

Ottawa Beach Road Study

**Prepared For:
Park Township**

**September 30, 2014
Project No. G140303**

frc&h



OTTAWA BEACH ROAD STUDY

**PREPARED FOR:
PARK TOWNSHIP**

**SEPTEMBER 30, 2014
PROJECT NO. G140303**

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LIST OF ABBREVIATIONS/ACRONYMS

ADA	Americans with Disabilities Act
ADT	average daily traffic
DNR	Department of Natural Resources
EB	eastbound
FHWA	Federal Highway Administration
FTCH	Fishbeck, Thompson, Carr & Huber, Inc.
MDOT	Michigan Department of Transportation
MMUTCD	Michigan Manual of Uniform Traffic Control Devices
mph	miles per hour
NB	northbound
OBI	Ottawa Beach Inn
OCRC	Ottawa County Road Commission
ROW	right-of-way
RRFB	Rectangular Rapid Flashing Beacons
SB	southbound
Township	Park Township
vpd	vehicles per day
vph	vehicles per hour
WB	westbound

1.0 EXECUTIVE SUMMARY

The following executive summary specifies the findings and recommendations of the traffic study for Ottawa Beach Road from 144th Avenue to the Holland State Park beach in Park Township (Township), Michigan.

1.1 FINDINGS

- A. The average daily traffic (ADT) volumes collected decrease along the corridor as traffic travels toward Holland State Park, which is consistent with historical volume data provided by the Ottawa County Road Commission (OCRC). The volumes collected are higher than the historical volumes due to the additional holiday traffic during Independence Day weekend, which supports the assumption that peak operations were observed as part of the study.
- B. The speed data showed that travel speeds varies throughout the corridor. In three locations, the travel speed was slightly lower than the posted speed limit. In one location, the posted speed limit was greatly exceeded. Possible changes in the posted speed limit should be investigated further.
- C. A 3-year crash analysis was performed for the Ottawa Beach Road corridor. Between January 2011 and December 2013, there were 122 crashes. Of those 122 crashes, the primary crash type was approximately 32% single motor vehicle, 21% angle and 19% rear-end crashes. When reviewing the crash reports, only one trend was found concerning crashes between eastbound and westbound left turns and opposing traffic at 144th Avenue. Most left turning drivers stated they did not see the opposing vehicle on Ottawa Beach Road. It is possible the curve in the road at the intersection creates an environment where such angle crashes potentially occur more frequently.
- D. Though the entire corridor was reviewed for traffic safety and operational issues, there were several target areas that were reviewed in detail. These areas include the Park Township Airport and Ottawa County Fairgrounds entrances, the four to two-lane transition at 160th Avenue, the Department of Natural Resources (DNR) Boat Launch, the Holland State Park Campground and the General Store Area. Safety, operational, pedestrian and bicycle issues, roadway signing and access points were observed for each target area.
- E. The significant safety and operational issues observed at each target area are as follows:
 1. Park Township Airport and Ottawa County Fairgrounds Entrances – Event signing and guidance seemed to be deficient during peak Ottawa County Fair traffic, which caused some confusion for visitors at the fairground driveways.
 2. Four to two-lane transition at 160th Avenue – Several westbound (WB) vehicles were observed to merge while in the right turn lane or in the intersection. This is an operational and potential safety concern, as many vehicles were observed cutting off traffic.

3. DNR Boat Launch – The DNR Boat Launch operates as a one way loop between the ramp on the south side of Ottawa Beach Road and an overflow parking lot on the north side. After parking in the overflow parking lot, pedestrians cross Ottawa Beach Road to and from their vehicles. Crosswalks and sidewalks are not present. Sight-lines for vehicles and pedestrians crossing Ottawa Beach Road are limited due the curve of the road.
 4. Holland State Park Campground – Several of the campers were observed to use the beach directly across Ottawa Beach Road for recreational activities. Pedestrians and bikes would cross the road at the campground entrance, but a crosswalk is not present. Pedestrians would carry beach gear, kayaks, canoes, etc. while crossing the road. The road's curve and illegally parked vehicles cause limited sight-lines. The path on the north side of the road is adjacent to a paved shoulder from the Ottawa Beach Inn (OBI) to the campground. This creates some confusion for motorists, pedestrians and bicyclists. Both the shoulder and path were observed to be used as a right turn lane by motorists entering the campground.
 5. General Store Area – High volumes of vehicular, pedestrian and bike traffic were observed in this area. The path transitions to a narrow shoulder and given the large amounts of pedestrian and bike traffic, some enter the road. Several pedestrians and bikes were also witnessed crossing the road to and from the General Store. No crosswalks are present near to the store.
- F. Though the primary focus of the traffic study was on the target areas, other key locations on the corridor were also reviewed in more detail where noteworthy concerns were witnessed. These other key locations include the Ottawa Beach Road and 144th Avenue intersection, the Anchorage Marina and the Holland State Park beach.
1. At the Ottawa Beach Road and 144th Avenue intersection, it was observed that sight-lines were restricted due to curve in Ottawa Beach Road. The crash analysis review confirmed the sight-lines maybe a contributing factor to the crashes.
 2. At the Anchorage Marina, it was observed that pedestrians cross to and from the Anchorage Condos and Anchorage Marina without a crosswalk.
 3. At the Holland State Park beach, even though “Full” parking signs were posted, vehicles queued along Ottawa Beach Road to enter the park and backed up past the General Store. Since Ottawa Beach Road dead ends at the beach, many U-turns were witnessed along Ottawa Beach Road.

1.2 RECOMMENDATIONS

Based on the review of existing conditions, the following measures would assist in mitigating issues observed during data collection.

- **Target Area 1: Park Township Airport and Ottawa County Fairgrounds Entrances**

After a broad analysis of the improvement concept in the Park Central Conceptual Plan, it was determined that a two-lane roundabout would likely address capacity needs at the airport and fairgrounds entrance. A transition from a four-lane roadway to a three-lane roadway with a center left turn lane and bike lanes in each direction on Ottawa Beach Road is a feasible option. A detailed study should be performed to determine the capacity of the roadway and exact roundabout layout. At a minimum, the Ottawa Beach Road and 152nd Avenue intersection should provide Americans with Disabilities Act (ADA) compliant sidewalks at all corners of the intersection and pavement markings at the intersection should be restriped.

Special event wayfinding signing should be updated and provided to help inform visitors on how to enter the grounds and park efficiently. Ticket fee collection locations should strive to efficiently move traffic and minimize queuing on the road.

Reconfiguration of the main entrance for the fairgrounds should be considered to consolidate the number of driveways as an interim improvement before the Park Central Conceptual Plan is implemented, depending on the timing of such improvements. The consolidated driveway should align with the airport driveway.

- **Target Area 2: Four to two-lane transition at 160th Avenue**

Since right-of-way (ROW) constraints and roadside features prevent the use of a far-side intersection lane drop on Ottawa Beach Road, signing and pavement marking improvements should be implemented at the current near-side intersection lane drop per Michigan Department of Transportation (MDOT) Traffic and Safety Note 614D.

An improvement to promote pedestrian and bike safety would be to provide special emphasis crosswalks on the north side to connect the east-west path and the west side of the intersection to connect the north-south path. To help alert motorists of the crossing on Ottawa Beach Road, a Pedestrian Hybrid Beacon or pedestrian crossing signs with Rectangular Rapid Flashing Beacons (RRFB) should be considered. Additional lighting should be reviewed at the pedestrian crossings.

Maintenance and tree trimming is encouraged to provide adequate sight distances for motorists, pedestrians and bicyclists at the Ottawa Beach Road and 160th Avenue intersection.

- **Target Area 3: DNR Boat Launch**

The DNR Boat Launch operations should be reviewed to see if the boat launching process can be expedited and thereby limit conflicts on Ottawa Beach Road. If queuing on Ottawa Beach Road continues, then lengthening the westbound center left turn lane should be considered to better accommodate vehicles and trailers.

To promote pedestrian safety, a marked crosswalk from the boat launch to the overflow parking lot should be considered. The new crosswalk should be provided between the boat launch driveways to avoid conflicts with turning vehicles and internal sidewalks should be provided on the DNR Boat Launch properties. A special emphasis crosswalk should be used for the crossing. To help alert motorists of the crossing, a Pedestrian Hybrid Beacon or pedestrian crossing signs with RRFB should be considered. Additional lighting should be reviewed at the pedestrian crossing.

Given the pedestrian and bike movements and boat launch operations in the area, a possible speed limit reduction should be investigated further.

- **Target Area 4: Holland State Park Campground**

Improvements should be made to visually or physically separate the path from the shoulder on the WB approach of the Holland State Park Campground entrance. Options would include colored pavement or markings on the path, and/or bollards or barriers.

To promote pedestrian and bike safety, a marked crosswalk from the campground to beach should be considered. The new crosswalk should be provided west of the campground entrance to avoid conflicts with right turning vehicles into the campground and internal sidewalks should be provided on the Holland State Park properties. A special emphasis crosswalk should be used for the crossing. To help alert motorists of the crossing, a Pedestrian Hybrid Beacon or pedestrian crossing signs with RRFB should be considered. Additional lighting should be reviewed at the pedestrian crossing.

Parking should be delineated with curb and gutter and pavement markings along Ottawa Beach Road to provide uniform parking and minimize illegal parking.

With the pedestrian and bike movements and parking operations in the area, a possible speed limit reduction should be investigated further.

The OBI access points and parking lot should be reconfigured to minimize conflicts between site traffic and Ottawa Beach Road traffic and to improve circulation.

- **Target Area 5: General Store Area**

Due to ROW constraints and the minimum path width required, a median between the path and road is not feasible. Therefore, a 10-foot path should be provided at the back of the curb on the north side to connect the existing path. A bike lane should also be provided on the south side. The existing retaining walls should be removed and relocated to the existing ROW line, or proposed ROW line if needed, to accommodate a 10-foot path.

To promote pedestrian and bike safety, marked crosswalks near the General Store is advised. New crosswalks could be provided at 1st Avenue and Auburn Avenue to encourage lawful, safe and protected crossings at designated locations, rather than random locations along the corridor. A special emphasis crosswalk should be used for each crossing along with signs with RRFB. The existing crosswalk west of Black Lake Avenue could be upgraded to a special emphasis crosswalk and signs with RRFB. Additional lighting should be reviewed at each pedestrian crossing.

With the high pedestrian and bike volumes and the residential nature of the area, a possible speed limit reduction to 25 miles per hour (mph) should be investigated further.

The General Store access points and parking lot configuration should be reviewed to reduce conflicts with the road and to improve circulation.

- **Other Key Locations**

The Ottawa Beach Road and 144th Avenue intersection appears to be under reconstruction. The horizontal curve and ADA facilities should be addressed.

At the Anchorage Marina, to promote pedestrian and bike safety, a marked crosswalk from the Anchorage Condos to the Anchorage Marina should be considered. A special emphasis crosswalk could be used for the crossing. To help alert motorists of the crossing, pedestrian crossing signs with RRFB could be installed.

The Holland State Park beach operations may need to be revisited to determine if improvements can be made to expedite the parking process, provide better parking information to motorists and limit backups on Ottawa Beach Road. Providing dynamic parking guidance signs along the Ottawa Beach Road corridor may help visitors to find parking quicker and more effectively manage traffic flows which could reduce traffic congestion and illegal parking.

2.0 INTRODUCTION

This document represents the summation of methodologies, analyses, findings, and recommendations of the traffic study for Ottawa Beach Road from 144th Avenue to the Holland State Park beach. The 4-mile Ottawa Beach Road corridor is the primary east-west connector located immediately north of Lake Macatawa and links critical uses in the community (airport, fairgrounds, state park, marinas, businesses, residences, etc.). The corridor is significant in many ways and varies in cross section, measures of capacity and traffic safety. The study area map is provided in Figure 1.

This traffic study reviewed the existing safety and operational issues along the Ottawa Beach Road corridor in order to develop conceptual solutions for areas of concern. Several safety and operational factors were reviewed and analyzed. These included existing roadway geometry, volume and speed data, 3-year crash data, roadway signing, access points along the corridor and vehicle, pedestrian and bike operations.

To observe existing operations and access roadway conditions, Fishbeck, Thompson, Carr & Huber, Inc. (FTCH) visited the study area on two separate weekends during the summer of 2014. FTCH collected video data and observations on Independence Day weekend (Thursday, July 3, 2014 to Saturday, July 5, 2014) and the Ottawa County Fair weekend (Friday, July 25, 2014 to Saturday, July 26, 2014) in order to observe peak operations on different segments of the corridor.

Though the entire corridor was evaluated, several target areas were reviewed in more detail. These areas include:

1. Park Township Airport and Ottawa County Fairgrounds Entrances
2. Four to two-lane transition at 160th Avenue
3. DNR Boat Launch
4. Holland State Park Campground
5. General Store Area

The following sections provide detail on existing roadway conditions, and safety and operational observations for the entire corridor and target areas, as well as other key locations. Recommendations for safety, design, and operational improvements are also provided.

3.0 OTTAWA BEACH ROAD CORRIDOR

The 4-mile segment of the Ottawa Beach Road corridor in the Township was reviewed for existing roadway conditions, and safety and operational issues. The sections that follow provide information obtained during the data collection process.

3.1 ROADWAY CHARACTERISTICS

The study area for the Ottawa Beach Road corridor extends from 144th Avenue to the Holland State Park beach. From 144th Avenue to 160th Avenue, Ottawa Beach Road is a four-lane roadway with a posted speed is 45 mph. Left turn lanes are provided at the 152nd Avenue intersection. The intersections of 144th Avenue and 152nd Avenue are signalized. At the 160th Avenue intersection, Ottawa Beach Road transitions to a two-lane roadway and continues as such to the Holland State Park beach. The posted speed limit varies between 160th Avenue to the Holland State Park beach as follows:

- 45 mph from 160th Avenue to Lake Street
- 40 mph from Lake Street to Ottawa Beach Inn
- 35 mph from Ottawa Beach Inn to 3rd Avenue
- 30 mph from 3rd Avenue to the Holland State Park beach

Existing conditions, roadway cross section information and general observations for the corridor are provided in Figures 2 through 10.

3.2 VOLUME AND SPEED DATA REVIEW

FTCH set up tube counters at five locations to gather traffic count data and travel speeds during Independence Day weekend (Thursday, July 3, 2014 to Monday, July 7, 2014). The tube counters were placed at the following locations:

1. East of 152nd Avenue
2. West of Ottawa County Fairgrounds
3. East of DNR Boat Launch
4. East of Holland State Park Campground
5. West of Auburn Avenue

Daily traffic volumes were collected and compared against historical counts along the corridor. Table 1 summarizes the daily and peak hour volume data obtained at each location. Refer to Appendix 1 for additional details.

Table 1 - Volume Data Summary

ID	Location on Ottawa Beach Rd	ADT Volume (vpd)	Peak Hour		Peak Hour Volume (vph)		Percent Heavy Vehicles
			AM	PM	AM	PM	
1	East of 152nd Ave	16,699	11:00 AM - 12:00 PM	5:00 PM - 6:00 PM	1,219	1,267	11.0%
2	West of Ottawa County Fairgrounds	14,552	11:00 AM - 12:00 PM	5:00 PM - 6:00 PM	1,055	1,119	1.5%
3	East of DNR Boat Launch	13,494	11:00 AM - 12:00 PM	5:00 PM - 6:00 PM	964	1,076	2.3%
4	East of Holland State Park Campground	9,729	11:00 AM - 12:00 PM	5:00 PM - 6:00 PM	696	780	6.6%
5	West of Auburn Ave	6,704	10:00 AM - 11:00 AM	7:00 PM - 8:00 PM	470	553	2.7%

As shown in Table 1, the volume decreases as traffic travels toward Holland State Park. This is consistent with historical volume data provided by the OCRC. The volumes collected are higher than the historical volumes due to the additional holiday traffic. This supports the assumption that peak operations were observed during the study. Historical volume data can be found in Appendix 1.

Speed data was also collected for the corridor. Studies have shown that 85% of drivers adhere to properly established speed limits which feel reasonable, comfortable and safe for conditions at the time of travel. This is what is considered the 85th percentile speed. The 85th percentile speed is the measure often used to set the posted speed limit. Per the Michigan Manual of Uniform Traffic Control Devices (MMUTCD), when a speed limit is posted, it should be within 5 mph of the 85th percentile speed of free-flowing traffic. However, other factors can be taken into account when setting the speed limit such as number and type of crashes, traffic volumes, pedestrians and bicycles volumes, roadside development, roadway and shoulder widths, condition of the roadway and the number of lanes, intersections, driveways, hills, curves, sidewalks, schools and parks. Table 2 summarizes the posted speed and travel speed data obtained at each location. Refer to Appendix 2 for additional details.

Table 2 - Speed Data Summary

ID	Location on Ottawa Beach Rd	Posted Speed Limit (mph)	Observed 85th Percentile Speed (mph)			Observed Percent Above Posted Speed Limit		
			WB	EB	All	WB	EB	All
1	East of 152nd Ave	45	58	55	57	82.4%	73.6%	78.0%
2	West of Ottawa County Fairgrounds	45	49	45	47	32.2%	10.9%	21.5%
3	East of DNR Boat Launch	45	39	41	40	0.7%	2.9%	1.8%
4	East of Holland State Park Campground	40	42	29	38	19.4%	0.1%	9.8%
5	West of Auburn Ave	30	29	25	27	5.5%	2.4%	3.9%

The speed data analysis east of 152nd Avenue showed that approximately 78% of vehicles were traveling over the speed limit of 45 mph. More enforcement in this area would help to keep travel speeds closer to the posted speed limit, which is important with the amount of pedestrian and bike traffic in the area during peak periods.

Travel speeds west of the Ottawa County Fairgrounds were slightly higher than the posted speed limit, especially in the eastbound (EB) direction. Continued enforcement in this area would help to keep operating speeds closer to the posted speed limit.

East of the DNR Boat Launch the speed data analysis revealed that the operating speed in the area is lower than the speed limit of 45 mph. With the pedestrian and bike movements and boat launch operations, a possible speed limit reduction should be investigated further. With the roadway geometry and operations at the boat launch, lowering the speed limit would be a reasonable consideration.

The speed data analysis east of the Holland State Park Campground showed that the travel speed in the area is slightly lower than the speed limit of 40 mph, especially in the EB direction. With the pedestrian and bike movements and parking operations, a possible speed limit reduction should be investigated further. Lowering the speed limit could help to improve safety in this area of the corridor without compromising vehicular operations.

Operating speeds west of Auburn Avenue were slightly lower than the speed limit of 30 mph. With the high pedestrian and bike volumes and the residential nature of the area, a possible speed limit reduction to 25 mph should be investigated further. Lowering the speed limit could help to improve safety in this area of the corridor without compromising vehicular operations.

3.3 CRASH DATA REVIEW

A 3-year crash analysis was performed for the Ottawa Beach Road corridor. Between January 2011 and December 2013, there were 122 crashes. Of those 122 crashes, the primary crash type was approximately 32% single motor vehicle, 21% angle and 19% rear-end. The large amount of single motor vehicle crashes can partially be attributed to deer crashes and wet, icy or snowy road conditions.

Of those 122 crashes, 38% occurred during the evening, 25% during dark conditions, 12% involved a deer and 22% resulted in injury crashes. Most of the injury crashes were Injury Type C. One fatality occurred within the study timeframe and study area. The fatality crash involved a pedestrian that was crossing Ottawa Beach Road east of 152nd Avenue between midnight and 1:00 a.m. The pedestrian had been drinking alcohol and did not cross at a designated crosswalk.

To review the corridor in more detail, the corridor was divided into 4 intersections and 4 segments. Table 3 summarizes crash information for each intersection and segment. Refer to Appendix 3 for additional details.

Table 3 - Crash Data Summary

ID	Intersection / Segment	Crashes		Injuries		Fatalities	
		Number	Percent	Number	Percent	Number	Percent
1	144th Avenue	36	29.5%	9	7.4%	0	0.0%
2	144th Avenue to 152nd Avenue	30	24.6%	8	6.6%	1	0.8%
3	152nd Avenue	12	9.8%	1	0.8%	0	0.0%
4	152nd Avenue to 160th Avenue	13	10.7%	2	1.6%	0	0.0%
5	152nd Avenue to 160th Avenue	7	5.7%	2	1.6%	0	0.0%
6	160th Avenue	15	12.3%	2	1.6%	0	0.0%
7	160th Avenue to 168th Avenue	5	4.1%	2	1.6%	0	0.0%
8	168th Avenue	4	3.3%	1	0.8%	0	0.0%
Total		122	100.0%	27	22.1%	1	0.8%

When reviewing the crash reports, a trend was found concerning crashes between eastbound and westbound left turns and opposing traffic at the 144th Avenue intersection. Most left turning drivers stated they did not see vehicle on Ottawa Beach Road. It is possible the road's horizontal curve creates an environment where such angle crashes occur more frequently. A possible countermeasure to such crashes is to reconstruct the intersection to provide better sight-lines for left turning traffic. It was observed during data collection that the Ottawa Beach Road and 144th Avenue intersection appears to be under construction.

4.0 TARGET AREAS

Though the entire corridor was reviewed for traffic safety and operation issues, there were several target areas that were reviewed in further detail. These areas include:

1. Park Township Airport and Ottawa County Fairgrounds Entrances
2. Four to two-lane transition at 160th Avenue
3. DNR Boat Launch
4. Holland State Park Campground
5. General Store Area

The following sections provide details on safety and operational observations, pedestrian and bicycle issues, roadway signing data and access management for each target area. Recommendations for safety, design, and operational improvements are also provided.

4.1 AIRPORT AND FAIRGROUNDS ENTRANCES

The Park Township Airport and Ottawa County Fairgrounds entrances were observed during the Ottawa County Fair weekend (Friday, July 25, 2014 to Saturday, July 26, 2014). Observations and photos for the Park Township Airport and Ottawa County Fairgrounds entrances are provided in Figures 4 and 5.

4.1.1 SAFETY AND OPERATIONAL OBSERVATIONS

During the Ottawa County Fair, three entrances to the fairgrounds were provided. Gate 1 was located at the Dog Park and Skate Park entrance, Gate 2 was located at the main fairground entrance across from the airport driveway and Gate 3 was located at the western driveway at the edge of the fairgrounds property. Visitors would enter the fairgrounds at one of the three gates, pay for their tickets and proceed to park on the grounds.

It was observed during data collection that the Gate 1 Entrance was closed until 4:00 p.m. on Friday. On Saturday, Gate 1 was used for private picnic parking only. The Gate 2 Entrance used both drives on Friday and west drive was closed for part of Saturday. The Gate 3 Entrance was open at all times and was the only entrance that could be used by vehicles with trailers.

Private picnics were held on Saturday at the fairgrounds and the airport. Police officers regulated parking for the private picnic on the fairgrounds and stopped traffic on Ottawa Beach Road for vehicles entering Gate 1. A tape fence was set up along the east-west path on the north side of Ottawa Beach Road to direct pedestrians to cross at Gate 2, which was regulated by a police officer and event staff. Event staff traveled around the grounds on golf carts and also transported pedestrians from the private picnic area at the airport to the fair. Traffic backed up to the Ottawa Beach Road and 152nd Avenue intersection when police officers stopped traffic at the gates.

Event signing and guidance was deficient for some of the fair activities, which caused some confusion for visitors at the driveways.

The Ottawa Beach Road and 152nd Avenue intersection is a signalized intersection located near the airport and fairgrounds. Sidewalks were not present on the southeast corner and all sidewalk ramps at the intersection were not ADA compliant. Crosswalk markings were found to be faded for the crossings at the intersection.

4.1.2 CONCEPTUAL SOLUTIONS & RECOMMENDATIONS

FTCH reviewed the Park Central Conceptual Plan for the roundabout application. The Park Central Conceptual Plan proposes reconfiguration and improvements to the airport and fairgrounds site, driveways and access along with some new development on the properties. Ottawa Beach Road would become a three-lane roadway with a center left turn lane and bike lanes in each direction. A roundabout would be provided at the entrance to the airport and fairgrounds. The Ottawa Beach Road and 152nd Avenue intersection would also be reconstructed.

SAFETY AND OPERATIONS

After a broad analysis of the improvement concept in the Park Central Conceptual Plan, it is recommended that a two-lane roundabout be pursued. Per the Federal Highway Administration (FHWA), a single-lane roundabout can service up to approximately 25,000 vehicles per day (vpd) and a two-lane roundabout can service up to approximately 45,000 vpd. During volume data collection on Independence Day weekend, the ADT near the airport and fairgrounds was approximately 14,500 vpd. Given the proposed development in the Park Central Conceptual Plan, additional special event traffic and potential for queues, the need for a two-lane roundabout would be a reasonable assumption.

The transition from a four-lane roadway to a three-lane roadway with a center left turn lane and bike lanes in each direction on Ottawa Beach Road shown in the Park Central Concept Plan is a feasible option. The MDOT policy on four-to-three Lane Conversions states that “on corridors with 15,000 ADT or less, four-to-three lane conversions across the country and across Michigan have been successfully implemented, recording safety gains with very little sacrifice to traffic flow. The three-lane section is safer at intersections and driveways, because the monitoring task of looking for traffic gaps is simpler. On the corridor links, the three-lane cross section is safer because the center lane acts as a buffer to through traffic lanes”. MDOT recommends guidance limits of 15,000 vpd to 17,500 vpd as being realistic volumes for four-to-three lane conversions. The ADT near the fairgrounds ranges from approximately 14,500 vpd to 16,700 vpd during peak holiday periods, and therefore falls within the guidance limits for conversion. Refer to Appendix four for MDOT four-to-three Lane Conversions.

Though a two-lane roundabout and a four-to-three lane conversion on Ottawa Beach Road is a feasible option, a detailed study should be performed to determine the capacity of the roadway and exact roundabout layout which takes into account the future volumes given the new developments. Turning movement counts would be required at Ottawa Beach Road and 152nd Avenue intersection and the airport and fairgrounds driveways. Counts would need to be taken during normal peak periods as well as special events to ensure the roundabout will operate properly.

The Ottawa Beach Road and 152nd Avenue intersection should also be upgraded to provide ADA compliant sidewalks at all corners of the intersection. Pavement markings at the intersection should be restriped.

ROADWAY SIGNING

Special event wayfinding signing should be updated and provided to help visitors enter the grounds and park efficiently. Ticket fee collection locations should strive to efficiently move traffic and minimize queuing on the road.

Appropriate signing for the roundabout and other road improvements should be provided per MMUTCD standards when the Park Central Conceptual Plan is implemented.

ACCESS MANAGEMENT

Reconfiguration of the main entrance for the fairgrounds should be considered to consolidate the number of driveways as an interim improvement before Park Central Conceptual Plan is implemented depending on the plans overall schedule. The consolidated driveway should align with the airport driveway.

When the Park Central Conceptual Plan is implemented, efforts should be made to limit the number of adjacent access points that may interfere with the roundabout operations.

4.2 FOUR TO TWO-LANE TRANSITION AT 160TH AVENUE

The four to two-lane transitions at 160th Avenue was observed during Independence Day weekend (Thursday, July 3, 2014 to Saturday, July 5, 2014). Observations and photos for the four to two-lane transitions at 160th Avenue are provided in Figure 6.

4.2.1 SAFETY AND OPERATIONAL OBSERVATIONS

Ottawa Beach Road transitions from a four-lane road to a two-lane road at 160th Avenue. The WB right lane drops at 160th Avenue and becomes a right turn lane for vehicles heading northbound (NB) on 160th Avenue. This is considered a near-side intersection lane drop. Several WB vehicles were observed to merge once in the right turn lane or in the intersection. This is an operational and potential safety concern as many vehicles were observed cutting off traffic.

Two multi-use paths cross at the northwest corner of the Ottawa Beach Road and 160th Avenue intersection: the east-west path the runs along the north side of Ottawa Beach Road for the entire study area and a north-south path the runs along the west side of 160th Avenue. Crosswalk markings were found to be faded for the crossings at the intersection. Pedestrians were observed running to cross Ottawa Beach Road due to the roadway width and higher speeds on the road. Signing found on the east-west path was not compliant with correct MMUTCD standards.

During data collection, it was observed that vegetation obstructed some of the sight-lines at the intersection.

4.2.2 CONCEPTUAL SOLUTIONS & RECOMMENDATIONS

SAFETY AND OPERATIONS

Since ROW constraints and roadside features prevent the use of a far-side intersection lane drop per MDOT Traffic and Safety Notes on Ottawa Beach Road, signing and pavement marking improvements should be implemented at the current near-side intersection lane drop. Refer to the following Roadway Signing section for details.

To promote pedestrian and bike safety, special emphasis crosswalks on the north side to connect the east-west path and the west side of the intersection to connect the north-south path should be considered. To help alert motorists of the crossing on Ottawa Beach Road, a Pedestrian Hybrid Beacon or pedestrian crossing signs with RRFB should be installed. Refer to the following Roadway Signing section for signing details.

Additional lighting could be provided at the pedestrian crossings. A lighting review of the corridor in this target area should also be performed to ensure proper lighting.

Maintenance and tree trimming is encouraged to provide adequate sight distances for motorists, pedestrians and bicyclists at the Ottawa Beach Road and 160th Avenue intersection.

ROADWAY SIGNING

Per MDOT Traffic and Safety Note 614D, the signing and pavement markings for a near-side intersection lane drop needs special emphasis. An advance warning sign, "Thru Traffic Merge Left" (W4-7), is recommended. Advance street name signs and special pavement markings in the dropped lane will also reinforce the advance warning sign and provide motorists with the necessary guidance to react and maneuver the vehicle safely and effectively to avoid the "trap lane". In addition, the lane control sign (R3-7F) and "Right Lane Must Turn Right" (R3-7R) support the use of the right turn lane. Signs and pavement markings should be installed per MDOT Traffic and Safety Note 614D and the MMUTCD. Refer to Appendix 5 for MDOT Traffic and Safety Note 614D.

Signing should be provided at and in advance of the pedestrian crossing. The use of either a Pedestrian Hybrid Beacon or pedestrian crossing signs with RRFB should be investigated further. If a Pedestrian Hybrid Beacon is used then appropriate signals and signing should be installed at the designated crossing per the MMUTCD. If pedestrian crossing signs with RRFB are used, then the pedestrian (W11-2) and downward diagonal arrow (W16-7P) signs with RRFB should be provided on both sides of the road and in both EB and WB directions. The RRFB should be pedestrian actuated with either passive detection or push buttons. In advance of the crossing the pedestrian (W11-2) and "Ahead" (W16-9P) signs should be provided on both sides of the road.

Pathway signing provided throughout the corridor should be installed per the MMUTCD. Pathway "Stop" (R1-1) signs should be used at all major crossings and intersections. Wayfinding signage may also be installed to inform pedestrians and bicyclists of area attractions and other important guidance.

ACCESS MANAGEMENT

Access management improvements are not needed for this target area.

4.3 DNR BOAT LAUNCH

The DNR Boat Launch was observed during Independence Day weekend (Thursday, July 3, 2014 to Saturday, July 5, 2014). Observations and photos for the DNR Boat Launch are provided in Figure 7.

4.3.1 SAFETY AND OPERATIONAL OBSERVATIONS

The DNR Boat Launch operates as a one-way loop between the ramp on the south side of Ottawa Beach Road and an overflow parking lot on the north side. Vehicles will enter the boat launch at the east driveway on the south side, pay the launching fee, launch their boat and, if parking is full on the south side, will cross the road to the north side for parking. After parking in the overflow parking lot, pedestrians need to cross the road to and from their vehicles. Crosswalks and sidewalks are not present. There also is no warning sign for crossing pedestrians in the area.

At the DNR Boat Launch, Ottawa Beach Road transitions to three-lane road with a center left turn lane. A right turn lane is also provided on the EB approach of the east driveway. The additional lanes proved to be needed as traffic waiting to use the boat launch ramp would occasionally back up onto the road during peak periods.

Sight-lines for vehicles and pedestrians crossing Ottawa Beach Road are limited due the curve of the road. With the limited sight distance at the boat launch and no warning signage for crossing vehicles or pedestrians, the speed limit in this target area of 45 mph is a safety concern.

4.3.2 CONCEPTUAL SOLUTIONS & RECOMMENDATIONS

SAFETY AND OPERATIONS

The DNR Boat Launch operations should be reviewed to see if the boat launching process can be expedited and thereby limit conflicts on Ottawa Beach Road. If queuing on Ottawa Beach Road continues, then lengthening the westbound center left turn lane should be considered to better accommodate vehicles and trailers.

To promote pedestrian safety, a marked crosswalk from the boat launch to the overflow parking lot should be considered. The new crosswalk should be provided between the boat launch driveways to avoid conflicts with turning vehicles and internal sidewalks should be provided on the DNR Boat Launch properties. A special emphasis crosswalk should be used for the crossing. To help alert motorists of the crossing, a Pedestrian Hybrid Beacon or pedestrian crossing signs with RRFB should be considered. Refer to the following Roadway Signing section for signing details.

Additional lighting could be provided at the pedestrian crossing. A lighting review of the corridor in this target area should also be performed to ensure proper lighting.

The speed data analysis revealed that the operating speed in the target area is lower than the speed limit of 45 mph. With the pedestrian and bike movements and boat launch operations in the area, a possible speed limit reduction should be investigated further. Lowering the speed limit could help to improve safety in this target area of the corridor without compromising vehicular operations.

ROADWAY SIGNING

Signing should be provided at and in advance of the pedestrian crossing. The use of either a Pedestrian Hybrid Beacon or pedestrian crossing signs with RRFB should be investigated further. If a Pedestrian Hybrid Beacon is used then appropriate signals and signing should be installed at the designated crossing per the MMUTCD. If pedestrian crossing signs with RRFB are used then the pedestrian (W11-2) and downward diagonal arrow (W16-7P) signs with RRFB should be provided on both sides of the road and in both EB and WB directions. The RRFB should be pedestrian actuated with either passive detection or push buttons. In advance of the crossing the pedestrian (W11-2) and "Ahead" (W16-9P) signs should be provided on both sides of the road.

ACCESS MANAGEMENT

Operations at the boat launch should be revisited to determine if there is a better way to manage the two access points.

4.4 HOLLAND STATE PARK CAMPGROUND

The Holland State Park Campground was observed during Independence Day weekend (Thursday, July 3, 2014 to Saturday, July 5, 2014). Observations and photos for the Holland State Park Campground are provided in Figure 9.

4.4.1 SAFETY AND OPERATIONAL OBSERVATIONS

The Holland State Park Campground is located on the north side of Ottawa Beach Road and directly across the road is a beach for Lake Macatawa. Several of the campers were observed to use this beach for recreational activities. Pedestrians and bikes would cross the road at the campground and beach entrance but a crosswalk was not present. Pedestrians would carry beach gear, kayaks, canoes, etc. while crossing the road. The road's curve and illegally parked vehicles cause limited sight-lines.

The path on the north side of the road is adjacent to a paved shoulder from the OBI to the campground. This creates some confusion for motorists, pedestrians and bicyclists. Both the shoulder and path were observed to be used as a right turn lane by motorists entering the campground.

Parking is prohibited near the beach entrance and permitted near the OBI on the south side of the road. The parking spaces were not marked so angled and 90° parking were both witnessed. As the parking area became full, vehicles started to illegally park near the beach entrance, restricting sight-lines for pedestrians, bikes and parked vehicles leaving the parking area. Illegally parked vehicles were ticketed but not towed.

4.4.2 CONCEPTUAL SOLUTIONS & RECOMMENDATIONS

Recommendations for the Holland State Park Campground area are provided in Figure 11.

SAFETY AND OPERATIONS

Improvements should be made to visually or physically separate the path from the shoulder on the WB approach of the Holland State Park Campground entrance. Options would include colored pavement or markings on the path, and/or bollards or barriers.

To promote pedestrian and bike safety, a marked crosswalk from the campground to beach should be considered. The new crosswalk should be provided west of the campground entrance to avoid conflicts with right turning vehicles into the campground and internal sidewalks should be provided on the Holland State Park properties. A special emphasis crosswalk should be used for the crossing. To help alert motorists of the crossing, a Pedestrian Hybrid Beacon or pedestrian crossing signs with RRFB should be considered. Refer to Figure 11 for the proposed improvements and the following Roadway Signing section for signing details.

Additional lighting could be provided at the pedestrian crossing. A lighting review of the corridor in this target area should also be performed to ensure proper lighting.

Parking should be delineated with curb and gutter and pavement markings along the south side of Ottawa Beach Road to provide uniform parking and minimize illegal parking. Hardscape in non-parking areas can also be provided to help minimize illegal parking. Parallel parking is recommended over angled or 90° parking for safety reasons, the need for a new sidewalk along the parking lane and ROW constraints.

The speed data analysis revealed that the operating speed in the target area is slightly lower than the speed limit of 40 mph, especially in the EB direction. With the pedestrian and bike movements and parking operations in the area, a possible speed limit reduction should be investigated further. Lowering the speed limit could help to improve safety in this target area of the corridor without compromising vehicular operations.

ROADWAY SIGNING

Signing should be provided at and in advance of the pedestrian crossing. The use of either a Pedestrian Hybrid Beacon or pedestrian crossing signs with RRFB should be investigated further. If a Pedestrian Hybrid Beacon is used then appropriate signals and signing should be installed at the designated crossing per the MMUTCD. If pedestrian crossing signs with RRFB are used then the pedestrian (W11-2) and downward diagonal arrow (W16-7P) signs with RRFB should be provided on both sides of the road and in both EB and WB directions. The RRFB should be pedestrian actuated with either passive detection or push buttons. In advance of the crossing the pedestrian (W11-2) and "Ahead" (W16-9P) signs should be provided on both sides of the road.

Parking and no parking signs should be provided in the proper areas. If time limits are needed for some parking areas, then signs should reflect these limits. Enforcement will ensure compliance in all parking and non-parking areas.

ACCESS MANAGEMENT

The OBI access points and parking lot should be reconfigured minimize conflicts between site traffic and Ottawa Beach Road traffic and to improve circulation. Improvements to the south side of the road will improve parking operations and access.

4.5 GENERAL STORE AREA

The General Store area observed during Independence Day weekend (Thursday, July 3, 2014 to Saturday, July 5, 2014). Observations and photos for the General Store area are provided in Figure 9.

4.5.1 SAFETY AND OPERATIONAL OBSERVATIONS

During the data collection process, high volumes of vehicular, pedestrian and bike traffic were observed in this area. The path transitions to a narrow shoulder and given the large amounts of pedestrian and bike traffic, some enter the road. Several pedestrians and bikes were also witnessed crossing the road to and from the General Store. No crosswalks are present near to the store.

Currently, the General Store parking lot provides 90° parking where vehicles must back out of the parking space onto the road. With the high level of pedestrian and bike traffic, this raises some safety concerns due to sight constraints.

4.5.2 CONCEPTUAL SOLUTIONS & RECOMMENDATIONS

Before developing recommendations, FTCH reviewed the Draft Park Township Master Plan (2011) and the Historic Ottawa Beach Waterfront Walkway Plan for future facilities recommended by the City. The Draft Master Plan calls for a multi-use path with a median on the north side of Ottawa Beach Road and a 5-foot bike lane on the south side. These improvements would require the removal of the existing retaining walls. The Historic Ottawa Beach Waterfront Walkway Plan proposes a 12-foot walkway on the south side with viewing and seating areas. Recommendations for the General Store area took these plans into consideration and are provided in Figure 12.

SAFETY AND OPERATIONS

Due to ROW constraints and the minimum path width required, a median between the path and roadway is not feasible. Therefore a 10-foot path should be provided at the back of the curb on the north side to connect the existing path. The existing retaining walls should be removed and relocated to the existing ROW line, or proposed ROW line if needed, to accommodate a 10-foot path. A bike lane should also be provided on the south side. Refer to Figure 12 for the proposed cross section.

To promote pedestrian and bike safety, marked crosswalks near the General Store is advised. New crosswalks should be provided at 1st Avenue and Auburn Avenue to encourage lawful, safe and protected crossings at designated locations, rather than random locations along the corridor. A special emphasis crosswalk should be used for each crossing along with signs with RRFB. The existing crosswalk west of Black Lake Avenue could be upgraded to a special emphasis crosswalk and signs with RRFB. Refer to Figure 12 for the proposed improvements and the following Roadway Signing section for signing details.

Additional lighting could be provided at each pedestrian crossing. A lighting review of the corridor in this target area should also be performed to ensure proper lighting.

The speed data analysis revealed that the operating speed in the target area is slightly lower than the speed limit of 30 mph. With the high pedestrian and bike volumes and the residential nature of the area, a possible speed limit reduction to 25 mph should be investigated further. Lowering the speed limit could help to improve safety in this target area of the corridor without compromising vehicular operations.

ROADWAY SIGNING

Signing should be provided at and in advance of pedestrian crossings. At each designated crossing the pedestrian (W11-2) and downward diagonal arrow (W16-7P) signs with RRFB should be provided on both sides of the road and in both EB and WB directions. The RRFB should be pedestrian actuated with either passive detection or push buttons. In advance of the crossing, the pedestrian (W11-2) and "Ahead" (W16-9P) signs should be provided on both sides of the road.

Signing should be provided all the beginning and ending of bike lanes. Additional wayfinding signage may be provided for guidance along the roadway.

Parking and no parking signs should be provided in the proper areas. If time limits are needed for some parking areas, then signs should reflect these limits. Enforcement will ensure compliance in all parking and non-parking areas.

ACCESS MANAGEMENT

The General Store access points and parking lot configuration should be reviewed to reduce conflicts with the road and to improve circulation. The General Store has built a patio deck within the parking lot since the Draft Master Plan was created, therefore other parking options given the patio deck will need to be investigated. A possible solution would be to provide two parallel parking spaces west of the store. Three parallel parking spaces will be provided to east of the store per the Draft Master Plan. This will help to alleviate some of the lost parking if the General Store lot is improved.

5.0 OTHER KEY LOCATIONS

Though the primary focus of the traffic was on the target areas, other key locations on the corridor were also reviewed in more detail. These other key locations include:

1. Ottawa Beach Road and 144th Avenue
2. Anchorage Marina
3. Holland State Park beach

The following sections provide details on safety and operational observations. Recommendations for safety, design, and operational improvements are also provided.

5.1 OTTAWA BEACH ROAD AND 144TH AVENUE

The Ottawa Beach Road and 144th Avenue intersection was observed during Independence Day weekend (Thursday, July 3, 2014 to Saturday, July 5, 2014). Observations and photos for the Ottawa Beach Road and 144th Avenue intersection are provided in Figure 2.

5.1.1 SAFETY AND OPERATIONAL OBSERVATIONS

The Ottawa Beach Road and 144th Avenue intersection is signalized with pedestrian signals on all corners. However, the pedestrian signal on the northwest corner was blocked by a pole. Sidewalks were not present on the southeast corner and all sidewalk ramps at the intersection were not ADA compliant.

The east-west path on the north side of Ottawa Beach Road continues through the shopping center parking lot on the northeast corner which conflicts with parking operations.

It was observed that sight-lines were restricted due to curve in Ottawa Beach Road that occurs at the intersection. The crash analysis review confirmed the sight-lines maybe a contributing factor to the crashes.

During data collection, it appeared the intersection was staked to be reconstructed.

5.1.2 CONCEPTUAL SOLUTIONS & RECOMMENDATIONS

The Ottawa Beach Road and 144th Avenue intersection looks to be under reconstruction. The horizontal curve and ADA facilities should be addressed.

5.2 ANCHORAGE MARINA

The Anchorage Marina was observed during Independence Day weekend (Thursday, July 3, 2014 to Saturday, July 5, 2014). Observations and photos for the Anchorage Marina are provided in Figure 7.

5.2.1 SAFETY AND OPERATIONAL OBSERVATIONS

During data collection, it was observed that pedestrians cross to and from the Anchorage Condos and Anchorage Marina without a crosswalk. There is a pedestrian warning sign on the WB approach but not on the EB approach. It was also found that Anchorage Marina visitor parking is available on the north side of Ottawa Beach Road, causing pedestrians to cross over the road.

5.2.2 CONCEPTUAL SOLUTIONS & RECOMMENDATIONS

To promote pedestrian and bike safety, a marked crosswalk from the Anchorage Condos to the Anchorage Marina should be considered. A special emphasis crosswalk could be used for the crossing. To help alert motorists of the crossing, pedestrian crossing signs with RRFB could be considered.

Signing should be provided at and in advance of pedestrian crossings. At each designated crossing the pedestrian (W11-2) and downward diagonal arrow (W16-7P) signs with RRFB should be provided on both sides of the road and in both EB and WB directions. The RRFB should be pedestrian actuated with either passive detection or push buttons. In advance of the crossing the pedestrian (W11-2) and "Ahead" (W16-9P) signs should be provided on both sides of the road.

Additional lighting could be provided at the pedestrian crossing. A lighting review this location should also be performed to ensure proper lighting.

5.3 HOLLAND STATE PARK BEACH

The Holland State Park beach was observed during Independence Day weekend (Thursday, July 3, 2014 to Saturday, July 5, 2014). Observations and photos for the Holland State Park beach are provided in Figure 10.

5.3.1 SAFETY AND OPERATIONAL OBSERVATIONS

The Holland State Park beach is located at the end of the Ottawa Beach Road corridor. Since the beach is a state park, beach goers must have a recreational pass or pay to park at the beach. During peak periods, the beach parking lot becomes full early in the day. Signs informing motorists that the beach parking was full were placed at three locations along Ottawa Beach Road, which include the DNR Boat Launch, the Holland State Park entrance at 168th Avenue and the state park headquarters east of 3rd Avenue. Even though "Full" parking signs were posted, vehicles queued along Ottawa Beach Road to enter the park and backed up past the General Store. Since Ottawa Beach Road dead ends at the beach, many U-turns were witnessed on Ottawa Beach Road. Motorists either did not see the full parking signs, ignored the signs assuming there was some availability or were looking for on-street parking.

5.3.2 CONCEPTUAL SOLUTIONS & RECOMMENDATIONS

The Holland State Park beach operations may need to be revisited to determine if improvements can be made to expedite the parking process, provide better parking information to motorists and limit backups on Ottawa Beach Road. Providing dynamic parking guidance signs along the Ottawa Beach Road corridor may help visitors to find parking quicker and more effectively manage traffic flows which could reduce traffic congestion and illegal parking.

The system would work by installing dynamic signs that display real-time parking information at key locations along the corridor and major side streets. The dynamic signs would guide visitors towards participating parking lots that have available spaces. Wayfinding signs could be provided to confirm that motorists are headed in the right direction.

Figures



PLOT INFO: Z:\2014\140303\CAD\CDCD\001\140303.DWG LAYOUT: FIGURE 1 DATE: 8/14/2014 TIME: 3:03:18 PM USER: KMW



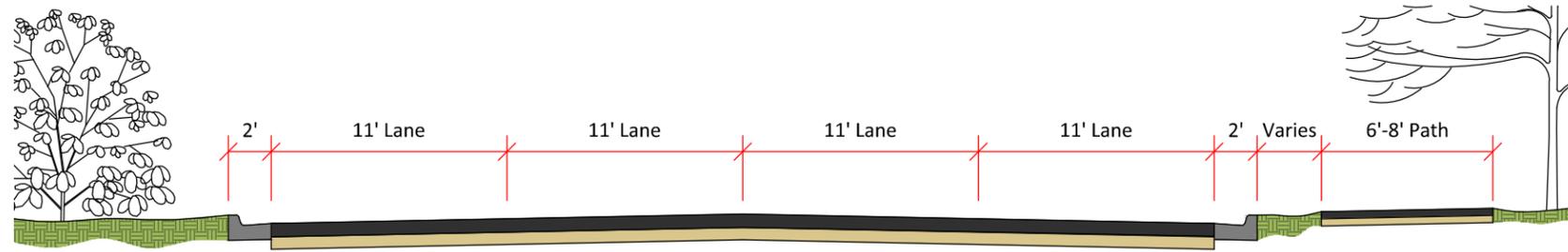
STUDY AREA MAP

NO SCALE

PROJECT NO.
G140303

FIGURE NO.

1



EXISTING CROSS SECTION
OTTAWA BEACH RD (LOOKING WEST)

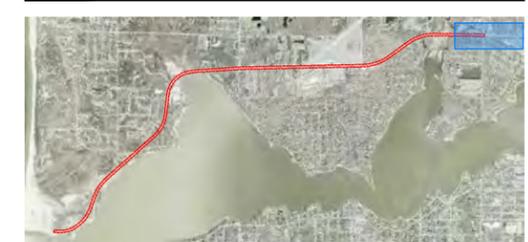
KEY NOTE LEGEND

- 1 The intersection is signalized. All corners have pedestrian signals, however, the pedestrian signal on the NW corner is blocked by a pole.
- 2 Sidewalks are not present on the SE corner and all sidewalk ramps at the intersection need to be updated to be ADA compliant.
- 3 The path continues through the shopping center parking lot which conflicts with parking operations.

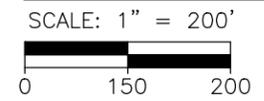
NOTES

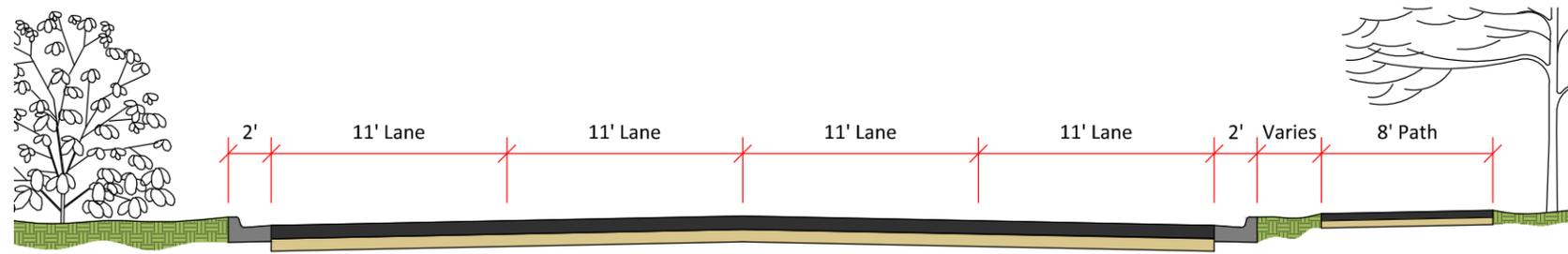
- | | |
|--|--|
| <p>OTTAWA BEACH RD CORRIDOR</p> <ol style="list-style-type: none"> The posted speed limit is 45 mph. Parking is prohibited on both sides of the road. | <p>OTTAWA BEACH RD AND 144TH AVE</p> <ol style="list-style-type: none"> Sight lines are restricted due to the curve in the road. During data collection, it appeared the intersection was staked to be reconstructed. |
|--|--|

KEY PLAN



**144TH AVENUE
EXISTING CONDITIONS**





EXISTING CROSS SECTION
OTTAWA BEACH RD (LOOKING WEST)

- KEY NOTE LEGEND**
- ◆ Stu Visser Trails parking lot and trailhead.
 - ◆ Beechwood Church Entrance.

- NOTES**
- OTTAWA BEACH RD CORRIDOR**
1. The posted speed limit is 45 mph.
 2. Parking is prohibited on both sides of the road.

KEY PLAN

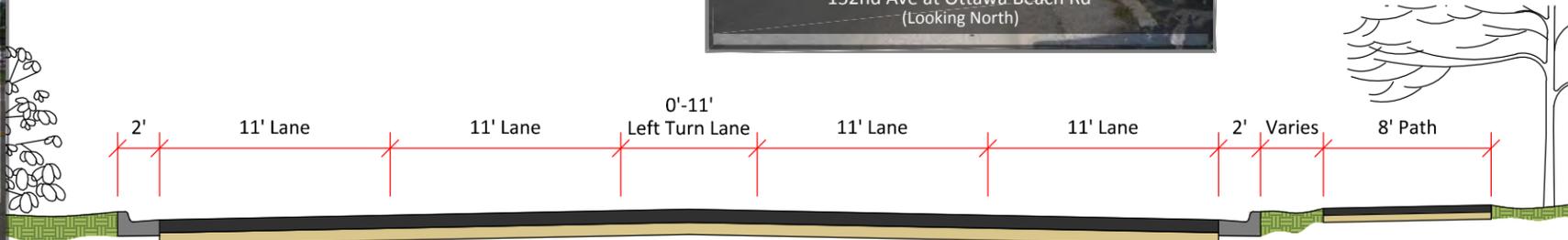
COUNTS COVE CT TO FOREST HILLS DR
EXISTING CONDITIONS

SCALE: 1" = 200'



PLOT INFO: Z:\2014\140303\CAD\CDC\003140303.DWG LAYOUT: FIGURE 3 DATE: 8/7/2014 TIME: 1:59:51 PM USER: KMW

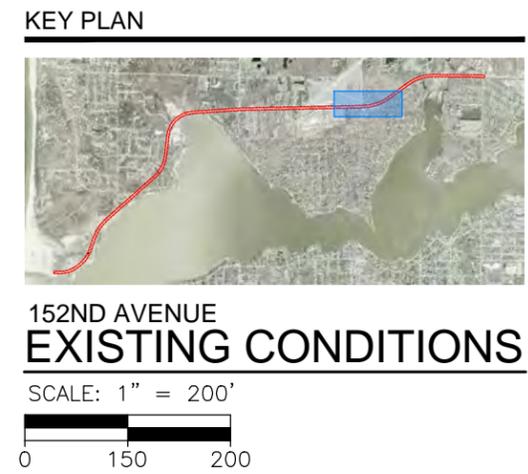
Hard copy is intended to be 11"x17" when plotted. Scale(s) indicated and graphic quality may not be accurate for any other size.



EXISTING CROSS SECTION
OTTAWA BEACH RD (LOOKING WEST)

- KEY NOTE LEGEND**
- ◆ 1 Tube Counter Location 1 for volume and speed data. ADT = 16,699 vpd, 85th Percentile Speed = 57 mph
 - ◆ 2 The intersection is signalized. All corners have pedestrian signals.
 - ◆ 3 Sidewalks are not present on the SE corner and all sidewalk ramps at the intersection need to be updated to be ADA compliant.
 - ◆ 4 Dog Park and Skate Park entrance. Gate 1 Entrance for the Ottawa County Fair. See photo.
 - ◆ 5 Gate 1 parking area.

- NOTES**
- OTTAWA BEACH RD CORRIDOR**
- The posted speed limit is 45 mph.
 - Parking is prohibited on both sides of the road.
- OTTAWA BEACH RD AND 152ND AVE**
- Dedicated left-turn lanes are provided on Ottawa Beach Rd.
 - Traffic backs up to intersection during Ottawa County Fair when police officers stop traffic at entrance gates. See photo.
- OTTAWA COUNTY FAIRGROUNDS**
- Gate 1 Entrance was closed until 4:00 p.m. on Friday. Gate 1 was used for private picnic parking only on Saturday.
 - Police officers regulated parking for the private picnic and stopped traffic on Ottawa Beach Rd for vehicles entering Gate 1. See photos.

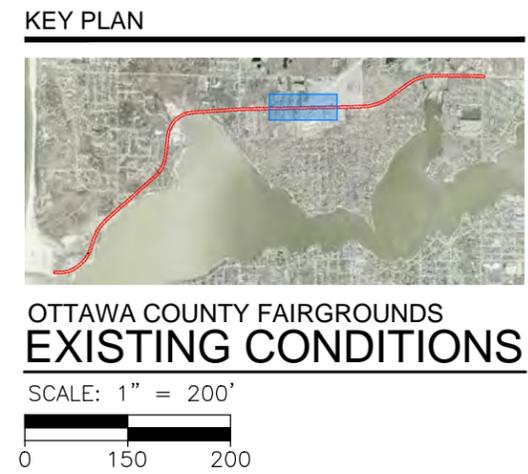




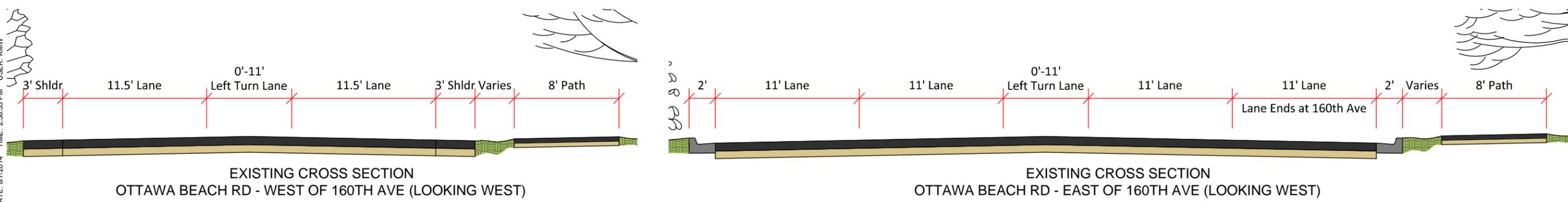
PLOT INFO: Z:\2014\140303\CADD\CDD\005140303.DWG LAYOUT: FIGURE 5 DATE: 8/7/2014 TIME: 4:31:30 PM USER: KMW

- KEY NOTE LEGEND**
- 1 Tube Counter Location 2 for volume and speed data. ADT = 14,552 vpd, 85th Percentile Speed = 47 mph
 - 2 The path continues through the Airport parking lot which conflicts with drive and parking operations.
 - 3 Gate 2 Entrance for the Ottawa County Fair. Three pay lanes at Gate 2. See photo.
 - 4 Gate 3 Entrance for the Ottawa County Fair. Vehicles with trailers can only use Gate 3. See photo.
 - 5 Handicapped parking area accessed by using Gate 2.
 - 6 Drive used for Gate 2 and 3 parking area in the back of the Fairgrounds.

- NOTES**
- OTTAWA BEACH RD CORRIDOR**
- The posted speed limit is 45 mph.
 - Parking is prohibited on both sides of the road.
- OTTAWA COUNTY FAIRGROUNDS**
- Gate 2 Entrance used both drives on Friday. The west drive at Gate 2 was closed part of Saturday. See photos.
 - A private picnic was held on Saturday at the airport. A tape fence was set up along the path to direct pedestrians to cross at Gate 2 which was regulated by a police officer and event staff. See photos.
 - Several event staff on carts were in the area. Carts were also used to transport pedestrians from the private picnic at the airport to the fair.



Hard copy is intended to be 11"x17" when plotted. Scale(s) indicated and graphic quality may not be accurate for any other size.

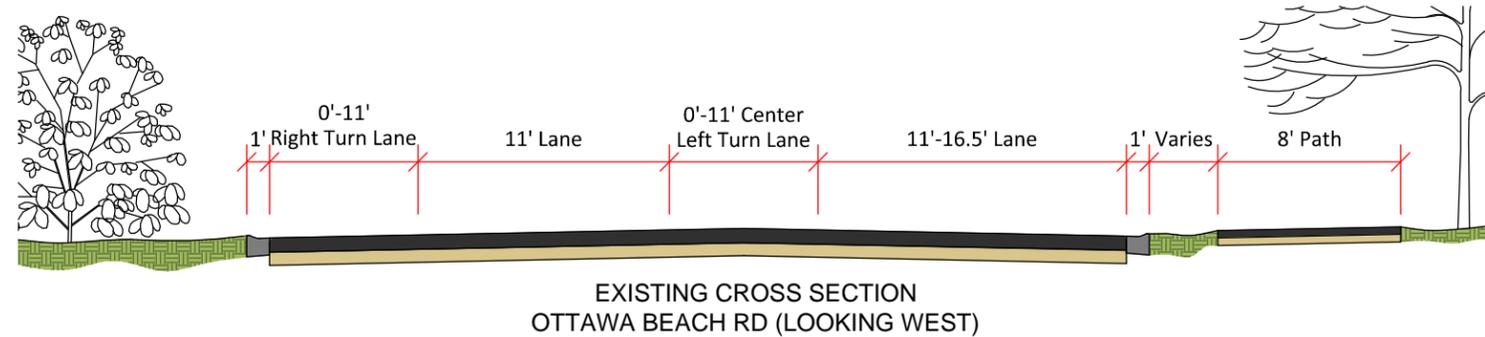


- KEY NOTE LEGEND**
- 1 The intersection is two-way stop-controlled. Ottawa Beach Rd does not stop.
 - 2 A pedestrian and bike path is located on the west side of 160th Ave.

- NOTES**
- OTTAWA BEACH RD CORRIDOR**
1. The posted speed limit is 45 mph.
 2. Parking is prohibited on both sides of the road.
 3. Ottawa Beach Rd transitions from a 4-lane road to a 2-lane road at 160th Ave. The WB right turn lane drops at 160th Ave. Several vehicles were observed to merge over once in the right turn lane or in the intersection.
- OTTAWA BEACH RD AND 160TH AVE**
1. Dedicated left-turn lanes are provided on Ottawa Beach Rd.
 2. The crosswalk across Ottawa Beach Rd is approximately 45'. Pedestrians were observed running across the road to cross since Ottawa Beach Rd does not stop and the speed limit is 45 mph.



PLOT INFO: Z:\2014\140303\CADD\CDD\006140303.DWG LAYOUT: FIGURE 6 DATE: 8/7/2014 TIME: 2:58:55 PM USER: KMMW



KEY NOTE LEGEND

- 1 Tube Counter Location 3 for volume and speed data. ADT = 13,494 vpd, 85th Percentile Speed = 40 mph
- 2 The DNR Boat Launch is a one-way loop and is stop-controlled at the driveways.
- 3 First sign notifying vehicles that the Holland State Park beach parking is full. See photo.
- 4 Pedestrians cross to and from the Anchorage Condos to the Anchorage Marina but a crosswalk is not present. See photo. There is a pedestrian warning sign on the WB approach but not on the EB approach. Marina visitor parking is available on the north side.

NOTES

OTTAWA BEACH RD CORRIDOR

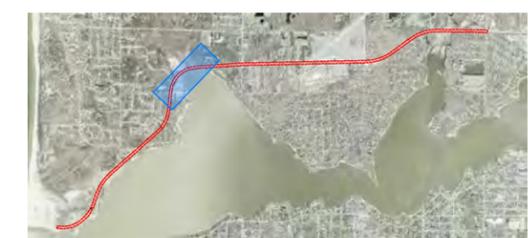
1. The posted speed limit is 45 mph. Given the sight distance and traffic flow, the speed limit is too fast for conditions in this area. See speed data.
2. Parking is prohibited on both sides of the road.
3. Ottawa Beach Rd transitions from a 2-lane road to a 3-lane road at the DNR Boat Launch.

DNR BOAT LAUNCH

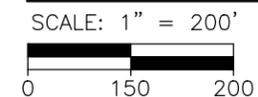
1. A center left turn lane and EB right turn lane are provided on Ottawa Beach Rd for the boat launch.

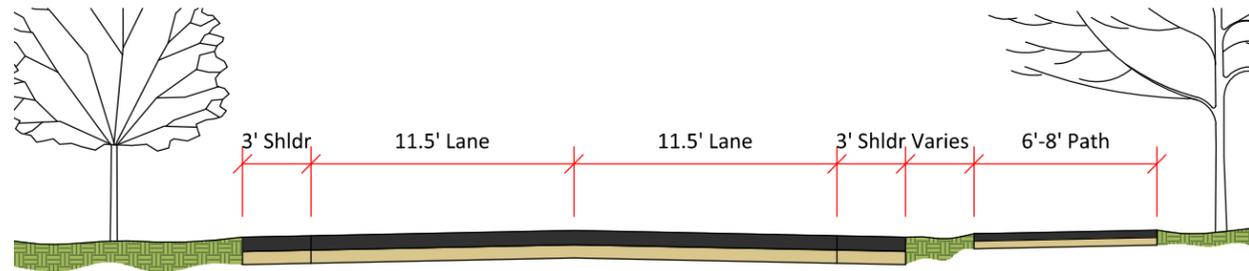
2. Vehicles will enter the boat launch on the south side, launch their boat and if parking is full on the south side will cross the street to north side for parking.
3. Pedestrians need to cross the road to and from their vehicles but a crosswalk and sidewalks are not present. There is no warning for crossing pedestrians. See photo.
4. Sight lines for vehicles and pedestrians crossing the road are limited due to the curve of the road.
5. During peak periods, waiting vehicles will back up onto Ottawa Beach Rd.

KEY PLAN



DNR BOAT LAUNCH EXISTING CONDITIONS





EXISTING CROSS SECTION
OTTAWA BEACH RD (LOOKING WEST)

KEY NOTE LEGEND

- 1 Vehicles parked illegally along Ottawa Beach Rd. See photo.
- 2 Vehicles start to park on side streets in the afternoon to go to the beach. See photo.

NOTES

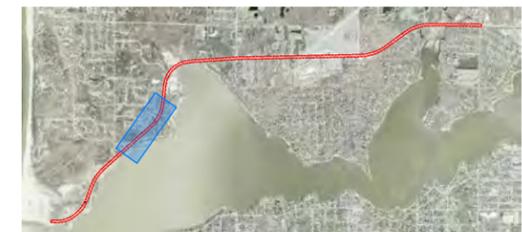
OTTAWA BEACH RD CORRIDOR

1. The posted speed limit is 45 mph east of Lake St and 40 mph west of Lake St.
2. Parking is prohibited on both sides of the road east of Lake St and on the north side west of Lake St. Parking is allowed on the south side west of Lake St.

OTTAWA BEACH RD AND LAKE ST

1. A right-turn lane is provided on Ottawa Beach Rd.
2. The path narrows to 6' at the right-turn lane. See photo.

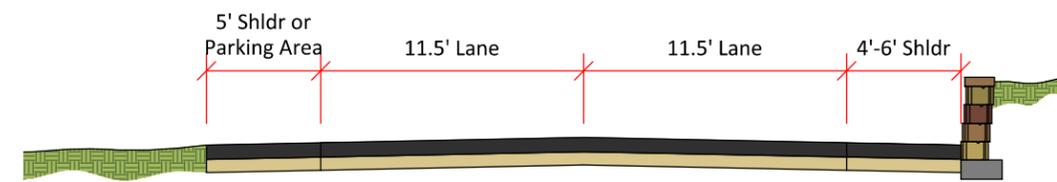
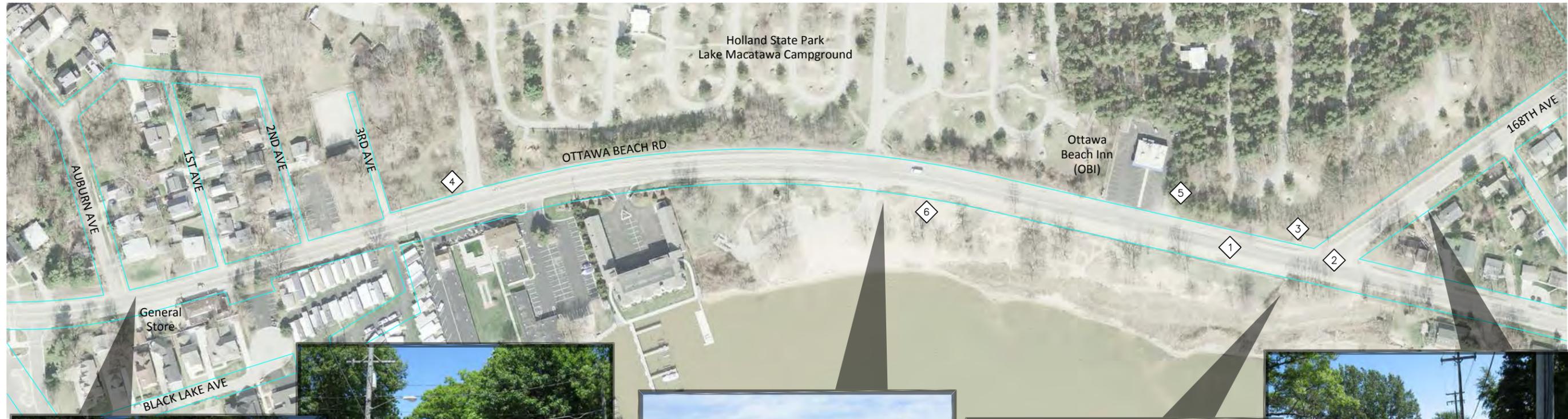
KEY PLAN



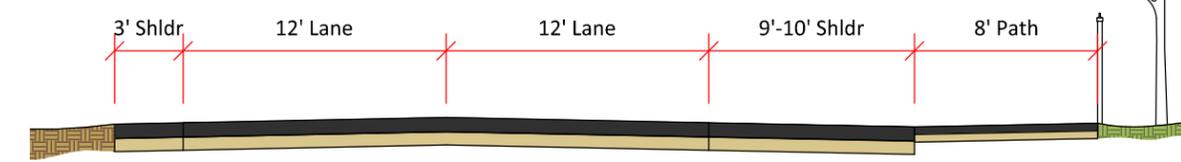
**POPLAR ST TO RICHARDSON AVE
EXISTING CONDITIONS**

SCALE: 1" = 200'





EXISTING CROSS SECTION
OTTAWA BEACH RD NEAR THE GENERAL STORE (LOOKING WEST)



EXISTING CROSS SECTION
OTTAWA BEACH RD NEAR HOLLAND STATE PARK CAMPGROUND (LOOKING WEST)

- KEY NOTE LEGEND**
- ◆ 1 Tube Counter Location 4 for volume and speed data. ADT = 9,729 vpd, 85th Percentile Speed = 38 mph
 - ◆ 2 The intersection is two-way stop-controlled. Ottawa Beach Rd does not stop.
 - ◆ 3 Second sign notifying vehicles that the Holland State Park beach parking is full.
 - ◆ 4 Third sign notifying vehicles that the Holland State Park beach parking is full. Mt. Pisgah trailhead.
 - ◆ 5 Parking is too close to the path. Vehicles back out of space onto path and shoulder to exit space.
 - ◆ 6 Vehicles are parked illegally along Ottawa Beach Rd.

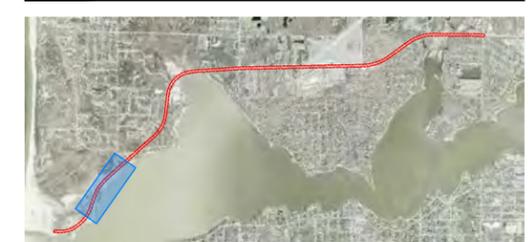
- NOTES**
- OTTAWA BEACH RD CORRIDOR**
1. The posted speed limit is 40 mph east of OBI, 30 mph west of 3rd Ave, and 35 mph in between.
 2. Parking is prohibited on both sides of the road west of OBI and on the north side east of OBI. Parking is allowed on the south side east of OBI.
 3. Parking is not delineated east of OBI. Angled and 90° parking were observed. Sight lines when leaving parking spot are limited.

- HOLLAND STATE PARK CAMPGROUND**
1. Several pedestrians and bikes crossing the road to

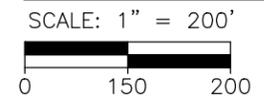
- go to the beach but a crosswalk is not present. See photo.
2. Sight lines for pedestrians and bikes crossing the road are limited due to the curve of the road and illegally parked vehicles.

- GENERAL STORE**
1. Several pedestrians and bikes crossing the road to go to the store but a crosswalk is not present.
 2. The path transitions to a narrow shoulder and with the large amount of pedestrian and bike traffic, some are forced into the road. See photos.

KEY PLAN

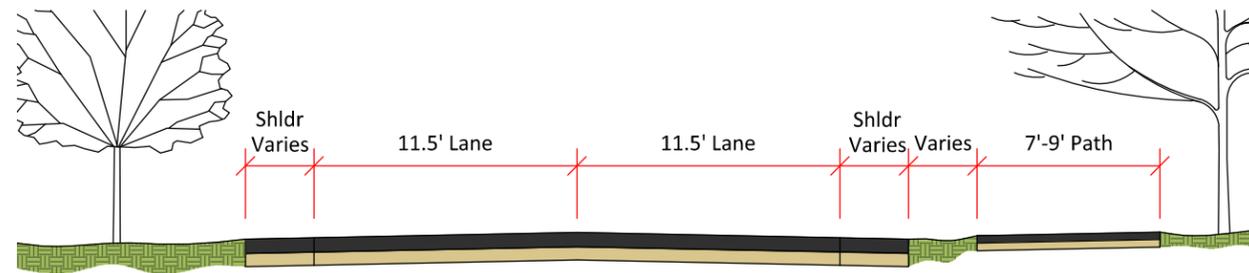


**168TH AVENUE TO GENERAL STORE
EXISTING CONDITIONS**



fishbeck, thompson,
carr & huber, inc.
Hard copy is
intended to be
11"x17" when
plotted. Scale(s)
indicated and
graphic quality may
not be accurate for
any other size.

PLOT INFO: Z:\2014\140303\CADD\CDD\009140303.DWG LAYOUT: FIGURE 9 DATE: 8/18/2014 TIME: 12:28:21 PM USER: KMW ©Copyright 2014 All Rights Reserved



EXISTING CROSS SECTION OTTAWA BEACH RD (LOOKING WEST)

KEY NOTE LEGEND

- 1 Tube Counter Location 5 for volume and speed data. ADT = 6,704 vpd, 85th Percentile Speed = 27 mph
- 2 The Pumphouse Museum is approximately 2' from the road and is protected by guardrail. See photo. Pedestrians and bikes using the shoulder need to enter the road to continue straight through.
- 3 The Historic Ottawa Beach Waterfront Walkway is currently under construction on the south side west of the Pumphouse Museum. See photo. This addition may change future pedestrian patterns.

NOTES

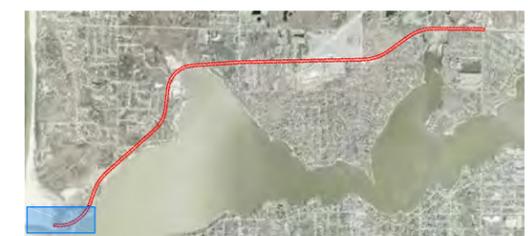
OTTAWA BEACH RD CORRIDOR

1. The posted speed limit is 30 mph. Given the amount of pedestrian and bike traffic, the speed limit is too fast for conditions in this area. See speed data.
2. Parking is prohibited on the entire north side and on the south side west of Parkside Marina to the Holland State Park beach. Parallel parking is allowed on the south side east of Parkside Marina.

HOLLAND STATE PARK BEACH

1. Even though signs are posted that the beach parking is full, vehicles wait in line to enter the park and back up past the General Store during peak periods. See photos. Many u-turns on Ottawa Beach Rd were witnessed during data collection.

KEY PLAN



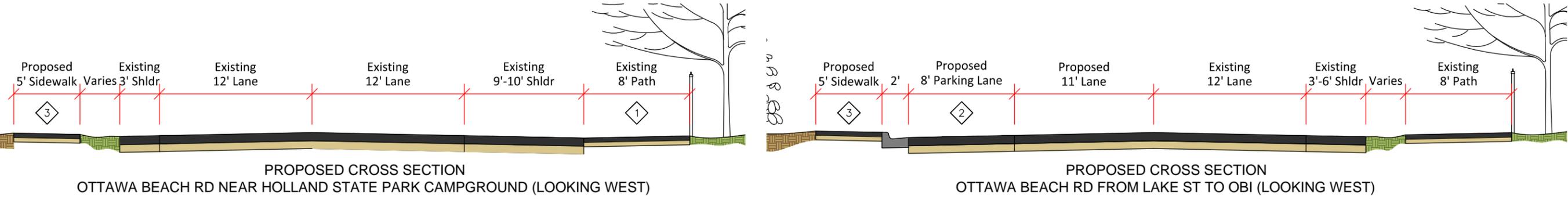
HOLLAND STATE PARK BEACH EXISTING CONDITIONS

SCALE: 1" = 200'
0 150 200



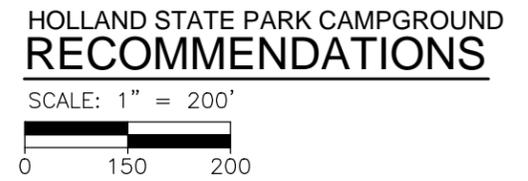


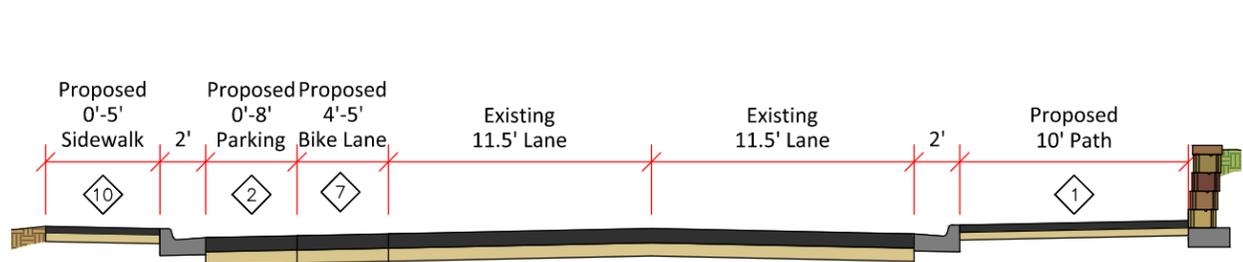
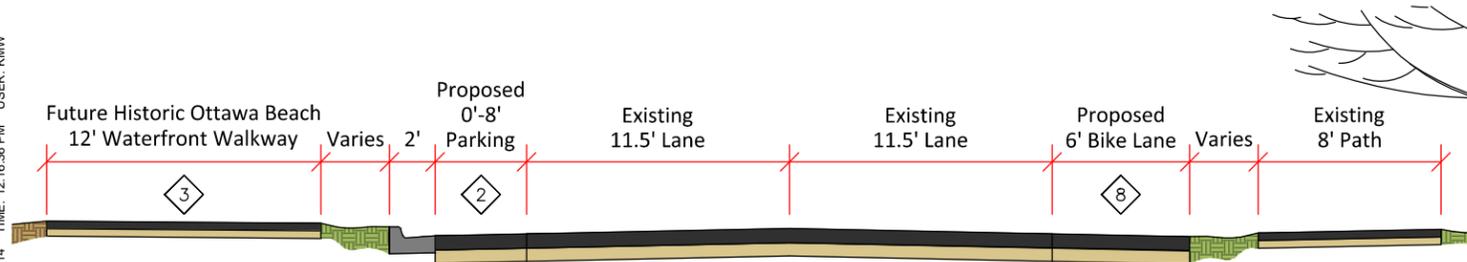
PLOT INFO: Z:\2014\140303\CADD\CD01140303.DWG LAYOUT: FIGURE 11 DATE: 8/18/2014 TIME: 12:11:28 PM USER: KMW



KEY NOTE LEGEND

- 1 Provide colored pavement or markings, and/or bollards or barrier to separate path from shoulder.
- 2 Delineate parallel parking along Ottawa Beach Rd with curb and gutter and pavement markings to help minimize illegal parking.
- 3 Provide sidewalk along parking lane and continue to Holland State Park Campground entrance.
- 4 Consider providing crosswalk and pedestrian hybrid beacons or W11-2 and W16-7P signs with RRFB. Also additional lighting could be provided at crossing.
- 5 Provide advance warning for pedestrian crossing with W11-2 and W16-9P signs in EB and WB directions.
- 6 Reconfigure OBI parking lot to minimize conflicts between site and Ottawa Beach Road traffic and to improve circulation.
- 7 Provide hardscape in no parking areas to help minimize illegal parking.
- 8 Provide internal sidewalks.
- 9 Update pavement markings for a no passing zone through parking and pedestrian crossing areas.





PROPOSED CROSS SECTION
OTTAWA BEACH RD NEAR HISTORIC OTTAWA BEACH WATERFRONT WALKWAY (LOOKING WEST)

PROPOSED CROSS SECTION
OTTAWA BEACH RD NEAR THE GENERAL STORE (LOOKING WEST)

- KEY NOTE LEGEND**
- 1 Provide 10' path on the back of curb and remove and relocate retaining walls.
 - 2 Delineate parallel parking along Ottawa Beach Rd with curb and gutter and pavement markings to help minimize illegal parking.
 - 3 Historic Ottawa Beach Waterfront Walkway to be constructed in the near future.
 - 4 Consider providing crosswalk and install W11-2 and W16-7P signs with RRFB. Also additional lighting could be provided at crossing.
 - 5 Provide advance warning for pedestrian crossing with W11-2 and W16-9P signs in EB and WB directions.
 - 6 Reconfigure General Store access points and parking lot configuration should be reviewed to reduce conflicts with the road and to improve circulation.
 - 7 Start bike lane in EB direction.
 - 8 Start bike lane in WB direction.
 - 9 End bike lane in WB direction. Bikes should use path.
 - 10 Provide 5' sidewalk in front of the General Store.
 - 11 Possible crossing location.

GENERAL STORE AREA RECOMMENDATIONS

SCALE: 1" = 200'

NORTH

fishbeck, thompson,
carr & huber, inc.
Hard copy is
intended to be
11"x17" when
plotted. Scale(s)
indicated and
graphic quality may
not be accurate for
any other size.

PLOT INFO: Z:\2014\140303\CADD\CD\012140303.DWG LAYOUT: FIGURE 12 DATE: 8/18/2014 TIME: 12:16:36 PM USER: KMW ©Copyright 2014 All Rights Reserved

Appendix 1

Ottawa County Road Commission

14110 Lakeshore Drive
P.O. Box 739
GRAND HAVEN, MI 49417
Phone (616) 842-5400 Fax (616) 850-7237

October 18, 2013

Mr. Jerry Felix, Manager
Park Township
52 152nd Avenue
Holland, MI 49424

Reference: 24-Hour Bi-directional Traffic Counts

Dear Mr. Felix:

Please find enclosed a listing of traffic counts conducted by the Road Commission within your township. The information includes count location, road classification (P = Primary or L = Local) and 2004 through 2013 traffic counts. These numbers are the actual volumes recorded during a 24-hour period and include both directions of travel for two-way roadways. A blank indicates a count was not taken during that particular year. Note that some volume fluctuations could be related to other than normal traffic changes because of construction activities or other reasons.

Hopefully this information will be useful in your township's operations. If you have any questions concerning the traffic count information please call me at 616/850-7220.

Sincerely,



Fred Keena
Traffic Engineer

Enclosure

Park Township 24-Hour Bi-Directional Traffic Counts

ROUTE	LOCATION	T	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
152ND AVE												
	S. of Post Ave.	L		1,125		1,342		1,425		1,211		
	S. of Ottawa Beach Rd.	L		4,143		4,428		4,635		3,801		
	N. of Ottawa Beach Rd.	P		2,938		3,182		2,620		2,771		
	N. of Lakewood Blvd.	L		3,227		3,486		3,109		3,365		
	N. of James St.	L		2,990		3,094		2,902		3,118		
	S. of Quincy St.	L		1,957		1,420		1,632		1,572		1,583
	N. of Quincy St.	L		1,415		1,134		1,172		1,177		1,055
	S. of New Holland St.	L		1,276		1,383		1,368		1,416		1,242
160TH AVE												
	N. of Ottogan St.	P	2,812		2,675		2,757		2,178		2,343	
	S. of Ottawa Beach Rd.	L	610		776		638		738			630
	N. of Ottawa Beach Rd.	L	3,038		2,757		3,100		3,106			2,953
	S. of Lakewood Blvd.	L	2,239		2,501		2,015		2,498			2,156
	N. of Lakewood Blvd.	L	2,000		2,592		1,691		2,189			1,824
	N. of James St.	L	1,230		1,233		1,201		1,389			1,370
	S. of Quincy St.	L	699		718		522		828			542
168TH AVE												
	S. of Lakeshore Ave.	P		3,025		4,081		3,364		3,162		2,776
	N. of Lakeshore Ave.	L		1,219		1,447		1,401		2,103		1,937
	S. of Lakewood Blvd.	L		3,631		2,969		2,721		3,274		2,812
	N. of Lakewood Blvd.	L		2,591		2,133		2,177		1,809		1,911
	S. of Riley St.	L		1,713		1,582		1,457		1,216		1,278
	N. of Riley St.	L		1,142		1,082		908		1,000		995
Butternut Dr.												
	S. of Quincy St.	P	6,206		6,273		5,747		5,422			5,927
	S. of New Holland St.	P	4,274		4,407		4,059		4,119			4,434
Greenly St.												
	W. of 152nd Ave	L	312		280		451		476		391	
James St.												
	W. of 144th Ave.	L		5,717		5,670		4,867		5,572		
	W. of 152nd Ave.	L		3,167		3,287		3,293		3,945		
	W. of 160th Ave.	L		1,945		2,257		1,974		2,413		
	E. of Lakeshore Ave.	L		487		651		701		934		
Lakeshore Ave.												
	W. of 168th Ave.	P	2,427		2,459		2,300		2,525		2,934	
	S. of Lakewood Dr.	P	2,872		2,941		2,962		2,881		3,416	
	N. of Lakewood Blvd.	P	3,086		2,815		2,897		3,499		3,356	
	N. of Riley St.	P		3,080		3,122		2,533		2,739		
Lakewood Blvd.												
	W. of 144th Ave.	P		10,170		9,389		8,103		9,341		9,181
	W. of 152nd Ave.	P		8,051		8,022		7,278		7,135		7,724

ROUTE	LOCATION	T	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	W. of 160th Ave.	P		5,412		5,782		5,364		5,513		5,801
	W. of 168th Ave.	P		2,520		2,311		2,066		2,606		2,474
Ottogon St.												
	E. of 160th Ave.	L		4,324		3,173			3,085		3,835	
	W. of 160th Ave.	L		3,060		2,984			2,475		2,489	
	S. of South Shore Dr.	L		1,228		1,157			886		993	
Ottawa Beach Rd.												
	W. of 144th Ave.	P		16,430		16,865		16,764		16,561		15,661
	E. of 152nd Ave.	P		11,740		15,308		15,760		16,020	13,199	
	W. of 152nd Ave.	P		12,802		12,623		13,210		15,261		11,402
	E. of 160th Ave.	P		9,289		13,149		11,249		12,554	9,092	
	W. of 160th Ave.	P		6,936		9,713		9,526		10,038		8,824
	E. of 168th Ave.	P		2,745		4,974		4,779		3,471		5,852
	W. of 168th Ave.	P		3,193		5,672		5,454		4,739		3,760
Perry St.												
	W. of 160th Ave.	L		1,480		1,501		1,446		1,559		1,341
	E. of Lakeshore Ave.	L		373		579		457		467		548
Post Ave.												
	E. of 152nd Ave.	L	655		769		592		569		559	
	W. of 152nd Ave.	L	2,698		2,775		2,493		2,522		2,302	
	E. of Waukazoo-W End	L	410		411		453		354		370	
Quincy St.												
	W. of 144th Ave.	L		3,887		3,677		3,568		4,003		
	W. of Butternut Dr.	L		3,608		3,329		3,199		3,490		
	W. of 160th Ave.	L		2,790		2,589		2,362		2,735		
	E. of Lakeshore Ave.	L		1,567		1,502		1,378		1,541		
Ransom St.												
	W. of 152nd Ave.	L		933		832		804		878		
Riley St.												
	W. of 144th Ave.	L		8,825		7,602		7,291		6,834		7,694
	W. of 152nd Ave.	L		4,583		4,297		3,969		3,291		3,879
	W. of 160th Ave.	L		3,529		3,356		2,840		2,571		2,899
	W. of 168th Ave.	L		2,134		2,021		1,748		1,620		1,774
South Shore Dr.												
	E. of 160th Ave.	P		3,987		4,742			3,959		4,283	
	W. of 160th Ave.	P		3,926		3,302			2,449		3,156	2,076
	W. of Saunders Ave.	P		2,946		2,620		3,202	2,373		2,425	
Waukazoo Dr.												
	W. of 160th Ave.	L	586		695		597		566		596	
Waukazoo Dr.(W)												
	S. of Post Ave.	L	627		799		723		604		561	

Table A1.2 - Volume Data for East of 152nd Ave

Start Time	Thursday 7/3		Friday 7/4		Saturday 7/5		Sunday 7/6		Monday 7/7		Bi-Directional Average
	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	
12:00 AM			93	58	128	356	86	64	41	18	211
01:00 AM			68	48	56	58	60	49	21	12	93
02:00 AM			21	19	25	15	28	18	12	0	35
03:00 AM			26	13	9	11	18	13	20	6	29
04:00 AM			29	12	16	17	15	11	20	18	35
05:00 AM			53	28	36	31	8	28	15	144	86
06:00 AM			60	82	44	73	29	59	45	295	172
07:00 AM			113	136	109	170	49	111	146	500	334
08:00 AM			240	235	163	308	114	265	201	454	495
09:00 AM			428	365	370	523	234	499	242	429	773
10:00 AM			677	408	643	593	323	447			1030
11:00 AM	504	492	793	437	840	595	783	432			1219
12:00 PM	621	496	794	470	766	551	595	503			1199
01:00 PM	601	459	724	458	804	574	578	433			1158
02:00 PM	613	492	727	472	724	594	575	487			1171
03:00 PM	638	549	695	533	703	635	542	572			1217
04:00 PM	722	547	645	629	602	724	543	593			1251
05:00 PM	817	609	643	573	577	692	524	633			1267
06:00 PM	608	496	562	557	505	649	464	580			1105
07:00 PM	590	484	541	606	480	598	416	566			1070
08:00 PM	640	379	530	546	484	584	343	559			1016
09:00 PM	505	461	370	548	385	552	183	229			808
10:00 PM	279	248	205	327	228	309	126	121			461
11:00 PM	183	123	318	843	145	137	69	46			466
Total	7321	5835	9355	8403	8842	9349	6705	7318	763	1876	
Day Total	13156		17758		18191		14023		2639		16699

Table A1.2 - Volume Data for West of Ottawa County Fairgrounds

Start Time	Thursday 7/3		Friday 7/4		Saturday 7/5		Sunday 7/6		Monday 7/7		Bi-Directional Average
	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	
12:00 AM			68	50	87	303	61	43	28	10	163
01:00 AM			55	19	40	47	35	23	18	8	61
02:00 AM			21	9	15	9	23	14	3	4	25
03:00 AM			19	7	6	8	11	5	6	11	18
04:00 AM			24	9	13	10	12	9	5	26	27
05:00 AM			53	21	37	27	10	20	7	95	68
06:00 AM			58	71	36	61	27	52	38	209	138
07:00 AM			100	117	84	138	47	101	103	364	264
08:00 AM			221	178	148	255	94	203	145	333	394
09:00 AM			400	344	327	418	205	406	184	320	651
10:00 AM			649	359	586	492	296	380			921
11:00 AM	421	387	715	387	792	506	603	408			1055
12:00 PM	558	376	761	418	660	481	520	431			1051
01:00 PM	494	353	688	386	725	497	558	377			1020
02:00 PM	503	409	664	439	677	541	514	420			1042
03:00 PM	508	460	629	492	622	575	481	516			1071
04:00 PM	584	490	548	561	500	680	488	562			1103
05:00 PM	641	488	586	576	493	654	466	573			1119
06:00 PM	497	411	526	512	453	606	406	539			988
07:00 PM	508	450	497	560	421	575	351	523			971
08:00 PM	545	374	487	508	415	535	297	534			924
09:00 PM	443	431	337	438	302	539	143	211			711
10:00 PM	203	205	144	299	172	283	96	94			374
11:00 PM	126	92	212	860	103	99	45	45			396
Total	6031	4926	8462	7620	7714	8339	5789	6489	537	1380	
Day Total	10957		16082		16053		12278		1917		14552

Table A1.3 - Volume Data for East of DNR Boat Launch

Start Time	Thursday 7/3		Friday 7/4		Saturday 7/5		Sunday 7/6		Monday 7/7		Bi-Directional Average
	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	
12:00 AM			48	36	76	286	38	37	16	7	136
01:00 AM			41	20	17	31	21	18	8	4	40
02:00 AM			12	5	8	9	14	13	4	2	17
03:00 AM			14	6	4	7	7	5	7	7	14
04:00 AM			16	8	9	6	7	7	3	20	19
05:00 AM			49	14	35	18	6	17	4	57	50
06:00 AM			56	57	36	46	30	36	19	131	103
07:00 AM			95	98	79	104	43	80	86	233	205
08:00 AM			214	146	134	221	89	175	119	247	336
09:00 AM			398	295	321	362	217	343	147	237	580
10:00 AM			664	299	565	409	284	310			844
11:00 AM	375	314	703	336	768	424	569	367			964
12:00 PM	495	314	735	349	673	429	525	368			972
01:00 PM	475	319	679	372	706	469	507	346			968
02:00 PM	451	342	667	433	672	506	506	394			993
03:00 PM	426	392	637	470	592	570	457	478			1006
04:00 PM	485	453	534	589	503	646	460	548			1055
05:00 PM	593	450	600	556	488	640	433	544			1076
06:00 PM	449	351	529	487	438	606	372	518			938
07:00 PM	464	396	507	525	413	578	322	500			926
08:00 PM	516	336	509	484	421	534	264	501			891
09:00 PM	379	429	361	386	279	530	119	195			670
10:00 PM	168	188	118	291	154	275	72	78			336
11:00 PM	80	71	158	902	71	83	33	33			358
Total	5356	4355	8344	7164	7462	7789	5395	5911	413	945	
Day Total	9711		15508		15251		11306		1358		13494

Table A1.4 - Volume Data for East of Holland State Park Campground

Start Time	Thursday 7/3		Friday 7/4		Saturday 7/5		Sunday 7/6		Monday 7/7		Bi-Directional Average
	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	
12:00 AM			11	14	29	155	15	23	4	3	64
01:00 AM			11	10	11	13	7	7	1	2	16
02:00 AM			5	2	3	5	4	10	1	4	9
03:00 AM			3	4	2	4	4	7	3	1	7
04:00 AM			6	2	2	2	3	4	2	5	7
05:00 AM			13	4	8	10	3	4	1	10	13
06:00 AM			32	25	21	21	20	14	19	38	48
07:00 AM			82	51	54	49	34	48	45	51	104
08:00 AM			196	91	93	111	67	81	61	77	194
09:00 AM			328	199	229	164	151	204	104	111	373
10:00 AM			524	200	441	230	235	189			606
11:00 AM	257	152	491	341	549	274	454	265			696
12:00 PM	296	200	444	417	456	389	360	271			708
01:00 PM	298	176	472	367	485	437	388	244			717
02:00 PM	271	232	433	382	497	434	405	290			736
03:00 PM	270	267	441	402	433	383	363	377			734
04:00 PM	255	314	378	421	372	448	376	426			748
05:00 PM	338	277	451	409	396	456	357	436			780
06:00 PM	291	241	419	309	375	454	320	421			708
07:00 PM	349	302	416	363	369	433	247	408			722
08:00 PM	364	294	437	377	365	435	214	458			736
09:00 PM	248	431	293	309	225	461	72	170			552
10:00 PM	70	120	47	197	74	208	34	51			200
11:00 PM	40	62	54	734	24	60	15	29			255
Total	3347	3068	5987	5630	5513	5636	4148	4437	241	302	
Day Total	6415		11617		11149		8585		543		9729

Table A1.5 - Volume Data for West of Auburn Ave

Start Time	Thursday 7/3		Friday 7/4		Saturday 7/5		Sunday 7/6		Monday 7/7		Bi-Directional Average
	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	
12:00 AM			10	10	17	97	11	8	2	0	39
01:00 AM			8	8	4	8	6	4	4	5	12
02:00 AM			2	1	2	2	2	4	1	1	4
03:00 AM			1	2	3	3	4	7	1	0	5
04:00 AM			5	2	2	2	1	1	1	2	4
05:00 AM			7	4	3	3	3	2	0	4	7
06:00 AM			22	12	17	12	10	7	9	14	26
07:00 AM			66	36	34	27	21	24	31	25	66
08:00 AM			167	62	74	64	56	40	43	47	138
09:00 AM			288	107	170	103	109	95	71	52	249
10:00 AM			460	149	346	124	207	125			470
11:00 AM	158	79	267	212	442	131	323	190			451
12:00 PM	219	124	244	307	218	228	267	184			448
01:00 PM	242	118	190	243	219	325	307	186			458
02:00 PM	193	181	146	245	247	291	315	246			466
03:00 PM	201	235	99	199	297	305	303	312			488
04:00 PM	156	241	91	251	278	368	289	350			506
05:00 PM	194	220	209	251	284	358	265	362			536
06:00 PM	177	160	327	270	288	366	250	345			546
07:00 PM	219	239	312	254	282	380	206	321			553
08:00 PM	258	210	241	238	297	346	172	344			527
09:00 PM	196	375	203	221	168	404	50	116			433
10:00 PM	33	61	44	132	39	123	17	29			120
11:00 PM	12	17	27	505	14	24	11	13			156
Total	2258	2260	3436	3721	3745	4094	3205	3315	163	150	
Day Total	4518		7157		7839		6520		313		6704

Appendix 2

Table A2.1 - Speed Data for East of 152nd Ave

Speed Range (mph)													
1-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76+
3803	17	28	50	362	2109	8080	17992	20222	10321	2389	328	46	20

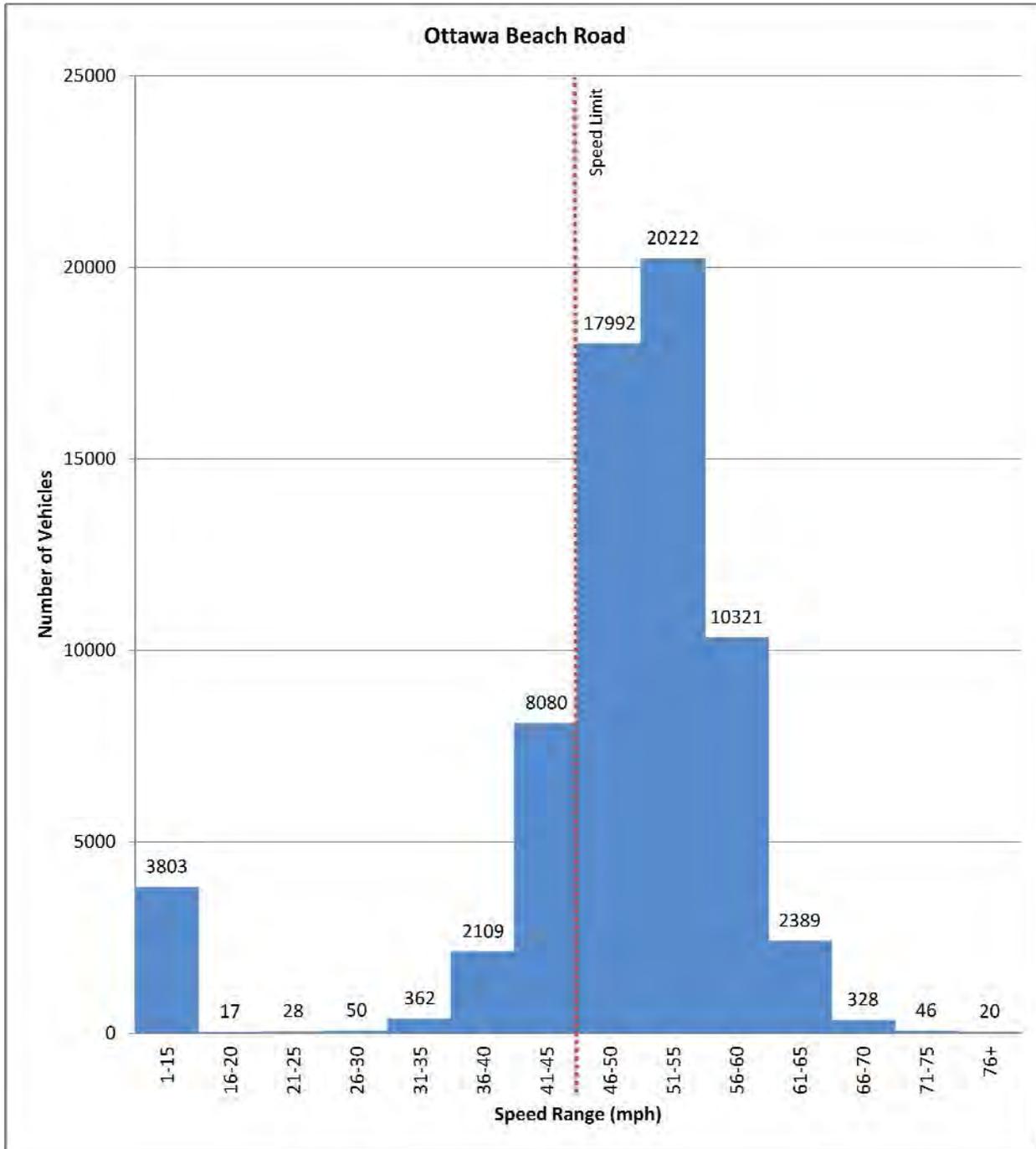


Table A2.2 - Speed Data for West of Ottawa County Fairgrounds

Speed Range (mph)													
1-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76+
2653	89	160	368	3043	14276	24386	10578	1538	156	17	12	7	4

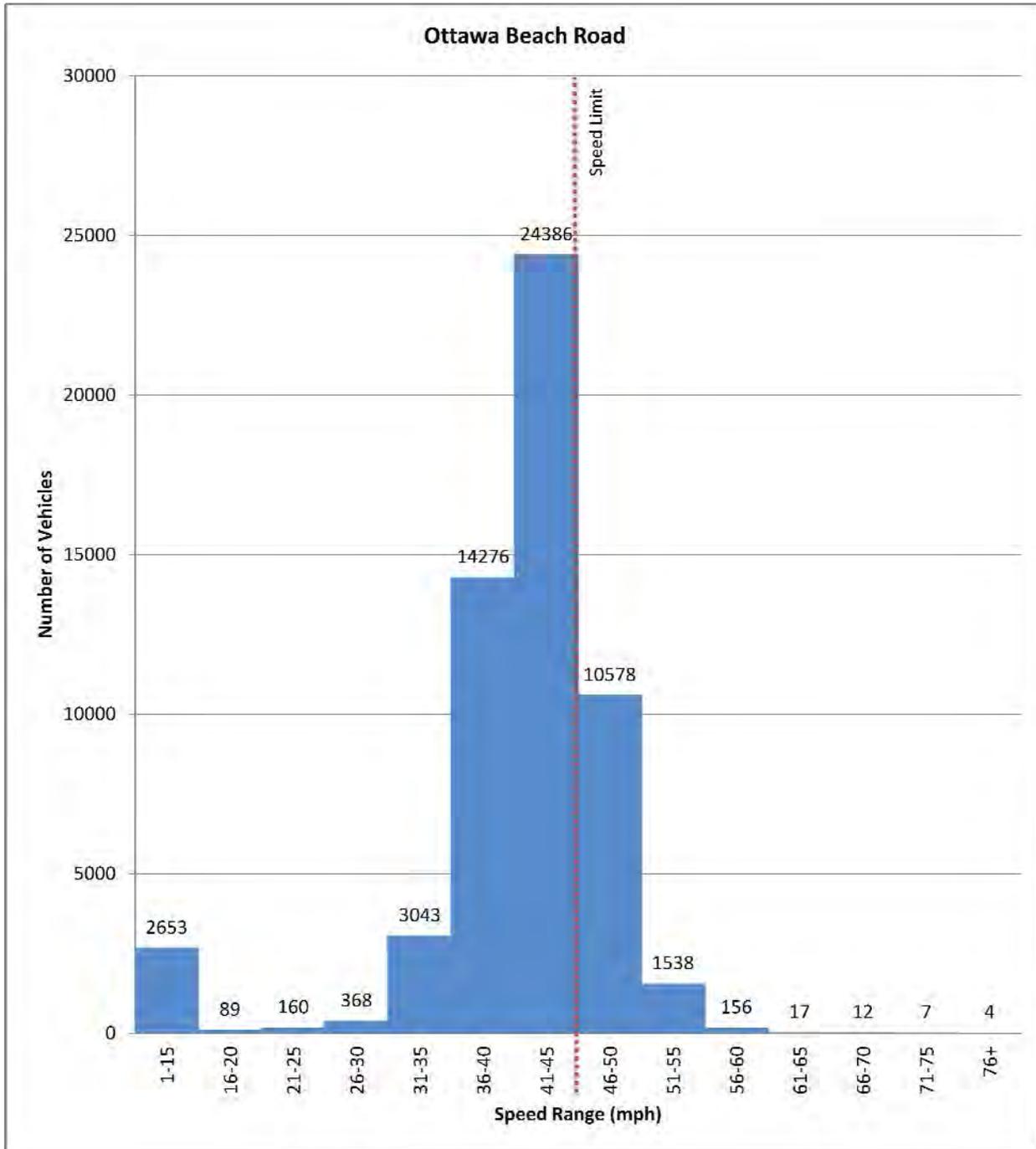


Table A2.3 - Speed Data for East of DNR Boat Launch

Speed Range (mph)													
1-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76+
3586	1045	1755	7441	17642	15519	5204	841	84	12	3	1	0	1

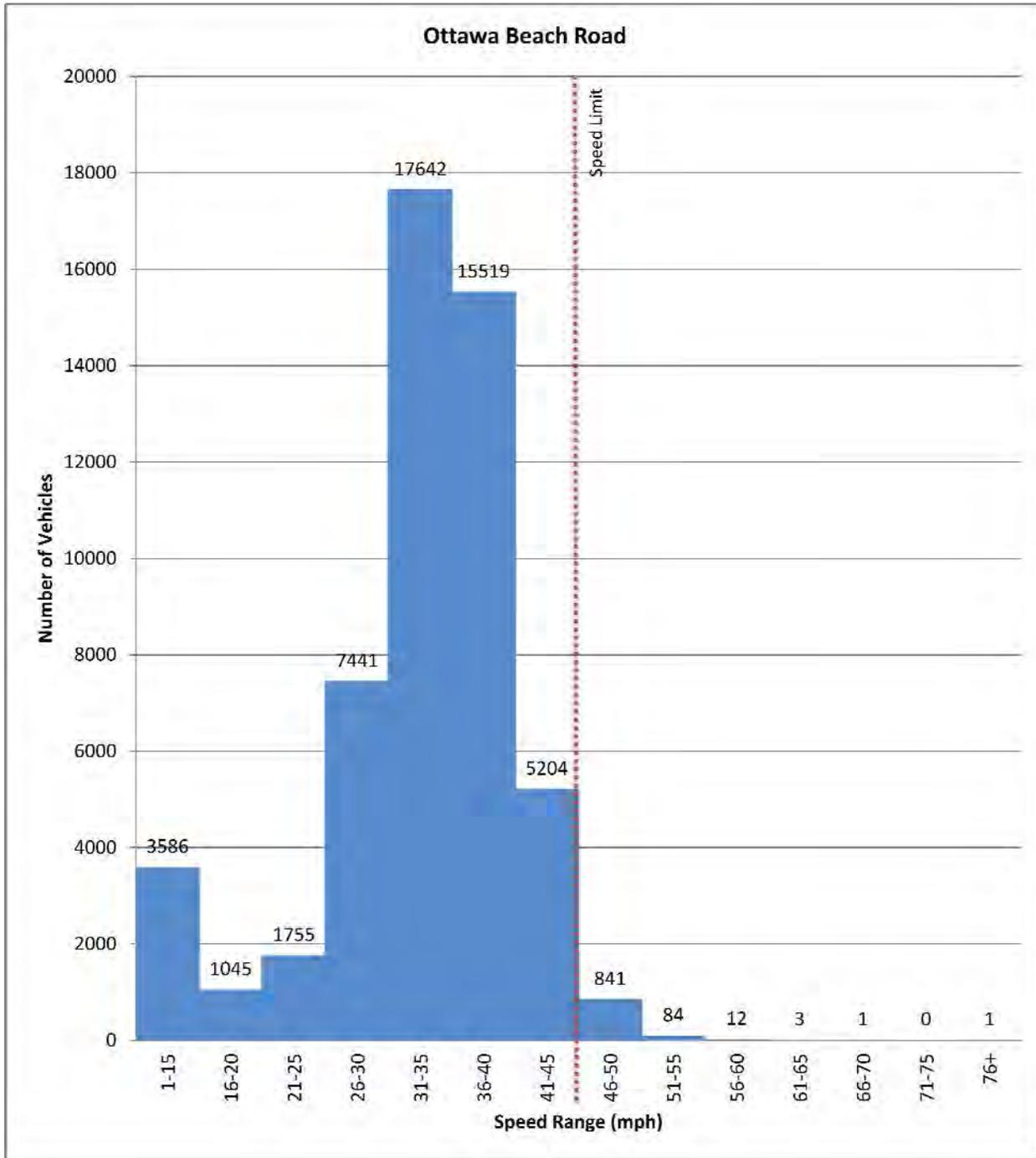


Table A2.4 - Speed Data for East of Holland State Park Campground

Speed Range (mph)													
1-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76+
5650	4989	7590	7652	5150	3525	2204	1081	344	94	13	10	5	2

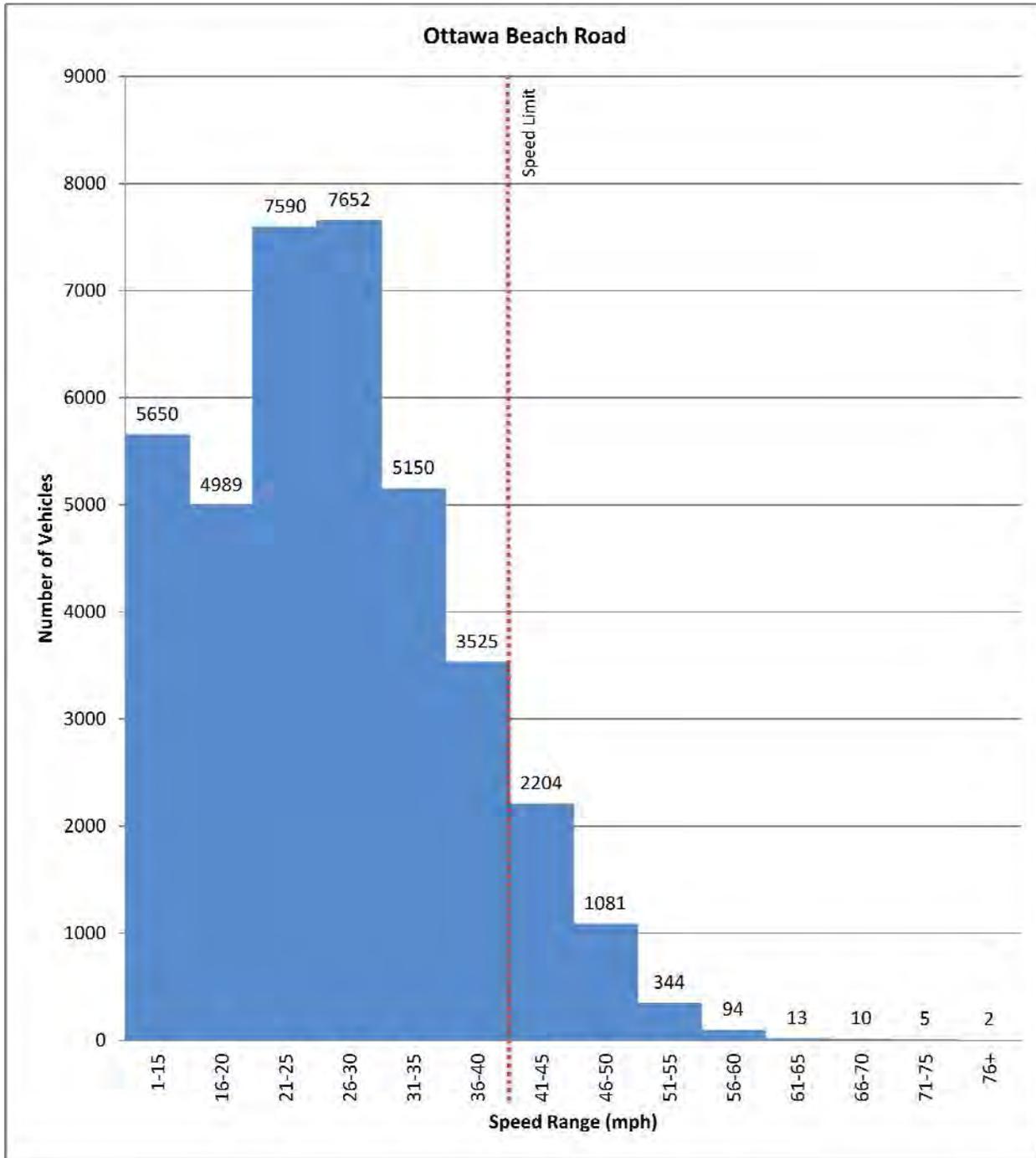
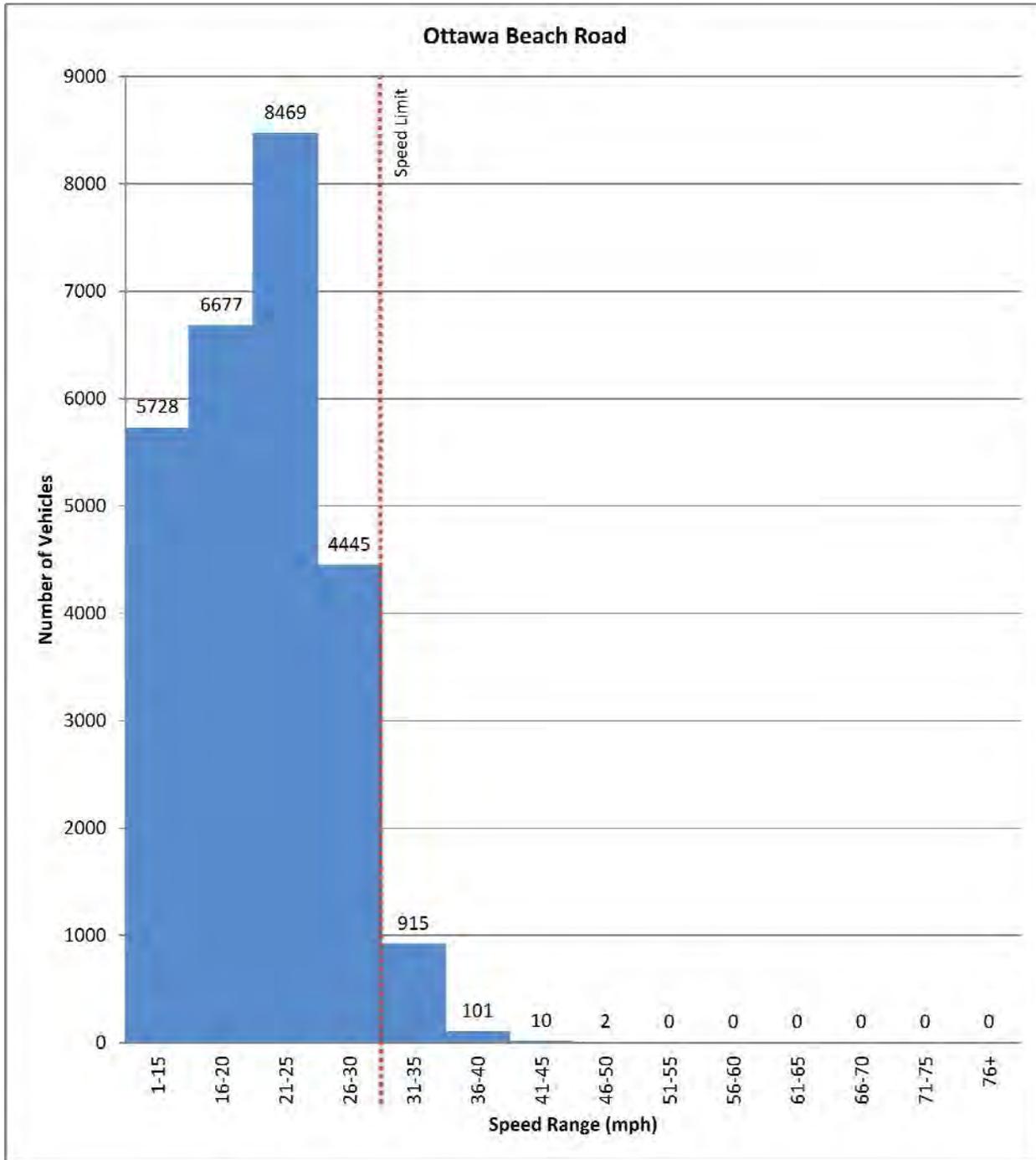


Table A2.5 - Speed Data for West of Auburn Ave

Speed Range (mph)													
1-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76+
5728	6677	8469	4445	915	101	10	2	0	0	0	0	0	0



Appendix 3

144th Avenue to Holland State Park beach INTERSECTION (SPOT)		CALC'ed RATE	3 YEAR Crashes	Ave. Crash	Casualty Ratio	ADT	Sig / Unsig	Injury Freq	Fatal
1	144th Avenue	1.79	36	12.00	0.25	18417.5	S	9	0

Type of Crash	# of Crashes	Percentage
Angle	11	30.6%
Head-on	0	0.0%
Head-on / Left Turn	5	13.9%
Other / Unknown	0	0.0%
Rear-end	8	22.2%
Rear-end Left Turn	4	11.1%
Rear-end Right Turn	0	0.0%
Sideswipe Opposite Direction	1	2.8%
Sideswipe Same Direction	3	8.3%
Single Motor Vehicle	4	11.1%
TOTAL	36	100.0%

Pavement Condition	# of Crashes	Percentage
Dry	21	58.3%
Wet	9	25.0%
Icy	2	5.6%
Snowy	4	11.1%
TOTAL	36	100.0%

Crash Severity	# of Crashes	Percentage
Injury Crashes	9	25.0%
Injury A	1	2.8%
Injury B	3	8.3%
Injury C	5	13.9%
Fatal	0	0.0%
Alcohol with Injury	1	2.8%
Alcohol without Injury	0	0.0%
Pedestrian with Injury	0	0.0%
Pedestrian without Injury	0	0.0%
Bicyclist with Injury	0	0.0%
Bicyclist without Injury	0	0.0%
Causality Ratio	0.25	

Time of Day	# of Crashes	Percentage
Morning	5	13.9%
Afternoon	13	36.1%
Evening	15	41.7%
Night	3	8.3%
TOTAL	36	100.0%

Day of Week	# of Crashes	Percentage
Monday	8	22.2%
Tuesday	5	13.9%
Wednesday	9	25.0%
Thursday	4	11.1%
Friday	5	13.9%
Saturday	5	13.9%
Sunday	0	0.0%
TOTAL	36	100.0%

Month	# of Crashes	Percentage
January	2	5.6%
February	2	5.6%
March	1	2.8%
April	2	5.6%
May	5	13.9%
June	1	2.8%
July	5	13.9%
August	7	19.4%
September	0	0.0%
October	6	16.7%
November	3	8.3%
December	2	5.6%
TOTAL	36	100.0%

Special Factors	# of Crashes	Percentage
Deer Involved	0	0.0%
Pedestrian Involved	0	0.0%
Bicyclist Involved	1	2.8%

Lighting	# of Crashes	Percentage
Dawn	1	2.8%
Daylight	27	75.0%
Dusk	1	2.8%
Dark Lighted	6	16.7%
Dark Unlighted	1	2.8%
TOTAL	36	100.0%

Weather	# of Crashes	Percentage
Clear	21	58.3%
Cloudy	4	11.1%
Rain	7	19.4%
Sleet/hail	0	0.0%
Snow/blowing Snow	4	11.1%
TOTAL	36	100.0%

Year	# of Crashes	Percentage
2011	9	25.0%
2012	8	22.2%
2013	19	52.8%
TOTAL	36	100.0%

144th Avenue to Holland State Park beach		CALC'ed RATE	3 YEAR	Ave. Crash	Casualty Ratio	ADT	Miles	Injury Freq	Fatal
SEGMENT			Crashes						
2	144th Avenue to 152nd Avenue	1.73	30	10.00	0.27	14430	1.1	8	1

Type of Crash	# of Crashes	Percentage
Angle	2	6.7%
Head-on	2	6.7%
Head-on / Left Turn	0	0.0%
Other / Unknown	2	6.7%
Rear-end	4	13.3%
Rear-end Left Turn	3	10.0%
Rear-end Right Turn	0	0.0%
Sideswipe Opposite Direction	0	0.0%
Sideswipe Same Direction	3	10.0%
Single Motor Vehicle	14	46.7%
TOTAL	30	100.0%

Pavement Condition	# of Crashes	Percentage
Dry	18	60.0%
Wet	7	23.3%
Icy	1	3.3%
Snowy	4	13.3%
TOTAL	30	100.0%

Crash Severity	# of Crashes	Percentage
Injury Crashes	8	26.7%
Injury A	2	6.7%
Injury B	2	6.7%
Injury C	4	13.3%
Fatal	1	3.3%
Alcohol with Injury	1	3.3%
Alcohol without Injury	0	0.0%
Pedestrian with Injury	1	3.3%
Pedestrian without Injury	0	0.0%
Bicyclist with Injury	0	0.0%
Bicyclist without Injury	0	0.0%
Causality Ratio	0.27	

Time of Day	# of Crashes	Percentage
Morning	4	13.3%
Afternoon	10	33.3%
Evening	11	36.7%
Night	5	16.7%
TOTAL	30	100.0%

Day of Week	# of Crashes	Percentage
Monday	5	16.7%
Tuesday	2	6.7%
Wednesday	2	6.7%
Thursday	6	20.0%
Friday	4	13.3%
Saturday	7	23.3%
Sunday	4	13.3%
TOTAL	30	100.0%

Month	# of Crashes	Percentage
January	4	13.3%
February	2	6.7%
March	2	6.7%
April	2	6.7%
May	1	3.3%
June	4	13.3%
July	2	6.7%
August	1	3.3%
September	2	6.7%
October	4	13.3%
November	5	16.7%
December	1	3.3%
TOTAL	30	100.0%

Special Factors	# of Crashes	Percentage
Deer Involved	7	23.3%
Pedestrian Involved	2	6.7%
Bicyclist Involved	0	0.0%

Lighting	# of Crashes	Percentage
Dawn	1	3.3%
Daylight	18	60.0%
Dusk	1	3.3%
Dark Lighted	9	30.0%
Dark Unlighted	1	3.3%
TOTAL	30	100.0%

Weather	# of Crashes	Percentage
Clear	12	40.0%
Cloudy	7	23.3%
Rain	6	20.0%
Sleet/hail	0	0.0%
Snow/blowing Snow	5	16.7%
TOTAL	30	100.0%

Year	# of Crashes	Percentage
2011	9	30.0%
2012	9	30.0%
2013	12	40.0%
TOTAL	30	100.0%

144th Avenue to Holland State Park beach INTERSECTION (SPOT)		CALC'ed RATE	3 YEAR Crashes	Ave. Crash	Casualty Ratio	ADT	Sig / Unsig	Injury Freq	Fatal
3	152nd Avenue	0.70	12	4.00	0.08	15586.5	S	1	0

Type of Crash	# of Crashes	Percentage
Angle	4	33.3%
Head-on	0	0.0%
Head-on / Left Turn	0	0.0%
Other / Unknown	0	0.0%
Rear-end	0	0.0%
Rear-end Left Turn	0	0.0%
Rear-end Right Turn	0	0.0%
Sideswipe Opposite Direction	1	8.3%
Sideswipe Same Direction	3	25.0%
Single Motor Vehicle	4	33.3%
TOTAL	12	100.0%

Pavement Condition	# of Crashes	Percentage
Dry	7	58.3%
Wet	0	0.0%
Icy	2	16.7%
Snowy	3	25.0%
TOTAL	12	100.0%

Crash Severity	# of Crashes	Percentage
Injury Crashes	1	8.3%
Injury A	0	0.0%
Injury B	1	8.3%
Injury C	0	0.0%
Fatal	0	0.0%
Alcohol with Injury	0	0.0%
Alcohol without Injury	0	0.0%
Pedestrian with Injury	0	0.0%
Pedestrian without Injury	0	0.0%
Bicyclist with Injury	0	0.0%
Bicyclist without Injury	0	0.0%
Causality Ratio	0.08	

Time of Day	# of Crashes	Percentage
Morning	1	8.3%
Afternoon	5	41.7%
Evening	4	33.3%
Night	2	16.7%
TOTAL	12	100.0%

Day of Week	# of Crashes	Percentage
Monday	1	8.3%
Tuesday	1	8.3%
Wednesday	1	8.3%
Thursday	0	0.0%
Friday	2	16.7%
Saturday	3	25.0%
Sunday	4	33.3%
TOTAL	12	100.0%

Month	# of Crashes	Percentage
January	3	25.0%
February	0	0.0%
March	0	0.0%
April	1	8.3%
May	1	8.3%
June	1	8.3%
July	1	8.3%
August	0	0.0%
September	1	8.3%
October	1	8.3%
November	2	16.7%
December	1	8.3%
TOTAL	12	100.0%

Special Factors	# of Crashes	Percentage
Deer Involved	0	0.0%
Pedestrian Involved	0	0.0%
Bicyclist Involved	0	0.0%

Lighting	# of Crashes	Percentage
Dawn	0	0.0%
Daylight	10	83.3%
Dusk	1	8.3%
Dark Lighted	1	8.3%
Dark Unlighted	0	0.0%
TOTAL	12	100.0%

Weather	# of Crashes	Percentage
Clear	7	58.3%
Cloudy	2	16.7%
Rain	0	0.0%
Sleet/hail	0	0.0%
Snow/blowing Snow	3	25.0%
TOTAL	12	100.0%

Year	# of Crashes	Percentage
2011	4	33.3%
2012	4	33.3%
2013	4	33.3%
TOTAL	12	100.0%

144th Avenue to Holland State Park beach		CALC'ed RATE	3 YEAR	Ave. Crash	Casualty Ratio	ADT	Miles	Injury Freq	Fatal
SEGMENT			Crashes						
4	152nd Avenue to 160th Avenue	1.16	13	4.33	0.15	10247	1	2	0

Type of Crash	# of Crashes	Percentage
Angle	0	0.0%
Head-on	1	7.7%
Head-on / Left Turn	0	0.0%
Other / Unknown	0	0.0%
Rear-end	7	53.8%
Rear-end Left Turn	1	7.7%
Rear-end Right Turn	0	0.0%
Sideswipe Opposite Direction	0	0.0%
Sideswipe Same Direction	0	0.0%
Single Motor Vehicle	4	30.8%
TOTAL	13	100.0%

Pavement Condition	# of Crashes	Percentage
Dry	11	84.6%
Wet	1	7.7%
Icy	1	7.7%
Snowy	0	0.0%
TOTAL	13	100.0%

Crash Severity	# of Crashes	Percentage
Injury Crashes	2	15.4%
Injury A	0	0.0%
Injury B	0	0.0%
Injury C	2	15.4%
Fatal	0	0.0%
Alcohol with Injury	0	0.0%
Alcohol without Injury	0	0.0%
Pedestrian with Injury	0	0.0%
Pedestrian without Injury	0	0.0%
Bicyclist with Injury	0	0.0%
Bicyclist without Injury	0	0.0%
Causality Ratio	0.15	

Time of Day	# of Crashes	Percentage
Morning	1	7.7%
Afternoon	5	38.5%
Evening	4	30.8%
Night	3	23.1%
TOTAL	13	100.0%

Day of Week	# of Crashes	Percentage
Monday	2	15.4%
Tuesday	1	7.7%
Wednesday	3	23.1%
Thursday	0	0.0%
Friday	4	30.8%
Saturday	3	23.1%
Sunday	0	0.0%
TOTAL	13	100.0%

Month	# of Crashes	Percentage
January	0	0.0%
February	0	0.0%
March	0	0.0%
April	0	0.0%
May	0	0.0%
June	3	23.1%
July	3	23.1%
August	2	15.4%
September	2	15.4%
October	1	7.7%
November	1	7.7%
December	1	7.7%
TOTAL	13	100.0%

Special Factors	# of Crashes	Percentage
Deer Involved	4	30.8%
Pedestrian Involved	0	0.0%
Bicyclist Involved	0	0.0%

Lighting	# of Crashes	Percentage
Dawn	0	0.0%
Daylight	7	53.8%
Dusk	1	7.7%
Dark Lighted	3	23.1%
Dark Unlighted	2	15.4%
TOTAL	13	100.0%

Weather	# of Crashes	Percentage
Clear	11	84.6%
Cloudy	0	0.0%
Rain	1	7.7%
Sleet/hail	1	7.7%
Snow/blowing Snow	0	0.0%
TOTAL	13	100.0%

Year	# of Crashes	Percentage
2011	5	38.5%
2012	6	46.2%
2013	2	15.4%
TOTAL	13	100.0%

144th Avenue to Holland State Park beach INTERSECTION (SPOT)		CALC'ed RATE	3 YEAR Crashes	Ave. Crash	Casualty Ratio	ADT	Sig / Unsig	Injury Freq	Fatal
5	160th Avenue	0.59	7	2.33	0.29	10749.5	U	2	0

Type of Crash	# of Crashes	Percentage
Angle	2	28.6%
Head-on	0	0.0%
Head-on / Left Turn	0	0.0%
Other / Unknown	0	0.0%
Rear-end	0	0.0%
Rear-end Left Turn	0	0.0%
Rear-end Right Turn	0	0.0%
Sideswipe Opposite Direction	0	0.0%
Sideswipe Same Direction	3	42.9%
Single Motor Vehicle	2	28.6%
TOTAL	7	100.0%

Pavement Condition	# of Crashes	Percentage
Dry	5	71.4%
Wet	0	0.0%
Icy	2	28.6%
Snowy	0	0.0%
TOTAL	7	100.0%

Crash Severity	# of Crashes	Percentage
Injury Crashes	2	28.6%
Injury A	1	14.3%
Injury B	0	0.0%
Injury C	1	14.3%
Fatal	0	0.0%
Alcohol with Injury	0	0.0%
Alcohol without Injury	0	0.0%
Pedestrian with Injury	0	0.0%
Pedestrian without Injury	0	0.0%
Bicyclist with Injury	1	14.3%
Bicyclist without Injury	0	0.0%
Causality Ratio	0.29	

Time of Day	# of Crashes	Percentage
Morning	2	28.6%
Afternoon	1	14.3%
Evening	3	42.9%
Night	1	14.3%
TOTAL	7	100.0%

Day of Week	# of Crashes	Percentage
Monday	0	0.0%
Tuesday	0	0.0%
Wednesday	0	0.0%
Thursday	1	14.3%
Friday	3	42.9%
Saturday	2	28.6%
Sunday	1	14.3%
TOTAL	7	100.0%

Month	# of Crashes	Percentage
January	1	14.3%
February	0	0.0%
March	0	0.0%
April	0	0.0%
May	1	14.3%
June	1	14.3%
July	1	14.3%
August	0	0.0%
September	0	0.0%
October	1	14.3%
November	1	14.3%
December	1	14.3%
TOTAL	7	100.0%

Special Factors	# of Crashes	Percentage
Deer Involved	0	0.0%
Pedestrian Involved	0	0.0%
Bicyclist Involved	1	14.3%

Lighting	# of Crashes	Percentage
Dawn	0	0.0%
Daylight	6	85.7%
Dusk	0	0.0%
Dark Lighted	1	14.3%
Dark Unlighted	0	0.0%
TOTAL	7	100.0%

Weather	# of Crashes	Percentage
Clear	4	57.1%
Cloudy	1	14.3%
Rain	0	0.0%
Sleet/hail	0	0.0%
Snow/blowing Snow	2	28.6%
TOTAL	7	100.0%

Year	# of Crashes	Percentage
2011	2	28.6%
2012	4	57.1%
2013	1	14.3%
TOTAL	7	100.0%

144th Avenue to Holland State Park beach		CALC'ed RATE	3 YEAR	Ave. Crash	Casualty Ratio	ADT	Miles	Injury Freq	Fatal
SEGMENT			Crashes						
6	160th Avenue to 168th Avenue	1.24	15	5.00	0.13	7338	1.5	2	0

Type of Crash	# of Crashes	Percentage
Angle	4	26.7%
Head-on	0	0.0%
Head-on / Left Turn	0	0.0%
Other / Unknown	0	0.0%
Rear-end	1	6.7%
Rear-end Left Turn	1	6.7%
Rear-end Right Turn	1	6.7%
Sideswipe Opposite Direction	0	0.0%
Sideswipe Same Direction	0	0.0%
Single Motor Vehicle	8	53.3%
TOTAL	15	100.0%

Pavement Condition	# of Crashes	Percentage
Dry	9	60.0%
Wet	0	0.0%
Icy	2	13.3%
Snowy	4	26.7%
TOTAL	15	100.0%

Crash Severity	# of Crashes	Percentage
Injury Crashes	2	13.3%
Injury A	0	0.0%
Injury B	1	6.7%
Injury C	1	6.7%
Fatal	0	0.0%
Alcohol with Injury	1	6.7%
Alcohol without Injury	0	0.0%
Pedestrian with Injury	0	0.0%
Pedestrian without Injury	0	0.0%
Bicyclist with Injury	0	0.0%
Bicyclist without Injury	0	0.0%
Causality Ratio	0.13	

Time of Day	# of Crashes	Percentage
Morning	3	20.0%
Afternoon	5	33.3%
Evening	4	26.7%
Night	3	20.0%
TOTAL	15	100.0%

Day of Week	# of Crashes	Percentage
Monday	2	13.3%
Tuesday	1	6.7%
Wednesday	0	0.0%
Thursday	1	6.7%
Friday	4	26.7%
Saturday	3	20.0%
Sunday	4	26.7%
TOTAL	15	100.0%

Month	# of Crashes	Percentage
January	1	6.7%
February	3	20.0%
March	1	6.7%
April	1	6.7%
May	0	0.0%
June	3	20.0%
July	1	6.7%
August	1	6.7%
September	0	0.0%
October	1	6.7%
November	2	13.3%
December	1	6.7%
TOTAL	15	100.0%

Special Factors	# of Crashes	Percentage
Deer Involved	3	20.0%
Pedestrian Involved	0	0.0%
Bicyclist Involved	0	0.0%

Lighting	# of Crashes	Percentage
Dawn	0	0.0%
Daylight	10	66.7%
Dusk	0	0.0%
Dark Lighted	4	26.7%
Dark Unlighted	1	6.7%
TOTAL	15	100.0%

Weather	# of Crashes	Percentage
Clear	10	66.7%
Cloudy	0	0.0%
Rain	0	0.0%
Sleet/hail	0	0.0%
Snow/blowing Snow	5	33.3%
TOTAL	15	100.0%

Year	# of Crashes	Percentage
2011	10	66.7%
2012	1	6.7%
2013	4	26.7%
TOTAL	15	100.0%

144th Avenue to Holland State Park beach INTERSECTION (SPOT)		CALC'ed RATE	3 YEAR Crashes	Ave. Crash	Casualty Ratio	ADT	Sig / Unsig	Injury Freq	Fatal
7	168th Avenue	0.74	5	1.67	0.40	6194	U	2	0

Type of Crash	# of Crashes	Percentage
Angle	1	20.0%
Head-on	0	0.0%
Head-on / Left Turn	0	0.0%
Other / Unknown	0	0.0%
Rear-end	2	40.0%
Rear-end Left Turn	0	0.0%
Rear-end Right Turn	1	20.0%
Sideswipe Opposite Direction	0	0.0%
Sideswipe Same Direction	0	0.0%
Single Motor Vehicle	1	20.0%
TOTAL	5	100.0%

Pavement Condition	# of Crashes	Percentage
Dry	5	100.0%
Wet	0	0.0%
Icy	0	0.0%
Snowy	0	0.0%
TOTAL	5	100.0%

Crash Severity	# of Crashes	Percentage
Injury Crashes	2	40.0%
Injury A	0	0.0%
Injury B	1	20.0%
Injury C	1	20.0%
Fatal	0	0.0%
Alcohol with Injury	1	20.0%
Alcohol without Injury	0	0.0%
Pedestrian with Injury	0	0.0%
Pedestrian without Injury	0	0.0%
Bicyclist with Injury	1	20.0%
Bicyclist without Injury	0	0.0%
Causality Ratio	0.40	

Time of Day	# of Crashes	Percentage
Morning	0	0.0%
Afternoon	1	20.0%
Evening	4	80.0%
Night	0	0.0%
TOTAL	5	100.0%

Day of Week	# of Crashes	Percentage
Monday	2	40.0%
Tuesday	0	0.0%
Wednesday	1	20.0%
Thursday	0	0.0%
Friday	1	20.0%
Saturday	0	0.0%
Sunday	1	20.0%
TOTAL	5	100.0%

Month	# of Crashes	Percentage
January	0	0.0%
February	0	0.0%
March	0	0.0%
April	1	20.0%
May	2	40.0%
June	1	20.0%
July	1	20.0%
August	0	0.0%
September	0	0.0%
October	0	0.0%
November	0	0.0%
December	0	0.0%
TOTAL	5	100.0%

Special Factors	# of Crashes	Percentage
Deer Involved	0	0.0%
Pedestrian Involved	0	0.0%
Bicyclist Involved	1	20.0%

Lighting	# of Crashes	Percentage
Dawn	0	0.0%
Daylight	3	60.0%
Dusk	2	40.0%
Dark Lighted	0	0.0%
Dark Unlighted	0	0.0%
TOTAL	5	100.0%

Weather	# of Crashes	Percentage
Clear	5	100.0%
Cloudy	0	0.0%
Rain	0	0.0%
Sleet/hail	0	0.0%
Snow/blowing Snow	0	0.0%
TOTAL	5	100.0%

Year	# of Crashes	Percentage
2011	3	60.0%
2012	2	40.0%
2013	0	0.0%
TOTAL	5	100.0%

144th Avenue to Holland State Park beach		CALC'ed RATE	3 YEAR	Ave. Crash	Casualty Ratio	ADT	Miles	Injury Freq	Fatal
SEGMENT			Crashes						
8	168th Avenue to Holland State Park beach	1.08	4	1.33	0.25	3760	0.9	1	0

Type of Crash	# of Crashes	Percentage
Angle	1	25.0%
Head-on	0	0.0%
Head-on / Left Turn	0	0.0%
Other / Unknown	0	0.0%
Rear-end	1	25.0%
Rear-end Left Turn	0	0.0%
Rear-end Right Turn	0	0.0%
Sideswipe Opposite Direction	0	0.0%
Sideswipe Same Direction	0	0.0%
Single Motor Vehicle	2	50.0%
TOTAL	4	100.0%

Pavement Condition	# of Crashes	Percentage
Dry	4	100.0%
Wet	0	0.0%
Icy	0	0.0%
Snowy	0	0.0%
TOTAL	4	100.0%

Crash Severity	# of Crashes	Percentage
Injury Crashes	1	25.0%
Injury A	0	0.0%
Injury B	1	25.0%
Injury C	0	0.0%
Fatal	0	0.0%
Alcohol with Injury	0	0.0%
Alcohol without Injury	0	0.0%
Pedestrian with Injury	1	25.0%
Pedestrian without Injury	0	0.0%
Bicyclist with Injury	0	0.0%
Bicyclist without Injury	0	0.0%
Causality Ratio	0.25	

Time of Day	# of Crashes	Percentage
Morning	0	0.0%
Afternoon	2	50.0%
Evening	1	25.0%
Night	1	25.0%
TOTAL	4	100.0%

Day of Week	# of Crashes	Percentage
Monday	0	0.0%
Tuesday	0	0.0%
Wednesday	1	25.0%
Thursday	0	0.0%
Friday	1	25.0%
Saturday	0	0.0%
Sunday	2	50.0%
TOTAL	4	100.0%

Month	# of Crashes	Percentage
January	0	0.0%
February	0	0.0%
March	0	0.0%
April	0	0.0%
May	1	25.0%
June	0	0.0%
July	3	75.0%
August	0	0.0%
September	0	0.0%
October	0	0.0%
November	0	0.0%
December	0	0.0%
TOTAL	4	100.0%

Special Factors	# of Crashes	Percentage
Deer Involved	0	0.0%
Pedestrian Involved	1	25.0%
Bicyclist Involved	0	0.0%

Lighting	# of Crashes	Percentage
Dawn	0	0.0%
Daylight	3	75.0%
Dusk	0	0.0%
Dark Lighted	1	25.0%
Dark Unlighted	0	0.0%
TOTAL	4	100.0%

Weather	# of Crashes	Percentage
Clear	4	100.0%
Cloudy	0	0.0%
Rain	0	0.0%
Sleet/hail	0	0.0%
Snow/blowing Snow	0	0.0%
TOTAL	4	100.0%

Year	# of Crashes	Percentage
2011	1	25.0%
2012	3	75.0%
2013	0	0.0%
TOTAL	4	100.0%

144th Avenue to Holland State Park beach		CALC'ed RATE	3 YEAR	Ave. Crash	Casualty Ratio	ADT	Miles	Injury Freq	Fatal
SEGMENT			Crashes						
ALL	Ottawa Beach Rd	2.77	122	40.67	0.22	8943.75	4.5	27	1

Type of Crash	# of Crashes	Percentage
Angle	25	20.5%
Head-on	3	2.5%
Head-on / Left Turn	5	4.1%
Other / Unknown	2	1.6%
Rear-end	23	18.9%
Rear-end Left Turn	9	7.4%
Rear-end Right Turn	2	1.6%
Sideswipe Opposite Direction	2	1.6%
Sideswipe Same Direction	12	9.8%
Single Motor Vehicle	39	32.0%
TOTAL	122	100.0%

Pavement Condition	# of Crashes	Percentage
Dry	80	65.6%
Wet	17	13.9%
Icy	10	8.2%
Snowy	15	12.3%
TOTAL	122	100.0%

Crash Severity	# of Crashes	Percentage
Injury Crashes	27	22.1%
Injury A	4	3.3%
Injury B	9	7.4%
Injury C	14	11.5%
Fatal	1	0.8%
Alcohol with Injury	4	3.3%
Alcohol without Injury	0	0.0%
Pedestrian with Injury	2	1.6%
Pedestrian without Injury	0	0.0%
Bicyclist with Injury	2	1.6%
Bicyclist without Injury	0	0.0%
Causality Ratio	0.22	

Time of Day	# of Crashes	Percentage
Morning	16	13.1%
Afternoon	42	34.4%
Evening	46	37.7%
Night	18	14.8%
TOTAL	122	100.0%

Day of Week	# of Crashes	Percentage
Monday	20	16.4%
Tuesday	10	8.2%
Wednesday	17	13.9%
Thursday	12	9.8%
Friday	24	19.7%
Saturday	23	18.9%
Sunday	16	13.1%
TOTAL	122	100.0%

Month	# of Crashes	Percentage
January	11	9.0%
February	7	5.7%
March	4	3.3%
April	7	5.7%
May	11	9.0%
June	14	11.5%
July	17	13.9%
August	11	9.0%
September	5	4.1%
October	14	11.5%
November	14	11.5%
December	7	5.7%
TOTAL	122	100.0%

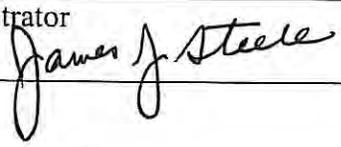
Special Factors	# of Crashes	Percentage
Deer Involved	14	11.5%
Pedestrian Involved	3	2.5%
Bicyclist Involved	3	2.5%

Lighting	# of Crashes	Percentage
Dawn	2	1.6%
Daylight	84	68.9%
Dusk	6	4.9%
Dark Lighted	25	20.5%
Dark Unlighted	5	4.1%
TOTAL	122	100.0%

Weather	# of Crashes	Percentage
Clear	74	60.7%
Cloudy	14	11.5%
Rain	14	11.5%
Sleet/hail	1	0.8%
Snow/blowing Snow	19	15.6%
TOTAL	122	100.0%

Year	# of Crashes	Percentage
2011	43	35.2%
2012	37	30.3%
2013	42	34.4%
TOTAL	122	100.0%

Appendix 4

D-121	MICHIGAN'S OPERATIONS MANUAL
DATE:	July 30, 2009
SUBJECT:	4-to-3 Lane Conversions
AUTHORITY/CFR REFERENCE:	
PURPOSE:	Provide Policy and Guidance
APPROVED:	Division Administrator 
Electronic File:	Subject: 100987

Definition:

4-to3 Lane Conversion is the changing of highway laneage, from a 4-lane undivided roadway section with all four lanes designated for through traffic movement, to a 3-lane cross-section, in which the center lane functions as a shared left turn lane in each direction, and the two outside lanes are designated for through traffic. 4-to-3 lane conversions are often accomplished through re-striping and signing alone, but can also involve reconstruction of pavement and re-establishment of curb lines.

Need for MOM:

The conversion of a corridor from 4 to 3 lanes is becoming a common treatment applied by MDOT and many local agencies in the state of Michigan. However, most corridors in this state get converted without FHWA involvement. When this type of project is proposed for federal-aid funding, there are issues for our office to resolve:

- How well will the proposed cross-section handle the anticipated traffic demand
- What design year is applicable to this type of project
- What are the air quality requirements for lane reduction in EPA non-attainment area
- What type of environmental document is appropriate
- How to respond to a community that decides they want to switch back to 4 lanes

Background

A discussion of issues related to a 4-to-3 lane conversion is included as an appendix to this document. In general, we believe it is appropriate to match project design life with the scope of project. For projected ADT of 15,000 or less, 4-to-3 lane conversions have been found in Michigan and throughout the nation to have a positive effect on crash reduction, with only minor or no effect on quality of traffic flow. Above 15,000 ADT, conversions have been successful, but inconvenience due to congestion increases and the project deserves closer scrutiny in the design phase, including more detailed traffic analysis and public involvement.

Policy

New projects: The conversion of 4-lane undivided corridor to 3-lane cross-section with center lane reserved for left turn is eligible for Federal-aid funding when documentation from the submitting jurisdiction shows positive resolution of the following issues. This documentation is to be submitted to the FHWA Area Engineer on FHWA oversight projects, following review and recommendation by MDOT:

1. Operational analysis shows that the 3-lane cross section will provide reasonable level of service for all traffic movements at major intersections through the design life. Reasonable level of service is generally considered to be LOS C; however, LOS D could be considered reasonable if part of a calculated trade-off to react to other community goals, such as traffic safety and traffic calming. Proposed projects with design year ADT projected to be 15,000 or less will not require operational analysis.
2. Projected ADT for the design life is consistent with the area Long Range Transportation Plan, for projects within an area covered by an MPO.
3. Project design life is determined to be:
 - a. For safety project, supported by a time-of-return (TOR) analysis, project design life can be as chosen for the TOR analysis
 - b. 3 years or longer – if the project consists mostly of signing, striping, and striping removal.
 - c. 10-20 years – if the project consists of significant pavement or curb work.
4. Public involvement has demonstrated sufficient support for the project within the community OR formal agreement has been reached for a trial project that would allow at least one year of operation of the 3-lane section.

Pilot projects: Because 4-to-3 lane conversions are viewed as a safety countermeasure, MDOT and/or local agencies will occasionally offer a low-cost conversion (removal and re-application of pavement markings only, no pavement or curb reconstruction) to communities on a trial basis. This approach by definition includes the possibility of a later reversal back to the 4-lane section if the trial period is deemed unsuccessful. Federal-aid funds are eligible for this type of project approach provided that FHWA agrees in the measures that will be used to evaluate the success of the trial.

Reversal of cross-section: If Federal aid was used to convert a 4-lane section to 3-lane, FHWA will not participate in the reversal of that cross-section back to 4-lane, unless justified by crash analysis, level of service analysis or unanticipated operational issues.

Exception: if a 3-lane corridor was installed on a pilot project as discussed above, and the project is deemed to be unsuccessful according to the agreed-upon evaluation measures, FHWA will participate in the return to 4-lane cross-section.

FHWA Processing

Requests for 4-to-3 lane conversion projects that are to be accomplished with use of Federal-aid highway funds will be processed and approved in the same manner as typical highway projects.

- STIP –
 - Safety projects which are documented with a time-of-return analysis that meets the definition of state or local safety project could be covered under one of the local or trunkline safety General Program Accounts (GPA); however, a road agency can choose to list the project in the STIP individually if it so desires.
 - Rural Task Force projects may be lumped under one GPA
 - Projects which are not documented as safety projects or rural task force projects must be listed on the STIP individually

- Air Quality Analysis –
 - In EPA designated air quality nonattainment and maintenance areas, proposed 4-to-3 lane conversions should be reviewed through the interagency consultation process to determine if an air quality conformity analysis is needed.
 - For projects that are not located in an EPA non-attainment or maintenance area, no air quality analysis is needed.

- Environmental Clearance –
 - Projects can be processed as a categorical exclusion with FHWA approval per 23 CFR 771.117 (b) and (d) pending other proposed project elements and results of MDOT environmental classification process. Consultation with the public is required on all 4-to-3 lane conversions to ensure there is no substantial controversy on environmental grounds.

- Project Approval
 - FHWA Oversight projects - FHWA Area Engineer
 - FHWA non-oversight projects – FHWA fiscal clerk
 - On all projects (oversight and non-oversight), FHWA approval document should contain the following statement: “FHWA will not participate in the reversal of cross-section from 3-lane back to 4-lane, unless justified by crash analysis, level of service analysis or unanticipated operational issues, or if the 3-lane cross-section on a pilot project is deemed to be unsuccessful according to the agreed-upon evaluation measures”.

APPENDIX

Project design life: FHWA generally requires agencies using Federal-aid highway funds to follow AASHTO guidelines that suggest that a project should be designed to accommodate the traffic demands that will be experienced throughout the design life of the improvement. For a typical pavement construction or reconstruction, where construction costs are relatively high, 20 years into the future is commonly used as project design life.

For an operational improvement such as the 4-to-3 lane conversion, the typically lower costs and almost universal safety benefits can result in an effective project that can be successfully planned and constructed, even with a much shorter project design life. For corridors in which the pavement will not undergo significant work, project costs will be minimal - re-striping and signing, and removal of old striping. Under this scenario, if the corridor is experiencing crashes that can be corrected by the 3-lane section, the conversion to 3-lane can be investigated to see if the expected crash reduction is great enough to allow the project to be addressed as a safety project; if it is, the project design life need only be as long as the time period calculated in the MDOT time-of-return safety analysis.

If there is not a significant safety problem to be addressed, and a road jurisdiction is proposing a 4-to-3 lane conversion with signing and marking as the major items of work, a project design life of 3-5 years would justify the limited costs.

If a conversion project is proposed in which significant pavement construction or reconstruction will be performed, the project design life will necessarily have to increase as the project cost increases: 10-20 years, depending on the costs.

For projects located within a Metropolitan Planning Area, the projected ADT at the end of the selected project design life should be checked against, and correspond with, the traffic volume projections shown in the Long Range Transportation Plan as maintained by the Metropolitan Planning Organization (MPO) for that area.

Safety and capacity: On corridors with 15,000 ADT or less, 4-to-3 lane conversions across the country and across Michigan have been successfully implemented, recording safety gains with very little sacrifice to traffic flow. Almost universally, converted corridors are documented as being safer, with reported crash reduction between 10% and 50% per corridor. A Michigan study of 8 converted corridors documented an average injury crash reduction of 26%, an average injury crash reduction for older drivers of 37%, and an average pedestrian crash reduction of 37%. The 3-lane section is safer at intersections and driveways, because the monitoring task of looking for traffic gaps is simpler. On the corridor links, the 3-lane cross-section is safer because the center lane acts as a buffer between through traffic lanes.

As ADT climbs from 15,000 to 20,000, users report that special treatment for turning traffic is often necessary at the intersections along the corridor to maintain sufficient

traffic flow. Organizations like Michigan DOT and Iowa DOT, both big users of this cross-section, set guidance limits of about 15,000 to 17,500 ADT as being realistic volumes for such conversions; however, depending on conditions and incentive, a 3-lane cross-section can be investigated at the higher levels.

At any of the ADT ranges mentioned above, left-turning traffic on the undivided 4-lane cross-section has a large and inverse relationship on capacity and safety: as left turning volume increases, capacity is rapidly diminished because the inside lane cannot move through traffic until the individual left turns are completed. The turning conflict itself, as well as the lane changing that results from through traffic switching to the outside lane poses increased safety risks to the road users. The 3-lane section is much better equipped to handle left turning traffic, without suffering as large a reduction in capacity and safety.

Finally, the Michigan Governor's Highway Traffic Safety commission, appointed by the governor for the purpose of setting overall statewide strategy in highway safety and developer of the Michigan Strategic Highway Safety Plan, has twelve subcommittees that pro-actively address issues and set strategy for safety in twelve specific subject areas. Three of these subcommittees – the Intersection Safety Team, the Elderly Mobility Work Group, and the Pedestrian and Bicycle Action Team – promote 4-to-3 lane conversions as a strategy to reduce crashes in their own subject area.

Pedestrian and bicyclist accommodation: A conversion to three lanes from existing 4-lane pavement often offers an opportunity for the constructing jurisdiction to provide bike lanes to the outside of each through lane; often helping communities progress toward a master plan for accommodation of non-motorized travel. For adult bikers, use of a bike lane within the roadway or curb lines places the bicyclist in more direct line of sight to motorists. As a result, turning conflicts are reduced because the motorists are more aware of bicyclists on the road, more alert when it comes time to scan for their turn, and more aware of where to look for bicyclists during their scan.

Community support: In communities where 3-lane cross-sections are uncommon, business owners and community citizens do not always appreciate the potential benefits of the cross-section as readily as the community leaders or agencies that are promoting the cross-section. The business owners, in particular, worry about loss of customer access, and the motoring citizens envision a large drop in capacity, with accompanying congested traffic flow. This can lead to local reluctance to install a 3-lane cross-section in the first place. – or occasionally, backlash after the installation. As of mid-2009, Michigan DOT has installed about 25 corridors using 4-to-3 lane conversion around the state; only one community after installation has objected to the cross-section.

Because of the documented safety benefits of a conversion to 3-lanes, road jurisdictions will sometimes offer trial periods of 1-3 years to the citizens of a community, with a promise to revert back to 4 lanes if the community as a whole does not want to keep the 3-lane section after the trial period. This can be a reasonable approach to take, if the conversion and reversion involve only signing and marking, with little or no pavement reconstruction.

Appendix 5

TRAFFIC AND SAFETY NOTE 614D

SUBJECT: Near Side/Far Side Lane Drops

PURPOSE: To Provide Guidance on Near Side/Far Side Lane Drops

COORDINATING AREA: Geometric Design

INFORMATION: The following guidelines, based on an ITE report, are qualitative in order to encourage the evaluation of lane drops at intersections on an individual basis:

General

1. Engineering judgment is the primary basis for determining the appropriate intersection lane drop, near-side or far-side. Additionally, engineering judgment should prevail when applying the distances recommended in these guidelines to specific traffic conditions.
2. Intersection capacity, intersection turning volumes (especially right turns), parking and right of way restrictions, design speed, lighting, and safety are significant considerations in the evaluation of the appropriate intersection lane drop either near-side or far-side.
3. The decision sight distance concept is applicable to the geometric design and placement of traffic control devices for both near-side and far-side intersection lane drops.
4. Intersection lane drops present the driver with a high judgment, complex driving situation and, therefore, the most effective signing and pavement marking is recommended. See drawings on page 3.
5. Far-side intersection lane drops are preferred over near-side. To some extent both types of lane drops have been used for different purposes (far-side – capacity, near-side – operations).
6. Intersection lane drops can be associated with an interim condition before a highway widening is extended at a future date. If it is planned to continue the widening, a far-side lane drop has the advantage of placing the beginning of the new construction well beyond the intersection. See drawings on page 3.

Near-Side Intersection Lane Drop

1. A near-side intersection lane drop is applicable at an urban area intersection with a heavy right turn volume and is not recommended for use in a high speed, unlighted rural area. The “trap lane” should be avoided except where extenuating circumstances such as a heavy right turn volume and/or where a far-

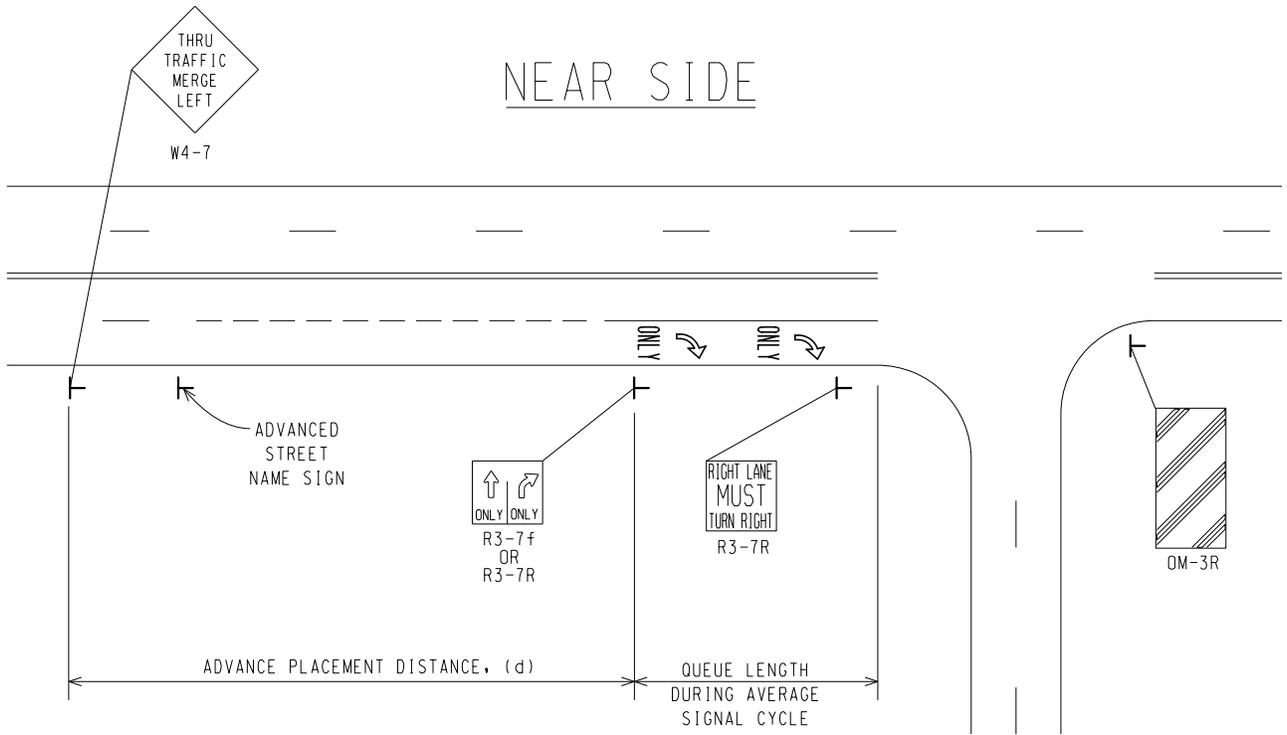
side intersection lane drop is not feasible (example-prohibitive right of way costs).

2. The decision sight distance concept can be applied to the placement of traffic control devices for near-side intersection lane drops. The distances traveled during the reaction time (detection, recognition, decision, response) plus the vehicle maneuver time will produce the total decision sight distance values required for various posted speeds (see Table 1). These decision sight distance values in addition to allowances for queue lengths (assumed signalized intersection) will establish reasonable sign and pavement marking locations (see top drawing on page 3).
3. The signing and pavement markings for near-side intersection lane drops need special emphasis. An advance warning sign, THRU TRAFFIC MERGE LEFT (W4-7), is recommended. Advance street name signs and special pavement markings in the dropped lane will also reinforce the advance warning sign and provide motorists with the necessary guidance to react and maneuver the vehicle safely and effectively to avoid the "trap lane" (see top drawing on page 3). In addition, the lane control sign (R3-7F) and RIGHT LANE MUST TURN RIGHT (R3-7R) support the use of the right turn lane.

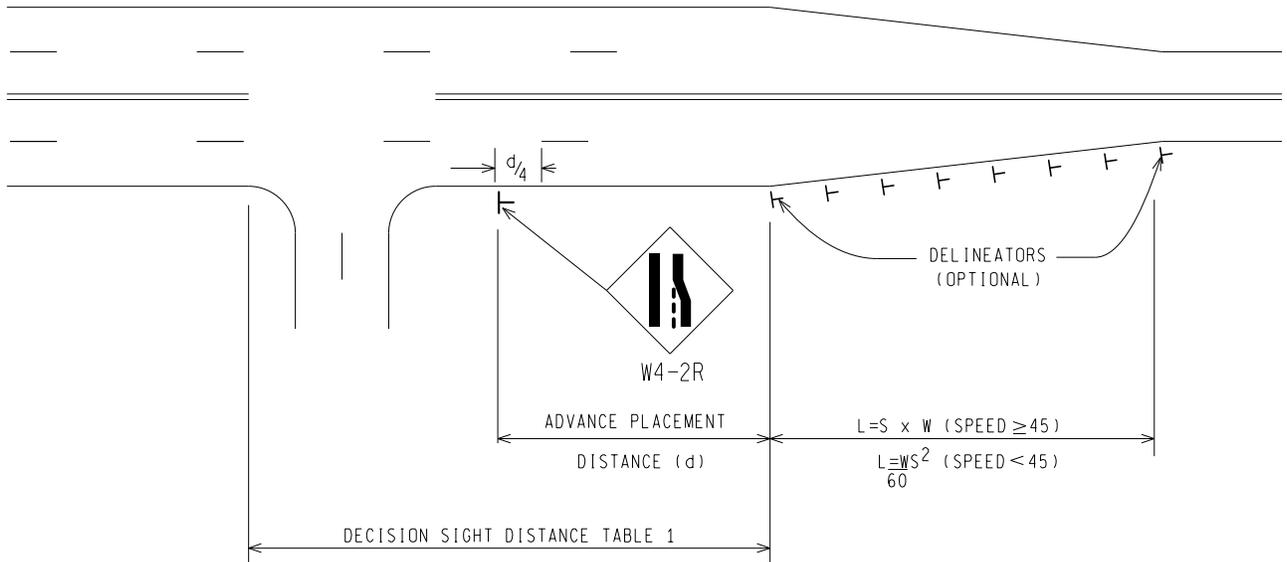
Far-Side Intersection Lane Drop

1. A far-side intersection lane drop is applicable to both an urban and rural area and is considered to be the preferred intersection lane drop treatment. See bottom drawing on page 3.
2. At unsignalized intersections, decision sight distance can be utilized to determine the length beyond the intersection at which the lane should be dropped using the values indicated in Table 1.
3. At signalized intersections a two part analysis is required. Adequate vehicle storage beyond the intersection, brought about by the release of vehicles from the traffic signal, must be considered in addition to the decision sight distance requirement. The larger of the values calculated using these analyses will provide the required length beyond the intersection as measured from the stop bar.
4. Proper taper lengths (L) are calculated from the equations: $(L = S \times W$ for S greater than or equal to 45 mph, or $L = WS^2/60$ for S less than 45 mph, where W = width in feet and S = speed in mph).
5. Effective signing and pavement markings are necessary components to ensure a successful lane drop operation. The signing and pavement markings shown on the bottom drawing on page 3 are recommended for far-side intersection lane drops.

NEAR SIDE



FAR SIDE



Advanced Placement Distance (d)
 See MMUTCD Table 2C-4
 Condition A
 Speed Reduction and Lane Changing

 Michigan Department of Transportation		NEAR SIDE/FAR SIDE LANE DROPS	
TRAFFIC AND SAFETY NOTE			
DRAWN BY: DJF	02/25/08	NOTE 614D	SHEET 3 OF 4
CHECKED BY: JAT	PLAN DATE:		
FILE: PW RD TS T Dev NOTE 614A tsn.dgn		REV.	07/19/13

Posted speed (mph)	Decision sight distance (ft)				
	Avoidance maneuver				
	A	B	C	D	E
30	220	490	450	535	620
35	275	590	525	625	720
40	330	690	600	715	825
45	395	800	675	800	930
50	465	910	750	890	1030
55	535	1030	865	980	1135
60	610	1150	990	1125	1280
65	695	1275	1050	1220	1365
70	780	1410	1105	1275	1445
75	875	1545	1180	1365	1545
80	970	1685	1260	1455	1650

Avoidance Manuever A: Stop on rural road – $t = 3.0$ s

Avoidance Manuever B: Stop on urban road – $t = 9.1$ s

Avoidance Manuever C: Speed/path/direction change on rural road – t varies between 10.2 and 11.2 s

Avoidance Manuever D: Speed/path/direction change on suburban road – t varies between 12.1 and 12.9 s

Avoidance Manuever E: Speed/path/direction change on urban road – t varies between 14.0 and 14.5 s

Decision Sight Distance

TABLE 1