such as:

1. Connect the sidewalks and add mid-block pedestrian crossings.
2. Add on-street bike lanes from Huron Parkway to Bluett Road.
3. Flatten the crest vertical curve between Argonne Drive and Westbury Court to improve the inadequate sight distance at this location.

This option does little to address motorist concerns who experience a lack of adequate gaps while attempting to access Nixon Road from minor side streets.

Alternative Two: Continuous Three-Lane Section

The second alternative proposes converting the existing two-lane sections of Nixon Road to three-lane sections with a continuous center two-way left-turn lane (TWLTL). The road would be further widened enough to allow buffered bike lanes in each direction. This option requires the relocation of portions of the sidewalk to create and/or maintain green belt separation from the proposed curb. This option improves, but does not fully address, resident concerns of accessing Nixon Road in the AM peak periods for east-side local streets. A typical cross section representing this alternative is shown in Figure 3.

Figure 3: Typical Cross Section - Alternative Two

Alternative Three: String of Roundabouts at Key Intersections

The third alternative proposes constructing roundabouts at five key intersections along the study corridor. These locations are detailed below:

- Nixon Road and Sandalwood Circle/Frontage Road
- Nixon Road and Meade Court/Bluett Drive
- Nixon Road and Traver Boulevard
- Nixon Road and Argonne Drive
- Nixon Road and Barclay Way

The intersections at Haverhill Court and at Sandalwood Circle/Aurora Street will become right-in/right-out only (RIRO) due to the boulevard continuing through the intersections at these locations. The segments between the proposed roundabouts will have the same outside curb placement (footprint) as alternative two. This option is the only alternative that fully addresses resident access concerns. A typical cross section and aerial view representing this alternative is shown in Figure 4 and Figure 5, respectively.

Figure 4: Typical Cross Section - Alternative Three

Figure 5: Aerial View - Alternative Three

Cost of Alternatives

The estimated costs of each alternative included in this section do not include elements such as purchasing right-of-way (ROW), utility relocation, landscaping and/or street lighting. Costs were estimated based on similar projects and professional judgement. The approximate cost estimate of each alternative is briefly described below. An assumed 10% of construction cost for preliminary engineering and design, and an assumed 15% of construction cost for construction engineering were added to estimated construction costs to arrive at total project costs.

Alternative One: Minor Work

- Connecting sidewalks:
  - 2,000 feet on west side of road between Dhu Varren Road and Traver Boulevard at $30 per foot = $60,000
- Adding mid-block crossings:
  - Three mid-block crossings at $25,000 per crossing = $75,000
- Adding on-street bike lanes in each direction from Huron Parkway to Bluett Road:
  - Roadway widening at $1,000,000 per lane mile (0.27 mile) = $270,000
- Flatten the crest vertical curve between Argonne Drive and Westbury Court
  - Roadway reconstruction at $2,000,000 per mile (0.10 mile) = $200,000
- **Total Construction Cost = $605,000**
- **Total Project Cost = $756,250**

Alternative Two: Continuous Three-Lane Section

- Roadway construction at $2,000,000 per mile per lane (1 mile) = $6,000,000
- **Total Cost = $6,000,000**
- **Total Project Cost = $7,500,000**

Alternative Three: String of Roundabouts at Key Intersections

- Roadway construction at $2,000,000 per mile per lane (1 mile) = $4,000,000
- Roundabout construction at $800,000 per intersection (5 intersections) = $4,000,000
- **Total Cost = $8,000,000**
- **Total Project Cost = $10,000,000**

VISSIM Evaluation Analysis

"Do Nothing" and Alternative One: Minor Work

AM Peak – 2017

As seen in Table 13, if no alternatives are pursued along the corridor in the 2017 Opening Year, the overall intersection delay increases at all study intersections except Nixon Road and Barclay Way, Nixon Road and Green Road/Dhu Varren Road and Plymouth Road and Huron Parkway.

The overall intersection delay at Nixon Road and Green Road/Dhu Varren Road decreases as expected due to the roundabout construction at the intersection. The roundabout is anticipated to substantially improve delay on the southbound approach, as the LOS of all turning movements improves from an 'F' to a 'B'. Delay on the eastbound approach is expected to increase compared to existing conditions due to the dominant southbound flow with a lack of counterflow from westbound through and left-turn movements. The LOS on the eastbound approach is still expected to remain within the acceptable LOS 'D' criteria for through and right turn movements, while falling slightly above the 35 second delay threshold for left-turn movements (which represents 6% of total eastbound traffic).

The overall intersection delay at Nixon Road and Barclay Way decreases despite an increase in traffic due to the proposed developments. This result can be explained by the reduction in the queue size for southbound Nixon Road traffic at the downstream intersection at Green Road/Dhu Varren Road, which according to field observation and replicated in VISSIM

simulations, tends to extend past Barclay Way during the AM peak. As seen in Table 12, the delay for the southbound through movement (which represents 55% of total intersection traffic) decreases from 14.31 seconds (LOS B) to 2.52 seconds (LOS A).

The overall intersection delay at Plymouth Road and Huron Parkway decreases by a mere 0.27 seconds. While an increase in delay may be expected due to development traffic, the signal at the intersection was coded as an adaptive signal, so signal phase splits were adjusted automatically to accommodate the extra traffic.

As seen in Table 15, compared to the existing condition, the average travel time to traverse the approximately 1.25 mile stretch of Nixon Road from just north of Huron Parkway to just south of M-14 in the 2017 Opening Year is expected to increase by 6.64 seconds in the northbound direction and decrease by 103.80 seconds in the southbound direction. The reduction in travel time in the southbound direction despite the increase in traffic volume can be explained by the roundabout at Nixon Road and Green Road/Dhu Varren Road decreasing southbound delay.

AM Peak- 2035

As seen in Table 12, if no corridor-wide alternatives are pursued by the 2035 Horizon Year, the overall intersection delay is expected to increase compared to the 2017 Opening Year at all study intersections except Nixon Road and Barclay Way, Nixon Road and Green Road/Dhu Varren Road, and Nixon Road and Haverhill Court.

The overall intersection delay at Nixon Road and Green Road/Dhu Varren Road decreases as expected due to the implementation of the right turn bypass lane for the eastbound approach to the roundabout. According to VISSIM simulation results and Rodel analysis, the bypass lane is expected to be necessary by 2035, otherwise the LOS of the eastbound approach could reach an 'F'. With the inclusion of the bypass lane, LOS improves to a LOS 'C' for left turn and through movements and a LOS 'B' for the right turn movement, despite the increase in traffic volumes. Overall intersection delay decreases by 1.72 seconds to remain at a LOS 'B', which is the same as 2017.

The delay reducing effects of the proposed bypass lane cascade to the two adjacent intersections at Nixon Road and Barclay Way and Nixon Road and Haverhill Court, as overall intersection delays are expected to decrease by 0.75 seconds and 0.22 seconds, respectively. This outcome can likely be attributed to the reduction in southbound through movement delay at both intersections, which may be a positive by-product of the bypass lane.

The intersections of most concern are Nixon Road at Meade Court/Bluett Drive and Nixon Road at Sandalwood Circle/Aurora Street, which experience an increase in overall intersection delay of 21.37 seconds and 34.79 seconds, respectively. At each of these intersections, as seen in Table 13, delay is expected to increase notably for people attempting to access Nixon Road from the minor side streets. The VISSIM simulation shows pronounced queuing for the southbound Nixon Road approach to the existing roundabout at Nixon Road and Huron Parkway. This queuing extends up to and past Meade Court/Bluett Drive.

As seen in Table 15, the average corridor travel time compared to the 2017 Opening Year is expected to increase by 2.19 seconds in the northbound direction and increase by 85.43 seconds in the southbound direction. The sharp increase in travel time in the southbound

direction can be explained by the aforementioned queuing exhibited in the southbound direction at the roundabout at Nixon Road and Huron Parkway.

PM Peak – 2017

Regarding the PM peak period in the 2017 Opening Year, if no alternatives are pursued along the corridor, the overall intersection delay is expected to increase at all intersections except for Nixon Road and Dhu Varren Road/Green Road, Nixon Road and Haverhill Court, Nixon Road and Traver Boulevard and Nixon Road and the Clague Middle School driveway, as shown in Table 13.

The overall intersection delay at Nixon Road and Green Road/Dhu Varren Road decreases as expected due to the roundabout construction at the intersection. The roundabout is anticipated to substantially improve delay on the northbound approach, as the LOS of all turning movements improves from an 'F' to an 'A'. Delay on the westbound approach is expected to increase compared to existing conditions due to the same phenomenon (but opposite direction) described in the AM Peak period on the previous page. The LOS on the westbound approach is still expected to remain within the acceptable LOS 'D' criteria for all movements.

The delay decreases expected at the three consecutive intersections south of the intersection at Nixon Road and Green Road/Dhu Varren road can be explained by the striking reduction in queue size for northbound vehicles south of the proposed roundabout. As seen, northbound through movement approach delay decreases by 39.54 seconds at Haverhill Court and 5.06 seconds and Traver Boulevard. While the northbound through movement delay increases by 0.03 seconds at the intersection of Nixon Road and the Clague Middle School driveway, the westbound right turn movement delay decreases by a more formidable 4.44 seconds, resulting in the minor overall intersection delay decrease of 0.15 seconds.

As seen in Table 15, compared to the existing condition, the average corridor travel time is expected to decrease by 177.77 seconds in the northbound direction and increase by 0.82 seconds in the southbound direction. The stark reduction in travel time in the northbound direction despite the increase in traffic volume can be explained by the roundabout at Nixon Road and Green Road/Dhu Varren Road decreasing northbound delay.

PM Peak – 2035

In the PM peak period at the 2035 Horizon Year without corridor-wide operational improvements, overall average intersection delay is expected to increase at all intersections, including the roundabout at Nixon Road and Green Road/Dhu Varren Road. The intersections with the greatest increases in overall intersection delay include Nixon Road and Green Road/Dhu Varren Road, Nixon Road and Sandalwood Circle/Aurora Street, and Nixon Road and Huron Parkway.

At the intersection of Nixon Road and Green Road/Dhu Varren Road, the overall intersection delay is expected to increase by 17.41 seconds which results in LOS changing from a 'B' to a 'D'. The primary cause of this increase in delay is the deteriorating performance of the westbound approach, as foreshadowed in the 2017 analysis. The delay for all westbound movements is expected to increase by at least 55 seconds, resulting in a LOS 'F' for all

movements. It is anticipated that the westbound approach may need a right-turn bypass lane by 2035, similar to the eastbound approach.

At the intersection of Nixon Road and Sandalwood Circle/Aurora Street, the overall intersection delay is expected to increase by 14.63 seconds, which causes the LOS to fall from an 'A' to a 'C'. According to the VISSIM simulation evaluation, most of the increase in delay can be attributed to queuing on the southbound Nixon Road approach downstream at the existing roundabout at Huron Parkway. The queue is expected to propagate past Sandalwood Circle/Aurora Street, which is located only approximately 230' north of Huron Parkway. The VISSIM evaluation reports southbound queue at Huron Parkway extending up to 240' past Huron Parkway. The evaluation additionally reports southbound Nixon Roads queues at Sandalwood Circle/Aurora Street extending up to 325' past the intersection. The southbound Nixon Road queues are increasing southbound Nixon Road delays at Sandalwood Circle by up to 32 seconds and preventing westbound Aurora Court vehicles from accessing or crossing Nixon Road as seen by the LOS F experienced by all westbound movements.

At the intersection of Nixon Road and Huron Parkway, the overall intersection delay is expected to increase by 13.20 seconds from LOS 'B' to LOS 'D'. Most of the increase in delay can be explained by the decline in LOS on the eastbound (movement LOS ranging from 'D' to 'E') and westbound approaches (LOS 'E' for all movements). Motorists attempting to access Nixon Road or travel through from these approaches are not finding adequate gaps due to the influx of northbound and southbound vehicles.

As seen in Table 15, the average corridor travel time compared to the 2017 Opening Year is expected to increase by 0.88 seconds in the northbound direction and increase by 38.54 seconds in the southbound direction. The moderate increase in travel time in the southbound direction can be explained by the aforementioned queuing exhibited at the roundabout at Nixon Road and Huron Parkway.

Alternative Two: Continuous 3-Lane Section:

AM Peak – 2017

Regarding the AM peak period in the 2017 Opening Year of the roundabout at Nixon Road and Green Road/Dhu Varren Road, if Alternative Two is pursued, overall intersection delay decreases compared to "Do Nothing" or Alternative One at the intersections of Nixon Road and Barclay Way, Nixon Road and Haverhill, Nixon Road and Traver Boulevard, Nixon Road and the Clague Middle School driveway, and Nixon Road and Meade Court/Bluett Drive. Overall intersection delay increases compared to "Do Nothing" or Alternative One at the intersections of Nixon Road and Green Road/Dhu Varren Road, Nixon Road and Sandalwood Circle/Aurora Street, Nixon Road and Huron Parkway, Plymouth Road and Nixon Road, and Plymouth Road and Huron Parkway. While the effects of Alternative Two vary depending on the intersection, no change in overall intersection delay exceeds 2.10 seconds (the increase in delay at Nixon Road and Sandalwood Circle/Aurora Street).

It was expected that Alternative Two would have a negligible effect on corridor-wide operations as implementing the continuous center TWLTL serves to improve throughput for northbound and southbound motorists by pulling left-turning vehicles out of the main travel lane. In addition, motorists wishing to turn left from minor side streets would now have the center lane

to use as a refuge to complete the turn, depending on gap adequacy. This expectation was verified as follows:

- Northbound through movement delays decreased at all intersections between Dhu Varren Road/Green Road and Huron Parkway
- Southbound through movement delays decreased at:
  - Nixon Road and Haverhill Court
  - Nixon Road and Traver Boulevard
- Westbound left-turn movement delays decreased at (with LOS improvements noted substantial decreases indicated):
  - Nixon Road and Haverhill Court (4.55 second decrease, LOS 'B' to LOS 'A')
  - Nixon Road and the Clague Middle School driveway (4.26 second decrease, LOS 'C' to LOS 'B')
  - Nixon Road and Meade Court/Bluett Drive
  - Nixon Road and Sandalwood Circle/Aurora Street (6.54 second decrease, LOS 'E' to LOS 'D')
- Eastbound left-turn movement delays decreased at (with LOS improvements noted):
  - Nixon Road and Haverhill Court
  - Nixon Road and Traver Boulevard (1.10 second decrease, LOS 'C' to 'B')
  - Nixon Road and Meade Court/Bluett Drive
  - Nixon Road and Sandalwood Circle/Aurora Street (1.17 second decrease, LOS 'C' to LOS 'B')

Given that Alternative Two primarily serves to improve operational performance at the intersections south of Green Road/Dhu Varren Road and north of Huron Parkway, the only intersection where overall intersection delay did not decrease as anticipated is at Nixon Road and Sandalwood Circle/Aurora Street. While delays decrease for all minor side street movements, the southbound Nixon Road through movement delay increases by 4.09 seconds due to increased throughput north of the intersection. Given that the southbound through movement is the dominant movement at the intersection, the increase in overall intersection delay is expected, however LOS remains a 'B' as in the "Do Nothing"/Alternative One approach.

Comparing Table 15 and Table 16, the average corridor travel time compared to Alternative One is expected to decrease by 0.32 seconds in the northbound direction and increase by 2.99 seconds in the southbound direction.

AM Peak- 2035

In the AM peak period at the 2035 Horizon Year under Alternative Two, the directional effects on overall intersection delay at the intersections south of Dhu Varren Road/Green Road and north of Huron Parkway mimic the 2017 results, except at Sandalwood Circle/Aurora Street, which shows a negligible decrease in delay compared to Alternative One.

Comparing Table 15 and Table 16, the average corridor travel time compared to Alternative One is expected to decrease by 0.13 seconds in the northbound direction and decrease by 5.24 seconds in the southbound direction.

PM Peak – 2017

Regarding the PM peak period in the 2017 Opening Year of the roundabout at Nixon Road and Green Road/Dhu Varren Road, if Alternative Two is deployed corridor-wide, overall intersection delay will decrease at all intersections except Plymouth Road and Huron Parkway (2.28 second increase). Alternative Two was expected to affect the Nixon Road corridor in the PM Peak similarly to the AM Peak, with delay decreases in the northbound and southbound through directions as well as for eastbound and westbound left- and right-turn movements. This expectation was verified as follows:

- Northbound and Southbound through movement delays decreased at all intersections between Dhu Varren Road/Green Road and Huron Parkway
- Westbound left-turn movement delays decreased at (with substantial decreases indicated):
    - Nixon Road and Haverhill Court (3.04 second decrease, LOS 'B' to LOS 'A')
    - Nixon Road and Meade Court/Bluett Drive (6.16 second decrease, LOS 'C' to LOS 'B')
- Eastbound left-turn movement delays decreased at:
    - Nixon Road and Haverhill Court
    - Nixon Road and Meade Court/Bluett Drive

Unlike the AM Peak in the 2017 Opening Year, all intersections between Dhu Varren Road/Green Road and Huron Parkway experienced a decrease in overall delay as a result of Alternative Two.

Comparing Table 15 and Table 16, the average corridor travel time compared to Alternative One is expected to decrease by 0.35 seconds and 1.91 seconds in the northbound and southbound directions, respectively.

PM Peak – 2035

In the PM peak period at the 2035 Horizon Year under Alternative Two, overall average intersection delay is expected to decrease at all intersections except Nixon Road and Dhu Varren Road/Green Road (2.51 second increase) and Plymouth Road and Huron Parkway (2.28 second increase).

- Northbound through movement delays decreased at all intersections between Dhu Varren Road/Green Road and Huron Parkway
- Southbound through movement delays decreased at (with substantial decreases indicated):
    - Nixon Road and Haverhill Court
    - Nixon Road and Meade Court/Bluett Drive
    - Nixon Road and Sandalwood Circle/Aurora Street (29.73 second decrease, LOS 'E' to LOS 'B')
- Westbound left-turn movement delays decreased at all intersections between Dhu Varren Road/Green Road and Huron Parkway (with substantial decreases indicated):
    - Nixon Road and Meade Court/Bluett Drive (6.16 second decrease, LOS 'C' to LOS 'B')
    - Nixon Road and Sandalwood Circle/Aurora Street (82.56 second decrease, LOS 'F' to LOS 'D')

- Eastbound left-turn movement delays decreased at all intersections between Dhu Varren Road/Green Road and Huron Parkway (with substantial decreases indicated):
    - Nixon Road and Meade Court/Bluett Drive (6.29 second decrease, LOS 'C' to LOS 'A')

Comparing Table 15 and Table 16, the average corridor travel time compared to Alternative One is expected to decrease by 0.74 seconds and 32.93 seconds in the northbound and southbound directions, respectively.

Table 16: Average Corridor Travel Time from North of Huron Parkway to South of M-14 - Alternative Two

Peak Period	Travel Direction	2017		2035	
		Vehicles[4]	Average Travel Time (sec/veh)	Vehicles	Average Travel Time (sec/veh)
AM	NB	36	169.39	37	171.76
	SB	179	190.93	200	268.13
PM	NB	193	168.49	217	168.98
	SB	74	170.06	89	177.58

[4] The 'Vehicles' variable represents the total number of vehicles who traveled the entire length of Nixon Road from north of Huron Parkway to South of M-14 without performing a turning maneuver to a minor side-street.

Table 17: HCM 2010 Level of Service – Nixon Road Corridor – Alternative Two: AM Peak

VISSIM Analysis by Intersection and Year		Year	LOS (Avg. Delay in sec/veh)												
			NB			SB			EB			WB			INT
			L	T	R	L	T	R	L	T	R	L	T	R	
Alternative Two – Continuous Three Lane Section	Nixon Road and Barclay Way	2017	A (4.46)	A (1.03)	C (17.40)	C (15.04)	A (1.64)	A (0.87)	A (8.85)	NA	A (8.39)	B (10.68)	NA	B (10.53)	A (3.90)
		2035	A (4.59)	A (0.74)	A (6.57)	C (15.15)	A (4.64)	A (2.51)	A (8.20)	NA	A (9.22)	C (15.53)	NA	B (10.7)	A (5.96)
	Nixon Road and Dhu Varren Road/Green Road	2017	A (7.33)	A (6.27)	A (5.17)	B (10.54)	A (9.94)	B (11.61)	E (42.00)	E (36.54)	E (36.81)	A (5.57)	A (5.57)	A (4.23)	C (16.56)
		2035	A (8.67)	A (7.10)	A (5.31)	C (18.06)	C (18.19)	C (17.69)	C (24.54)	C (22.47)	B (14.24)	A (6.45)	A (6.34)	A (5.05)	B (14.84)
	Nixon Road and Haverhill Court	2017	A (7.36)	A (0.30)	A (0.57)	A (0.58)	A (0.43)	A (3.28)	A (4.62)	NA	A (3.83)	A (5.57)	NA	A (9.45)	A (0.97)
		2035	A (6.36)	A (0.31)	A (0.59)	A (2.39)	A (0.28)	A (0.44)	A (5.34)	NA	A (4.72)	A (7.63)	NA	A (6.14)	A (0.79)
	Nixon Road and Traver Boulevard	2017	A (5.67)	A (0.73)	NA	NA	A (4.64)	A (1.60)	B (14.01)	NA	C (19.08)	NA	NA	NA	A (6.16)
		2035	A (9.23)	A (0.96)	NA	NA	A (5.75)	A (3.15)	C (20.71)	NA	F (51.69)	NA	NA	NA	B (13.05)
	Nixon Road and the Clague Middle School driveway	2017	NA	A (2.50)	A (1.12)	A (3.96)	A (0.52)	NA	NA	NA	NA	B (14.20)	NA	B (12.48)	A (2.54)
		2035	NA	A (3.84)	A (1.41)	A (4.11)	A (2.79)	NA	NA	NA	NA	D (32.11)	NA	D (25.79)	A (5.83)
	Nixon Road and Meade Court/Bluett Drive	2017	A (5.78)	A (1.15)	A (1.41)	A (3.09)	A (1.26)	NA	B (13.74)	A (5.19)	A (8.62)	C (15.77)	B (10.14)	B (14.34)	A (3.23)
		2035	A (6.24)	A (1.67)	A (1.67)	A (4.1)	C (18.18)	NA	C (15.67)	NA	D (33.38)	F (104.91)	E (47.51)	F (80.43)	C (21.47)
	Nixon Road and Sandalwood Circle/Aurora Street	2017	C (18.39)	A (1.49)	A (1.52)	A (6.72)	C (20.00)	A (4.43)	B (14.41)	NA	C (19.17)	D (30.84)	NA	A (8.25)	A (14.38)
		2035	C (24.85)	A (1.96)	A (1.12)	E (39.45)	F (64.66)	F (72.88)	NA	NA	D (25.65)	F (71.60)	NA	F (114.04)	E (43.02)
	Nixon Road and Huron Parkway	2017	B (12.83)	B (13.09)	B (8.21)	A (4.96)	A (8.53)	A (4.67)	C (24.16)	D (34.70)	D (36.63)	A (9.32)	A (6.82	A (7.40)	A (9.78)
		2035	C (17.91)	B (14.75)	A (9.82)	A (6.47)	C (16.04)	A (5.17)	F (73.86)	F (61.3)	F (79.59)	C (16.80)	A (7.68)	A (8.94)	C (15.54)
	Plymouth Road and Nixon Road	2017	E (63.23)	E (60.02)	D (53.42)	F (86.18)	F (83.84)	F (83.04)	E (64.01)	B (14.63)	B (14.85)	F (93.37)	B (15.04)	B (13.60)	C (34.86)
		2035	E (73.55)	E (55.96)	E (57.99)	F (118.71)	F (116.37)	F (116.31)	E (66.34)	B (16.17)	B (14.91)	F (92.99)	B (17.58)	B (16.52)	D (42.45)
	Plymouth Road and Huron Parkway	2017	F (96.60)	E (58.31)	E (56.91)	F (83.43)	E (55.40)	D (54.53)	D (38.88)	D (37.09)	D (36.59)	E (56.36)	B (15.24)	B (15.71)	D (43.17)
		2035	F (108.10)	E (57.80)	E (59.18)	F (86.55)	E (55.56)	E (56.48)	F (57.74)	D (38.08)	D (39.00)	F (80.74)	B (18.92)	B (19.89)	D (48.48)

Table 18: HCM 2010 Level of Service – Nixon Road Corridor – Alternative Two: PM Peak

VISSIM Analysis by Intersection and Year		Year	LOS (Avg. Delay in sec/veh)												
			NB			SB			EB			WB			INT
			L	T	R	L	T	R	L	T	R	L	T	R	
Alternative One - Center TWLTL	Nixon Road and Barclay Way	2017	A (1.69)	A (0.71)	A (0.93)	A (3.21)	A (0.57)	A (0.70)	A (7.90)	NA	A (6.56)	A (9.38)	NA	A (8.11)	A (1.48)
		2035	A (1.80)	A (0.75)	A (1.06)	A (6.99)	A (0.70)	A (0.74)	A (8.44)	NA	A (6.69)	B (10.03)	NA	A (9.33)	A (1.61)
	Nixon Road and Dhu Varren Road/Green Road	2017	A (8.32)	A (7.58)	A (6.05)	B (10.62)	A (9.66)	B (11.34)	A (6.24)	A (3.94)	A (3.43)	D (26.72)	D (27.13)	D (26.86)	B (13.25)
		2035	A (8.66)	A (8.00)	A (7.36)	B (12.49)	B (12.50)	B (14.17)	A (5.33)	A (4.53)	A (3.27)	F (93.14)	F (90.95)	F (91.27)	D (33.19)
	Nixon Road and Haverhill Court	2017	A (2.78)	A (0.87)	A (0.70)	A (2.77)	A (0.20)	A (0.51)	A (4.93)	NA	A (1.47)	A (7.53)	NA	A (6.57)	A (0.86)
		2035	A (2.44)	A (0.88)	A (0.76)	A (5.58)	A (0.11)	A (0.45)	A (4.85)	NA	A (1.85)	A (7.92)	NA	A (7.45)	A (0.93)
	Nixon Road and Traver Boulevard	2017	A (1.96)	A (0.62)	NA	NA	A (2.85)	A (0.71)	A (9.77)	NA	A (7.32)	NA	NA	NA	A (1.94)
		2035	A (1.39)	A (0.64)	NA	NA	A (3.11)	A (0.88)	B (11.67)	NA	A (7.77)	NA	NA	NA	A (2.09)
	Nixon Road and the Clague Middle School driveway	2017	NA	A (1.60)	A (0.61)	A (6.06)	A (0.44)	NA	NA	NA	NA	B (11.90)	NA	B (10.27)	A (1.83)
		2035	NA	A (1.64)	A (0.74)	A (7.34)	A (0.45)	NA	NA	NA	NA	B (11.82)	NA	B (13.83)	A (1.97)
	Nixon Road and Meade Court/Bluett Drive	2017	A (3.39)	A (1.47)	A (1.61)	A (6.10)	A (0.44)	A (0.53)	A (9.76)	A (9.72)	A (7.71)	B (11.76)	A (8.86)	A (9.28)	A (1.89)
		2035	A (2.82)	A (1.60)	A (1.51)	A (8.66)	A (0.45)	A (0.64)	A (9.23)	C (15.38)	A (7.96)	B (12.86)	B (10.62)	B (10.44)	A (2.14)
	Nixon Road and Sandalwood Circle/Aurora Street	2017	A (4.94)	A (1.25)	A (0.72)	A (6.50)	A (5.58)	A (0.94)	NA	A (2.97)	A (8.85)	C (23.62)	B (11.49)	B (12.31)	A (3.65)
		2035	A (6.37)	A (1.42)	A (0.69)	B (11.10)	A (9.98)	A (3.42)	NA	A (3.72)	B (12.37)	D (32.30)	C (16.84)	C (18.57)	A (5.85)
	Nixon Road and Huron Parkway	2017	C (16.21)	B (14.07)	B (10.10)	A (6.13)	A (6.47)	A (4.97)	B (14.71)	B (14.37)	B (13.27)	C (18.88)	C (20.06)	C (19.33)	B (13.23)
		2035	C (19.10)	C (18.40)	B (14.70)	A (7.26)	B (10.46)	A (5.71)	D (25.05)	C (24.96)	C (24.44)	D (31.61)	D (26.76)	D (28.35)	C (19.34)
	Plymouth Road and Nixon Road	2017	E (73.35)	E (61.25)	E (56.42)	F (81.45)	E (78.27)	E (70.49)	E (79.81)	B (17.93)	B (19.71)	F (200.95)	C (22.44)	C (22.64)	D (38.55)
		2035	E (73.76)	E (61.36)	E (62.24)	F (95.72)	F (81.69)	E (78.44)	F (104.26)	C (27.77)	C (19.00)	F (189.90)	C (25.99)	C (25.38)	D (46.54)
	Plymouth Road and Huron Parkway	2017	F (116.20)	E (57.04)	E (74.37)	E (72.76)	D (54.58)	D (49.28)	E (71.51)	C (23.24)	C (23.14)	F (87.27)	B (18.69)	B (18.69)	D (42.49)
		2035	F (142.01)	E (65.88)	F (158.91)	F (87.87)	D (54.67)	E (69.54)	F (82.59)	C (25.27)	C (28.30)	F (90.58)	C (22.89)	C (21.94)	D (54.61)

Alternative Three: String of Roundabouts at Key Intersections

AM Peak – 2017

Regarding the AM peak period in the 2017 Opening Year of the roundabout at Nixon Road and Green Road/Dhu Varren Road, if Alternative Three is pursued, overall intersection delay decreases compared to Alternative Two at the intersections of Nixon Road and Barclay Way, Nixon Road and Green Road/Dhu Varren Road, Nixon Road and Traver Boulevard, Nixon Road and Sandalwood Circle/Aurora Street, Nixon Road and Huron Parkway, and Plymouth Road and Nixon Road. Overall intersection delay increases compared to Alternative Two at the intersections of Nixon Road and Haverhill Court, Nixon Road and the Clague Middle School driveway, Nixon Road and Meade Court/Bluett Drive, and Plymouth Road and Huron Parkway. The largest decrease in delay compared to Alternative Two occurs at the existing roundabout at Nixon Road and Huron Parkway at 4.37 seconds, while the largest increase in delay occurs at Nixon Road and Meade Court/Bluett Drive at 4.70 seconds.

At the intersection of Nixon Road and Huron Parkway, most of the decrease in overall intersection average delay may be attributed to the decrease in average delay on the eastbound approach for all movements. Eastbound left turns (10 vehicles) experienced a 16.53 second decrease in average delay, right turns (29 vehicles) experienced a 31.78 second decrease in average delay, and through vehicles (69 vehicles) experienced a 29.88 second decrease in average delay. The substantial decrease in delay for eastbound motorists may be attributed to the increase in adequate gaps due to the proposed roundabouts north of the intersection. These proposed roundabouts are acting to "meter" the southbound traffic flow, whereas in the "Do Nothing" / Alternative One and Alternative Two options, southbound vehicles were allowed to flow practically unimpeded (particularly in Alternative Two).

At the intersection of Nixon Road and Meade Court/Bluett Drive, the majority of the increase in overall intersection delay is likely a result of the increase in delay on the eastbound approach and southbound approaches, as shown when comparing Table 17 and Table 20. The intersection of Nixon Road and Meade Court/Bluett Drive has the highest volume of westbound left-turning AM Peak traffic of any of the study intersections on Nixon Road. These westbound left-turning vehicles constrict the free-flow of southbound and eastbound vehicles at the roundabout, resulting in the observed increases in delay.

AM Peak – 2035

The directional effect on overall average intersection delay of Alternative Three compared to Alternative Two on the corridor in the 2035 Horizon Year was the same as the 2017 Opening Year, except at the intersection of Nixon Road and Meade Court/Bluett Drive which experienced a decrease in delay of 6.08 seconds (as opposed to an increase in delay of 4.70 seconds in 2017). The largest decrease in overall average intersection delay occurred at the intersection of Nixon Road and Sandalwood Circle/Aurora Street (9.39 seconds, from LOS 'E' to LOS 'D'), while the largest increase in overall average intersection delay occurred at Nixon Road and Haverhill Court (4.97 second increase, LOS 'A' in both 2017 and 2035).

The decrease in delay at Meade Court/Bluett Drive can likely be explained by the drastic reduction in delay for motorists on the westbound approach to the intersection. Westbound right turns (29 vehicles) experienced a 71.73 second decrease in average delay and left turns

(129 vehicles) experienced an 86.17 second decrease in average delay compared to Alternative Two. The sheer magnitude of total delay reduction for the westbound approach overcame the increases in delay to the Nixon Road southbound and northbound through movements at the intersection to result in the observed overall intersection average delay reduction, unlike in the 2017 Opening Year.

The intersection of Nixon Road and Sandalwood Circle/Aurora Street had a large enough reduction in delay (9.39 seconds) to change from LOS 'E' to LOS 'D'. This decrease in overall average intersection delay can be explained by the associated reduction in delay for the eastbound right-turn movement (12.86 seconds, LOS 'D' to LOS 'A') and that southbound through movement (17.88 seconds, LOS 'F' to LOS 'E'). Each of these decreases can likely be attributed to the same phenomenon responsible for decreasing eastbound delay at Nixon Road and Huron Parkway described in the previous section, namely gap creation due to upstream roundabouts and the subsequent queue length reduction at the Nixon Road and Huron Parkway roundabout.

PM Peak – 2017 & 2035

Regarding the PM peak period in the 2017 Opening Year as well as the 2035 Horizon Year, if Alternative Three is pursued, overall intersection delay decreases compared to Alternative Two at the intersections of Nixon Road and Haverhill Road, Nixon Road and Huron Parkway, and Plymouth Road and Huron Parkway. Overall average intersection delay increases at all other intersections.

The most likely explanation of the diminished performance of Alternative Three compared to Alternative Two in the PM Peak period is the increase in northbound through movement delay at most of the intersections. In the 2017 Opening Year, northbound through delay is expected to increase compared to Alternative Two at Nixon Road and Barclay Way (1.81 seconds), Nixon Road and Traver Boulevard (3.14 seconds), Nixon Road and the Clague Middle School driveway (2.00 seconds), Nixon Road and Meade Court/Bluett Drive (3.55 seconds), and Nixon Road and Sandalwood Circle/Aurora Street (7.01 seconds). While northbound delay increases at these intersections, the LOS remains an 'A' as also expected under Alternative Two. However, given that the northbound through movement is the dominant movement in the Nixon Corridor during the PM peak, the moderate decreases in delay expected for many of the minor side streets are negated.

Average Corridor Travel Time Comparison of The Three Alternatives

As seen by comparing Table 15, Table 16 and Table 19, the average corridor travel time for Alternative Three compared to Alternatives One and Two is higher in both directions for both the 2017 Opening Year as well as the 2035 Horizon Year. This is due to the increase in primary northbound and southbound delay at the proposed roundabouts. In Alternative Three, northbound and southbound vehicles are required to yield to circulating vehicles at the proposed roundabouts which do not exist at the five previously specified locations in either Alternatives One or Two.

Table 19: Average Corridor Travel Time from North of Huron Parkway to South of M-14 - Alternative Three

Peak Period	Travel Direction	2017		2035	
		Vehicles[5]	Average Travel Time (sec/veh)	Vehicles	Average Travel Time (sec/veh)
AM	NB	37	213.27	39	214.60
	SB	185	226.14	196	320.97[6]
PM	NB	189	211.81	214	218.82
	SB	80	204.33	87	213.47

[5] The 'Vehicles' variable represents the total number of vehicles who traveled the entire length of Nixon Road from north of Huron Parkway to South of M-14 without performing a turning maneuver to a minor side-street.

[6] While the average vehicle delay is expected to increase by approximately 95 seconds from 2017 to 2035, the average standard deviation in the average vehicle delay is 64 seconds, which shows that delay will vary substantially by vehicle.

Table 20: HCM 2010 Level of Service – Nixon Road Corridor – Alternative Three: AM Peak

VISSIM Analysis by Intersection and Year		Year	LOS (Avg. Delay in sec/veh)												
			NB			SB			EB			WB			INT
			L	T	R	L	T	R	L	T	R	L	T	R	
Alternative One - Center TWLTL	Nixon Road and Barclay Way	2017	A (1.77)	A (2.39)	A (2.35)	A (2.79)	A (3.04)	A (3.53)	A (5.39)	NA	A (4.96)	A (1.50)	NA	A (2.43)	A (2.88)
		2035	A (2.70)	A (2.89)	A (2.31)	A (3.50)	A (3.78)	A (5.52)	A (7.42)	NA	A (6.27	A (1.72)	NA	A (2.23)	A (3.51)
	Nixon Road and Dhu Varren Road/Green Road	2017	A (6.53)	A (6.59)	A (5.13)	A (9.61)	A (9.02)	A (9.57)	E (36.17)	D (32.09)	D (29.94)	A (5.06)	A (5.55)	A (3.69)	B (14.36)
		2035	A (7.18)	A (5.95)	A (4.95)	C (15.51)	C (16.90)	B (14.95)	C (17.72)	C (18.05)	B (13.47)	A (4.98)	A (5.60)	A (6.77)	B (12.91)
	Nixon Road and Haverhill Court	2017	NA	A (0.28)	A (0.58)	NA	A (0.30)	A (1.00)	NA	NA	A (9.10)	NA	NA	A (4.97)	A (0.99)
		2035	NA	A (0.26)	A (0.50)	NA	A (4.82)	A (1.44)	NA	NA	D (32.28)	NA	NA	A (5.08)	A (5.76)
	Nixon Road and Traver Boulevard	2017	A (1.21)	A (2.57)	NA	NA	A (6.33)	A (5.67)	A (9.12)	NA	A (7.30)	NA	NA	NA	A (5.19)
		2035	A (2.45)	A (2.71)	NA	NA	C (15.07)	B (12.71)	B (13.08)	NA	C (18.17)	NA	NA	NA	B (11.47)
	Nixon Road and the Clague Middle School driveway	2017	NA	A (2.28)	A (0.90)	NA	A (2.78)	NA	NA	NA	NA	NA	NA	A (5.89)	A (2.70)
		2035	NA	A (2.51)	A (1.00)	NA	A (9.72)	NA	NA	NA	NA	NA	NA	A (6.22)	A (6.87)
	Nixon Road and Meade Court/Bluett Drive	2017	A (5.57)	A (5.59)	A (5.92)	A (7.49)	A (8.34)	NA	D (33.24)	C (20.45)	C (20.60)	A (9.57)	A (3.70)	A (7.29)	A (7.93)
		2035	A (5.10)	A (6.30)	A (5.39)	B (13.06)	C (19.16)	NA	B (12.21)	D (26.99)	F (106.11)	C (18.74)	A (5.00)	A (8.70)	C (15.39)
	Nixon Road and Sandalwood Circle/Aurora Street	2017	NA	A (8.10)	A (0.40)	NA	C (15.22)	C (16.69)	NA	NA	A (7.80)	NA	NA	C (20.10)	B (12.76)
		2035	NA	A (9.46)	A (0.39)	NA	E (46.78)	E (39.99)	NA	NA	A (12.79)	NA	NA	C (16.82)	D (33.63)
	Nixon Road and Huron Parkway	2017	A (6.82)	B (10.38)	A (7.05)	A (4.33)	A (4.63)	A (3.05)	A (7.63)	A (4.82)	A (4.85)	A (7.54)	A (6.86)	A (5.54)	A (5.41)
		2035	C (17.32)	B (13.00)	A (7.87)	A (6.76)	B (14.65)	A (4.41)	A (9.91)	A (6.98)	C (16.94)	C (19.74)	A (7.42)	A (6.96)	B (10.05)
	Plymouth Road and Nixon Road	2017	E (70.98)	E (56.31)	D (48.39)	E (69.01)	E (74.95)	E (77.14)	E (65.98)	B (16.02)	B (16.69)	F (103.05)	B (16.49)	B (13.96)	C (34.16)
		2035	E (73.84)	D (47.88)	D (49.64)	F (90.08)	F (110.87)	F (107.17)	E (63.32)	B (19.11)	B (17.08)	F (98.88)	B (19.21)	B (18.40)	D (41.68)
	Plymouth Road and Huron Parkway	2017	F (91.20)	D (54.91)	D (58.59)	F (84.00)	E (53.38)	E (57.37)	C (26.38)	D (40.56)	D (42.91)	D (56.23)	B (18.92)	B (19.06)	D (44.62)
		2035	F (98.01)	E (55.87)	D (54.80)	F (85.41)	D (51.98)	E (55.31)	F (114.21)	D (40.95)	D (43.01)	E (77.19)	C (22.15)	C (22.86)	D (48.56)

Table 21: HCM 2010 Level of Service – Nixon Road Corridor – Alternative Three: PM Peak

VISSIM Analysis by Intersection and Year		Year	LOS (Avg. Delay in sec/veh)												
			NB			SB			EB			WB			INT
			L	T	R	L	T	R	L	T	R	L	T	R	
Alternative One - Center TWLTL	Nixon Road and Barclay Way	2017	A (2.11)	A (2.52)	A (2.22)	A (2.66)	A (2.43)	A (1.66)	A (3.51)	NA	A (2.54)	A (4.54)	NA	A (6.95)	A (2.55)
		2035	A (2.74)	A (2.68)	A (2.17)	A (4.36)	A (2.73)	A (2.48)	A (2.66)	NA	A (2.14)	A (5.03)	NA	A (7.85)	A (2.74)
	Nixon Road and Dhu Varren Road/Green Road	2017	A (8.14)	A (6.96)	A (5.90)	B (10.01)	A (9.30)	B (10.92)	A (6.27)	A (4.29)	A (3.44)	D (34.33)	D (31.45)	D (32.11)	B (14.70)
		2035	A (7.92)	A (8.41)	A (6.34)	B (11.63)	B (11.55)	B (13.15)	A (6.28)	A (4.52)	A (2.66)	F (103.99)	F (105.91)	F (105.47)	D (36.74)
	Nixon Road and Haverhill Court	2017	NA	A (0.74)	A (0.62)	NA	A (0.24)	A (0.55)	NA	NA	A (7.26)	NA	NA	A (5.41)	A (0.82)
		2035	NA	A (0.89)	A (0.75)	NA	A (0.24)	A (0.56)	NA	NA	A (7.31)	NA	NA	A (5.70)	A (0.87)
	Nixon Road and Traver Boulevard	2017	A (1.34)	A (3.76)	NA	NA	A (3.48)	A (2.98)	A (4.11)	NA	A (2.62)	NA	NA	NA	A (3.34)
		2035	A (1.20)	A (4.60)	NA	NA	A (3.89)	A (3.08)	A (6.26)	NA	A (2.50)	NA	NA	NA	A (3.92)
	Nixon Road and the Clague Middle School driveway	2017	NA	A (2.61)	A (0.77)	NA	A (0.66)	NA	NA	NA	NA	NA	NA	A (5.44)	A (2.06)
		2035	NA	A (2.93)	A (0.83)	NA	A (0.94)	NA	NA	NA	NA	NA	NA	A (5.75)	A (2.37)
	Nixon Road and Meade Court/Bluett Drive	2017	A (4.12)	A (5.02)	A (4.75)	A (3.45)	A (3.84)	A (0.67)	A (4.24)	A (3.45)	A (4.77)	B (14.26)	A (3.42)	B (14.34)	A (5.12)
		2035	A (6.54)	A (5.86)	A (5.61)	A (4.50)	A (4.74)	A (1.31)	A (9.92)	A (2.13)	B (14.61)	C (16.75)	NA	C (20.19)	A (6.23)
	Nixon Road and Sandalwood Circle/Aurora Street	2017	NA	A (8.26)	A (0.74)	NA	A (8.14)	A (4.3)	NA	NA	A (5.43)	NA	NA	B (13.86)	A (8.10)
		2035	NA	B (10.61)	A (0.44)	NA	B (10.98)	A (5.20)	NA	NA	A (6.72)	NA	NA	C (18.02)	B (10.57)
	Nixon Road and Huron Parkway	2017	B (13.54)	B (12.32)	A (9.83)	A (3.95)	A (3.57)	A (2.17)	B (10.30)	A (7.76)	A (9.29)	C (17.70)	C (18.21)	C (17.83)	B (10.94)
		2035	C (20.15)	C (18.13)	B (14.35)	A (5.52)	A (8.70)	A (2.68)	B (13.84)	A (9.42)	A (9.84)	D (34.63)	D (29.16)	D (29.63)	C (17.44)
	Plymouth Road and Nixon Road	2017	E (73.25)	D (53.04)	D (51.94)	E (72.51)	D (48.76)	D (51.86)	F (83.53)	C (22.23)	C (24.28)	F (206.67)	C (24.18)	C (28.74)	D (38.83)
		2035	E (76.26)	E (56.07)	E (60.61)	F (100.14)	E (78.05)	E (76.61)	F (102.42)	C (33.90)	C (24.38)	F (204.18)	C (32.10)	C (33.31)	D (50.59)
	Plymouth Road and Huron Parkway	2017	F (113.65)	D (52.53)	E (61.95)	E (73.48)	D (51.96)	D (51.11)	E (62.10)	C (24.13)	C (23.76)	F (81.23)	C (23.63)	C (23.00)	D (42.08)
		2035	F (144.06)	E (56.77)	E (73.86)	F (85.83)	D (49.94)	E (57.82)	D (52.06)	C (27.64)	C (29.06)	F (82.48)	C (30.34)	C (27.09)	D (49.26)

10. RECOMMENDED PLAN OF IMPROVEMENTS

Summary of Desired Outcomes

The comments and concerns gathered by local residents at the three public meetings held by OHM at Clague Middle School determined the following key focus areas:

- Non-Motorized transportation
    4. Unsafe intersections and mid-block crossings
    5. Lack of bus stops
    6. Disconnected non-motorized network
- Motorized vehicles
    3. Unacceptable levels of delay and safety at the intersection of Nixon Road and Green Road/Dhu Varren Road presently operating under all-way STOP-control
    4. Inadequate access to Nixon Road from minor side-street approaches

Final Selection of Corridor Improvement Alternative

With regards to the first key focus area for vehicles, the proposed roundabout at Nixon Road and Green Road/Dhu Varren road will substantially reduce delay at the intersection as shown in Table 13, particularly in the southbound Nixon Road direction. Further, the roundabout will increase pedestrian safety by providing median islands separating incoming and outgoing auto traffic, allowing pedestrians to seize a gap in traffic in only one direction at a time rather than in two directions. Bicycle safety was accommodated by providing exit ramps to the shared use path around the roundabout for less confident cyclists.

The vehicle operations evaluation of potential alternatives determined that Alternative Three outperforms Alternative Two in the AM peak period against the second key public focus area for motorists due to improved minor street access. Further, under Alternative Three out to the 2035 horizon year, the average vehicle delay in the northbound and southbound directions does not exceed 47 seconds at any intersection on Nixon Road between Huron Parkway and Barclay Way. In fact, delays are expected to fall under 20 seconds for every movement on every northbound/southbound approach except the AM peak period southbound movements at Nixon Road and Sandalwood Circle/Aurora Street (46.78 seconds for throughs and 39.99 seconds for right-turns). However, delays for these movements are expected to reach even higher values under Alternative Two.

To maintain satisfactory LOS by 2035 at the proposed roundabout at Nixon Road and Green Road/Dhu Varren Road, a right-turn bypass lane may need to be incorporated at the eastbound approach, as analyzed in the present study. Although not investigated, it is also possible that the westbound approach may require a bypass lane to keep LOS below an “F”. The proposed design of the roundabout incorporated the potential future addition of these bypass lanes.

Finally, all three non-motorized transportation key focus areas are accomplished under Alternative Three by incorporating the five non-motorized improvements described in Section 8 of the report. Additionally, Alternative Three allows for enhanced AAATA bus service on Nixon Road north of Green Road/Dhu Varren Road through the inclusion of the roundabout at Barclay Way.