

**TRAFFIC IMPACT STUDY
FOR
PROPOSED MAPLE ROAD HIGH SCHOOL**

**Ann Arbor Township, Scio Township
and
City of Ann Arbor, Michigan**

**November 9, 2004
Revised December 7, 2005**

prepared by

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**MAPLE ROAD HIGH SCHOOL
Traffic Study Data**

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PROPOSED MAPLE ROAD HIGH SCHOOL

EXECUTIVE SUMMARY

The Ann Arbor Public Schools (AAPS) system is planning to construct a new comprehensive high school. This new high school will allow AAPS to balance the student enrollment among three (3) high schools --- the two (2) existing Huron and Pioneer High Schools --- and the new high school. All schools are planned to have approximately 1600 students. The new school site is located on the east side of Maple Road and northerly of M-14. The site is located in Ann Arbor Township.

The study area identified for analysis in this traffic impact study includes ten (10) intersections with Maple Road, from Huron River Drive on the north to Miller Road on the south. These intersections are under the jurisdiction of the Washtenaw County Road Commission (the seven most northerly); the Michigan Department of Transportation (the two (2) ramp intersections with M-14); and, the City of Ann Arbor (Miller Road). The study evaluated how these intersections were operating given existing AM and PM traffic volumes, and maintaining existing intersection right-of-way control, and geometrics.

A second analysis was conducted given an increase in traffic volumes based on background growth out to the design year of 2009. The third operational analysis utilized the addition of the projected new trips to/from the actual high school itself. As a result of these studies, two existing intersections (the westbound and eastbound ramp locations with Maple Road), and one new intersection (the central access driveway to the new school with Maple Road), were identified for changes in intersection control, and modification in geometry. This is based on the Highway Capacity Manual analysis utilizing the HCS-2000 software which is the recognized standard in the transportation engineering profession for signalized intersections.

These potential changes, and their evaluation, took two (2) forms:

- 1) Signalized control (a change from the existing 2-way stop control at the two M-14 ramp intersections, plus the use of a signal at the new central school access). Also, at selected roadway sections, additional lanes will be needed.*
- 2) Roundabout intersection operations at the two M-14 ramp intersections, as well as the new central school access.*

The analysis identifies that both of these intersection operational types will result in acceptable traffic operations based on the level of service (LOS) analysis techniques. Other implications related to the two (2) operational types include the following:

- the need for additional right-of-way;*
- construction costs,*
- maintenance costs;*
- motorist users understanding of operations; and*
- pedestrian/bicyclist users understanding of operations.*

INTRODUCTION

A proposal has been made to construct a new 1600 student high school in Ann Arbor Township. The site is located on the east side of Maple Road, and is north of M-14. Access to/from the site is provided by three (3) driveway connections, all at Maple Road. The area for study identified the following Maple Road intersections:

- Huron River Drive
- Newport
- Whippoorwill
- Laurentide
- Blueberry
- Craig
- Timber Hills
- Westbound M-14 ramp
- Eastbound M-14 ramp
- Miller

These roadways and intersections are under the jurisdiction and control of either the Washtenaw County Road Commission (WCRC), the Michigan Department of Transportation (MDOT), or the City of Ann Arbor. During the course of this study, the impact of new trips associated with the new high school development will be analyzed and compared to the existing, as well as a background growth scenario, traffic operation service levels at the above ten (10) intersections.

AREA ROADWAYS

Maple Road is a northbound/southbound county primary roadway. It consists of a paved 2-lane cross-section with gravel shoulders. Most of the east/west cross roads intersecting with Maple Road are 2-lane cross-sections. The southern three (3) are multi-lane: MDOT's M-14 interchange westbound and eastbound ramps; and Miller Road in the City. The northern nine (9) intersections have right-of-way controlled by stop signs, while the Maple/Miller intersection is signal controlled.

STUDY PROCEDURE

Roadway operations are examined and analyzed by traffic flow and delay characteristics. This concept and the methods of study are detailed in the Transportation Research Board publication entitled *Highway Capacity Manual* (HCM). Highway Capacity Software 2000, Version 4.1d was utilized for the capacity analysis. THE HCM formed the basis of the study for this project. A capacity analysis represents a comparison of the supply and demand characteristics of a roadway facility. The available supply refers to the physical and control features (number of lanes, lane width, and right-of-way control), and the demand refers to the traffic volume expected to use the facility. A level of service (LOS) rating, ranging from LOS A (the best) to LOS F (the worst) results from the analysis. LOS E represents volume equaling capacity, with LOS A, B, C and D representing acceptable overall intersection operations. The WCRC and MDOT agencies require an overall intersection LOS D (or better), while the City of Ann Arbor standard is LOS C. The following two (2) tables list the threshold values of vehicular delay that are associated with each LOS:

Level of Service Criteria for Non-signalized Intersections

LOS	Delay/Vehicle (Seconds)	Description
A	≤ 10	Little or no delay, very low main street volumes
B	> 10 and < 15	Short traffic delays, many acceptable gaps
C	> 15 and < 25	Average traffic delays, frequent gaps still occur
D	> 25 and < 35	Long traffic delays, limited number of acceptable gaps
E	> 35 and ≤ 50	Very long traffic delays, very small number of acceptable gaps
F	> 50	Extreme traffic delays, virtually no acceptable gaps in traffic

Source: Transportation Research Board, Highway Capacity Manual, 2000

Level of Service Criteria for Signalized Intersections

LOS	Delay/Vehicle (Seconds)	Description
A	≤ 10	Most vehicles do not stop at all
B	> 10 and < 20	More vehicles stop than for LOS A
C	> 20 and < 35	The number of vehicles stopping is significant, although many pass thru without stopping
D	> 35 and < 55	Many vehicles stop. Individual cycle failures are noticeable.
E	> 55 and ≤ 80	Considered being the limit of acceptable delay. Individual cycle failures are frequent.
F	> 80	Extreme traffic delays, virtually no acceptable gaps in traffic

Source: Transportation Research Board, Highway Capacity Manual, 2000

ANALYSIS

Base Traffic Volume

Manual traffic counts were conducted at the study area intersections on September 14, 15 and 16, 2004. These days were judged to be typical and representative of area traffic operations. The counts were conducted for 7:00 AM - 8:00 AM and 2:00 PM - 3:00 PM. These times were selected to correspond to peak periods associated with school activities. This data is attached in the Appendix. Plan Sheets 2 (AM) and 9 (PM) summarized the actual peak hour data for intersection approach and turning volume movements for all ten (10) study locations. Also included in the Appendix are machine count data for two (2) Maple Road locations for the week of September 13, 2004.

Background Growth Traffic

An overall general increase of five percent (5%) was applied to account for other possible growth in the area (out to the design year of 2009). This one percent (1%) per year growth factor was developed based on discussions with the Washtenaw Area Transportation Study (WATS). WATS provided a transportation planning map for various zones around and including the study area. For these various zones, projected growth rates were determined. This information was then compiled and the one percent (1%) per year rate was selected. This factor was then verified through discussions with MDOT, WCRC, and City representatives.

Traffic volumes shown on Plan Sheets 3 (AM) and 10 (PM) represent existing volumes increased by this factor. The only exception to this is the eastbound Miller Road approach to Maple Road. In that particular case, the yearly factor applied to increase existing volume is two percent (2%) per year --- for an overall increase of ten percent (10%).

Project Traffic

Trip generation data for the proposed new high school is presented in Plan Sheet 4 and is summarized, as follows:

	<u>Ingress</u>	<u>Egress</u>
AM	1072	549
PM	106	373

These new trip volumes were developed with discussions with other project team members, representative staff of the Ann Arbor Public School system, and a detailed on-site study at Pioneer High School. The Pioneer study included observing and recording a variety of data. This included driveway volumes at all site access locations, the number of student-driven vehicles, the number of vehicle occupants in each student-driven vehicle, the number of drop-off vehicles, the number of occupants in each drop-off vehicle, the number of buses, the number of students on each bus.

This data allowed a calculation to be made to determine the ratio of students that arrived via bus (30%), drop-off vehicle (40%), or student driven vehicle (30%). Further, the average number of students for each vehicle type was identified.

Since Pioneer High School has more students than the planned new high school, the Pioneer data was reduced to represent a 1600 student high school. This information is provided in Plan Sheet 4. To be conservative, it is assumed that no students will walk or bicycle to the new high school.

For comparison purposes, the data in the ITE *Trip Generation* manual (7th Ed.) was reviewed for a high school type development (ITE 530) for the AM and PM peak hour of the generator. In both cases, the average rate factor was utilized since the provided fitted curve equations had low regression factor values (0.50 and 0.51, respectively). When the average rates were applied for a 1600 student high school, the following totals (inbound plus outbound) were identified:

$$\text{AM} \quad 1600 \times 0.41 = 656; \quad \text{and,} \quad \text{PM} \quad 1600 \times 0.28 = 448$$

For the AM hour, our calculated value based on the field study is significantly higher (1621 vs. 656). For the PM hour, the totals are much closer 479 vs. 448. Therefore, by utilizing actual data (the preferred method) a more conservative analysis results.

The two existing high schools, Huron and Pioneer, are located in what could be considered a more urban setting than is the planned new high school. It is, therefore, more likely that more students will arrive at the new high school via bus.

The new high school is planned to open in 2007 with less than full enrollment --- possibly only the freshman and sophomore classes. The possible phasing would continue with enrolling a new freshman class in 2008 and also 2009 to achieve full enrollment by 2009. If full enrollment were to exceed 1600 students after 2009, a new impact analysis should be conducted.

The on-site circulation scheme had the intent of separating school bus movements/student-driven vehicles/drop-off vehicles from each other. This goal was achieved in the site plan design. Also, adequate queueing storage is provided on-site in the design.

NEW TRIP DISTRIBUTION SCENARIOS

The above trips were assigned to the access driveways as presented in Plan Sheets 6 (AM) and 7 (PM). For the intersections in the study area, both north and south of the site, the trip assignments are summarized in Plan Sheets 5A, 5B, and 5C. The three sheets are based on three possible student district areas (north-A, west-B and northwest-C). No actual district has yet been established for the new school. Therefore, for purposes of this study the three (3) possible districts were developed based on the criteria of attempting to achieve a student population of approximately 1200 in each. The remaining 400 students, for a total of 1600, would come from the remaining overall school district due to the school district's proposed "magnet" concept. Given these three scenarios, trips were assigned to the public roadways based on available routes to/from the high school site. Each high school related trip that would pass through the study area intersections were then added to the existing plus background level volumes to produce the final study volumes show in Plan Sheets 8A, 8B, and 8C for the AM, and 11A, 11B, and 11C for the PM. A summary tabulation showing possible trip assignment for the three scenarios is provided on the following page.

Although this complicated the study, the end result was the same lane requirements for each scenario, except for the westbound M-14 ramp. These lanes differ by one small feature. For Scenario A, the westbound center lane is designated as a thru/right, rather than a thru only as in Scenarios B and C.

SIGNALIZED INTERSECTION CONTROL PLAN

INTERSECTION CAPACITY ANALYSIS

A capacity analysis was conducted for each of the study intersections for existing volumes (with existing geometrics and right-of-way control) with level of service results summarized in Plan Sheets 12 (AM) and 15 (PM). For the existing plus background volume levels, also with existing geometrics and right-of-way control, the LOS results are summarized in Plan Sheets 13 (AM) and 16 (PM). Finally, for the existing plus background plus site traffic related volumes (for all three scenarios), the LOS results are summarized in Plan Sheets 14A, 14B, and 14C (AM) and 17A, 17B, and 17C (PM).

For the projected traffic volumes analysis condition, selected geometric modifications were selected to achieve an acceptable LOS (see Plan Sheet 18). Additionally, stop control was replaced by signal control at three (3) intersections.

Maple Road/Main Access (this is a new intersection),
Maple Road/M-14 westbound ramp, and
Maple Road/M-14 eastbound ramp.

All of the HCS-2000 analysis data sheets are provided in the Appendix.

MAPLE ROAD / MAIN SITE ACCESS SIGNAL WARRANT ANALYSIS

A peak hour signal warrant analysis was conducted for 7-8 AM time period at the main access site driveway at Maple Road. The analysis, consisting of two graphs, is provided in the following pages. It is concluded that a traffic signal is, indeed, warranted. This signal should be operated in the semi-actuated mode. Although the MMUTCD provides other warrants for signal evaluation, only the peak-hour warrant was studied since that was the only one with available data. Some reasons why the other warrants were not analyzed include:

- Warrant 1, 8-Hour Vehicular Volume - Discussions with MDOT staff indicate this warrant is not met.

- Warrant 2, 4-Hour Vehicular Volume - Discussions with MDOT staff indicate this warrant is not met.
- Warrant 3, Peak Hour - This warrant was analyzed and was found to be satisfied.
- Warrant 4, Pedestrian Volume - Pedestrian counts are low and the warrant is not met.
- Warrant 5, School Crossing - No school crossing is yet established and the school is not yet open so no student counts are available.
- Warrant 6, Coordinated Signal System - No series of signals exist on Maple Road in this area so the warrant is not met.
- Warrant 7, Crash Experience - The type of crashes susceptible to possible correction by signal control are not occurring with the required frequency and, therefore, the warrant is not met.
- Warrant 8, Roadway Network - No network of intersections exist in this area so the warrant is not met.

Additionally, an operational analysis was conducted for the two (2) M-14 ramp intersections with Maple Road. An improved overall LOS will be achieved if the current stop control is replaced with signal control. With these two (2) new signals, and the recommended widening of Maple Road itself under the M-14 overpass, sight line requirements are satisfied as presented in AASHTO 2001 Green Book (4th Ed.) Case D that states the following:

"At signalized intersections, the first vehicle stopped on one approach should be visible to the driver of the first vehicle stopped on each of the other approaches. Left-turning vehicles should have sufficient sight distance to select gaps in oncoming traffic and complete left turns. Apart from these sight conditions, there are generally no other approach or departure sight triangles needed for signalized intersections. Signalization may be an appropriate crash countermeasure for higher volume intersections with restricted sight distance that have experienced a pattern of sight-distance related crashes."

The related potential queue lengths for the M-14 westbound and eastbound ramps and Maple Road itself is shown in the sketch on the following page. The lengths shown are the individual longest needed for either Scenarios A, B or C (in combination).

PEDESTRIAN AND NON-MOTORIZED SITE ACCESS

Pedestrian facilities and access will be provided along the east side Maple Road from Blueberry Lane on the north to the existing sidewalk south in the City, as well as from the subdivisions located to the east of the school site. This will obviously include a multi-use facility under the M-14 overpass along the east side of Maple Road. No direct access will be provided from Blueberry Lane. Additionally, a non-motorized facility is planned for the school frontage along Maple Road.

CRASH HISTORY SUMMARY

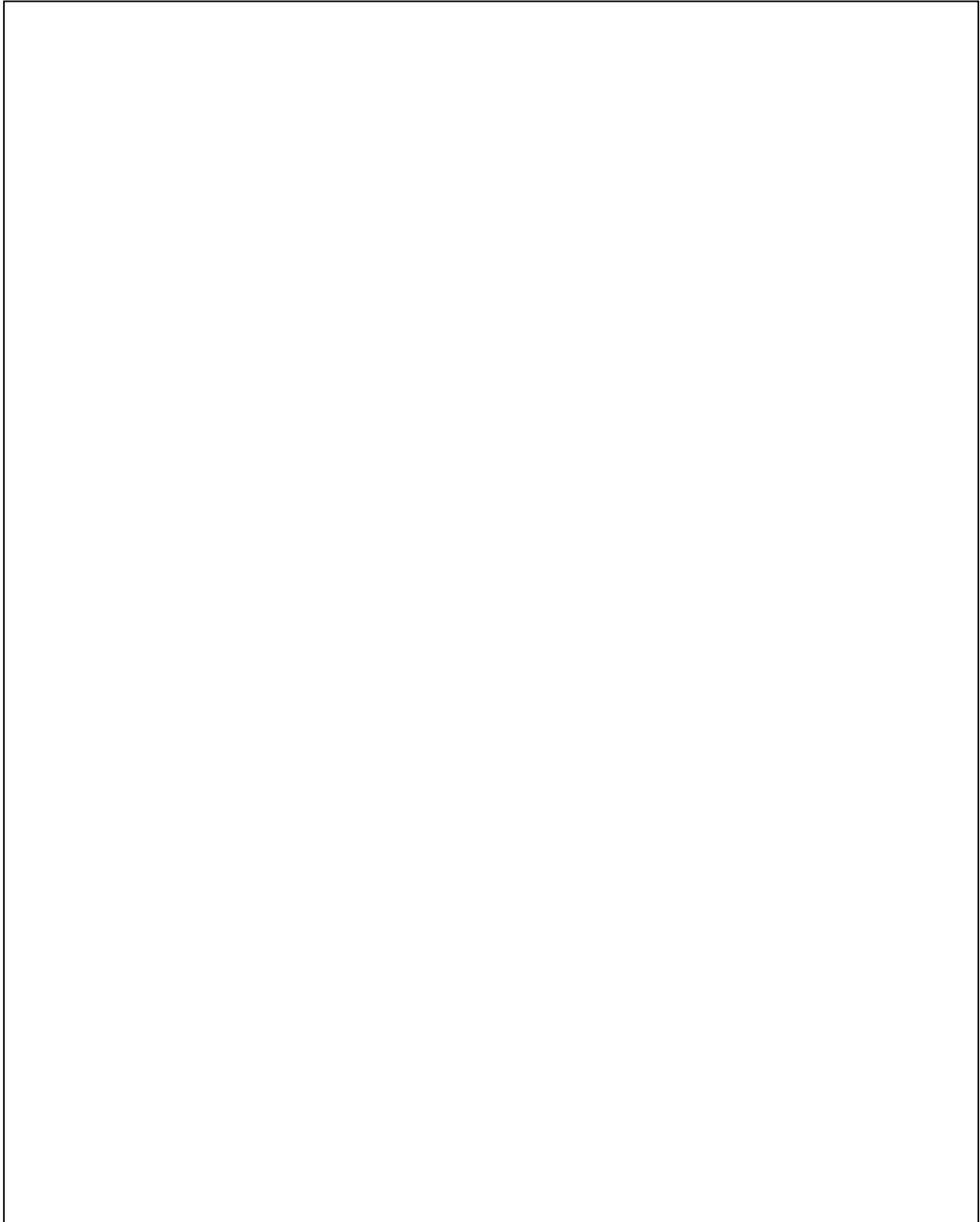
A traffic crash study was conducted along N. Maple Road between Miller Road and Huron River Drive. Traffic crash reports (Form UD-10) were obtained from the Washtenaw County Road Commission (WCRC) for all recorded crashes occurring between January 1, 1999, and July 9, 2004. The City of Ann Arbor provided a computer printout of the crashes that occurred at the intersection of Miler and Maple Road for the calendar years 1999 through 2003. UD-10 forms were not provided in the City data.

The UD-10 form is generated at the crash scene by the responding enforcement officer and contains valuable information regarding the accident environment and other conditions. The purpose of a traffic crash study is to identify crash trends that may be associated with roadway geometry and/or traffic control device operations. If it is discovered that a particular pattern is prevalent along a specific roadway section, or at an intersection, then accident reduction measures can be evaluated and targeted at reducing those prevalent accident patterns.

A traffic crash study is also useful in determining how the roadway compares to other area roads and streets. Crash rates are often expressed in terms of crashes per million entering vehicles for intersections and crashes per million vehicle miles of travel for roadway segments. These two statistics provide a means of comparing intersections and roadway segments with others for which crash statistics have been evaluated. There are additional measures of crashes that are typically used. The crash severity statistic provides a means of allowing for the more serious injury crashes to be more heavily weighted. Thus, a fatal crash is more significant than a crash which results in property damage only.

Traffic crashes are unavoidable consequences of all roadway transportation systems. They are very rare, but do occur with enough regularity to be a significant consideration in the planning and design of transportation facilities. The design engineer's duty is to consider the crash potential for each intersection and roadway design and assure that reasonable design standards have been applied.

These design standards provide the normally competent driver with every opportunity to conduct themselves in a safe manner while traveling along the roadway. There are times, however, when even the most competent vehicle operator will encounter unanticipated events, such as the sudden appearance of an animal in the vehicle path.



Potential queue lengths are shown in feet and each is the maximum length of Scenarios A, B or C.

For these rare occasions, the duty of the design engineer is to provide a safe roadside environment to accommodate the emergency maneuvers of vehicles who may leave the improved portion of the roadway intended for vehicular travel and still retain vehicle control.

Crash Summary

During the study period, a total of 78 crashes were reported to enforcement agencies who responded to the scene and produced a UD-10 report. Table 1 - Crash Statistics provides a listing of each year's crash statistics that are of interest to the traffic engineer. This table lists all crashes that were reported. As these crashes are analyzed, certain crash types are considered to be more relevant to the design and operational features of the roadway. Animal crashes, impaired driving crashes and crashes occurring during wet or slippery pavement conditions are crash types where the geometry of the roadway or traffic control device operation is probably not a significant factor. For this study, there were a total of nine (9) crashes with animals in the roadway, five (5) impaired driving crashes (which included the single fatality crash) and twenty-four (24) crashes which occurred during inclement weather conditions and wet or slippery pavements. These 38 crashes were removed from the crash database and only dry pavement crash statistics were used for the remaining elements of this study.

Table 1 - Crash Accident Statistics

	1999	2000	2001	2002	2003	2004*	Total	12-Month Average
Total Crashes	12	13	14	17	20	3	78	13.97
Fatal Crashes	0	0	1	0	0	0	1	0.18
Fatalities	0	0	1	0	0	0	1	0.18
Injury Crashes	3	2	4	4	3	0	16	2.86
Injuries	3	3	5	6	6	0	23	4.11
Property Damage Crashes	9	11	9	13	17	3	62	11.10
Animal Crashes	1	1	1	2	3	1	9	1.61
Single Vehicle	4	4	4	3	4	1	20	3.58
Multi Vehicle	8	9	10	14	16	2	59	10.57
Impaired Driving	0	3	2	0	0	0	5	0.89
Citations Issued	6	10	11	9	15	1	52	9.31
Clear Sky	5	5	6	6	4	3	29	5.19
Cloudy Sky	6	1	4	9	11	0	31	5.55
Rain/Snow	2	6	3	2	3	0	16	2.87
Dry Pavement	9	5	9	10	14	3	50	8.96
Wet/Snowy/Ice Pavement	2	9	6	7	6	0	30	5.37
Daylight	10	9	9	14	14	1	57	10.21
Darkness	2	4	5	3	6	2	22	3.94

* Through July of 2004

The crash summaries provided by the City of Ann Arbor did not include copies of the UD-10 reports. Thus, the level of detail contained in the city's data was not sufficient to provide information regarding vehicle direction, driver age or exact time of day. The following summaries do not include the City of Ann Arbor data, where insufficient data was available.

Time of Day Analysis

The time of day that crashes occur may indicate a traffic characteristic that is unique to a specific time of day. For example, a large number of crashes occurring in the night time along a curve may indicate the need to provide reflectors or overhead street lights. Figure 1 - Crash Time of Day illustrates the distribution of crash times as recorded on the UD-10 reports.

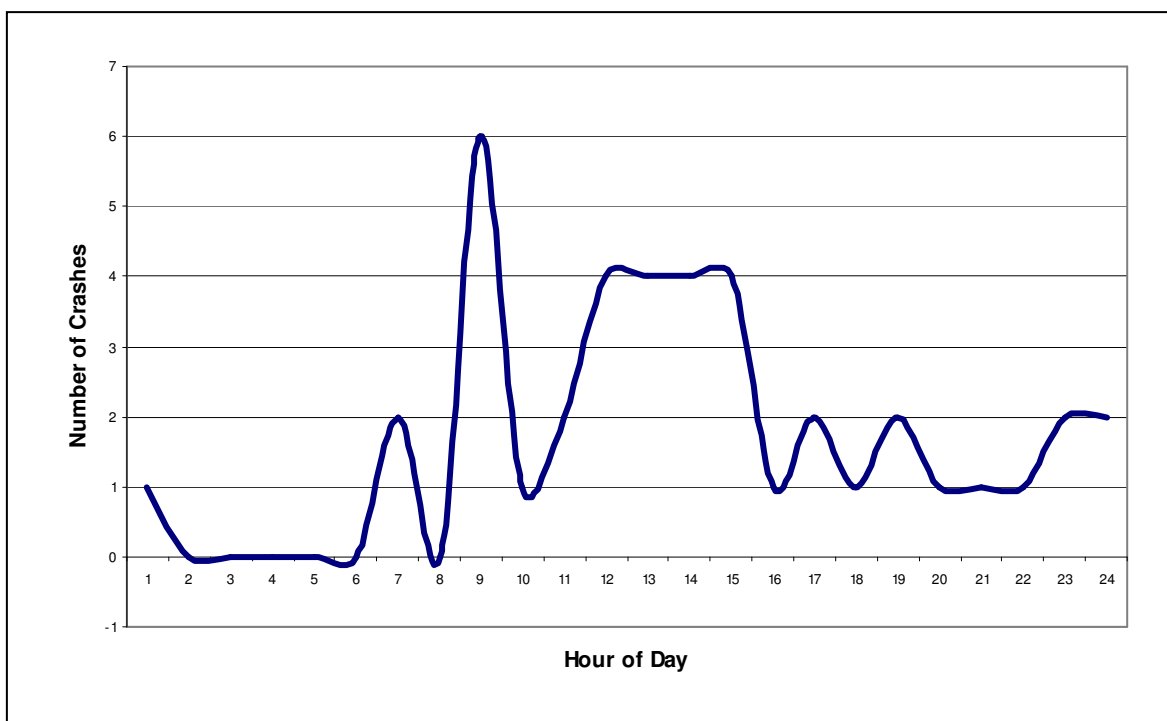


Figure 1 - Crash Time of Day (not including city data)

The peak time for a crash to occur is between 8:00 a.m. and 9:00 a.m. which is toward the end of the normally expected morning rush hour (7:00 a.m. to 9:00 a.m.). Note that there is no pronounced crash spike between 4:00 p.m. and 6:00 p.m. which is normally associated with the p.m. peak hour.

Age of Driver Involved

The distribution of driver ages may also indicate that the roadway is contributing to an abnormal crash distribution. For example, a high percentage of older driver crashes may indicate the need to provide additional delineation of roadway alignment. Figure 2 - Crash Driver Age illustrates the distribution of the ages of the vehicle which precipitated the crash according to the UD-10 report. This figure lists the percent of the crashes that involved a driver in one of six age categories.

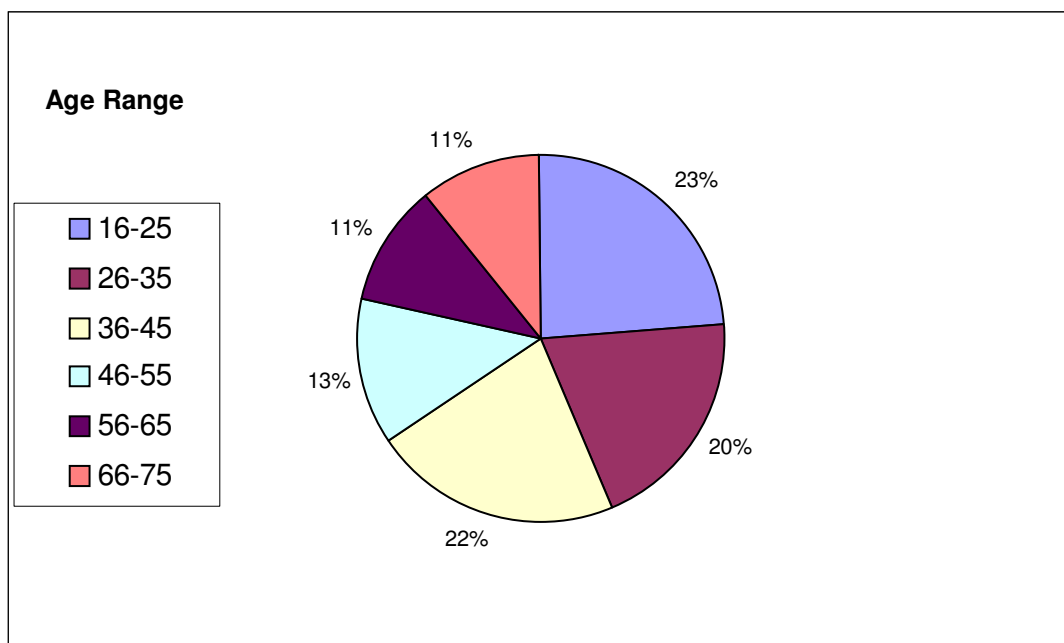


Figure 2 - Crash Driver Age (not including city data)

Crash Type and Location

In addition to recognizing the injuries and property damage, it is sometimes useful to identify other aspects of the crash to see if there is an overall crash pattern. Figure 3 - Crash Type illustrates the types of crashes that have occurred along N. Maple Road. Note that angle crashes and deer crashes comprise 62 percent of all crashes (not including City data).

The location of these crashes along N. Maple Road is indicative of specific roadway sections or intersections where most of the crashes occur. Along N. Maple Road most of the crashes (14 crashes) occurred at the intersection of N. Maple Road and the westbound off-ramp to M-14. The intersection of N. Maple Road and Huron River Drive experienced six total crashes. All of the crashes at the M-14 intersection were angle crashes (where research has shown could be decreased by a signal) and all of the crashes at Huron River Drive were rear-end crashes.

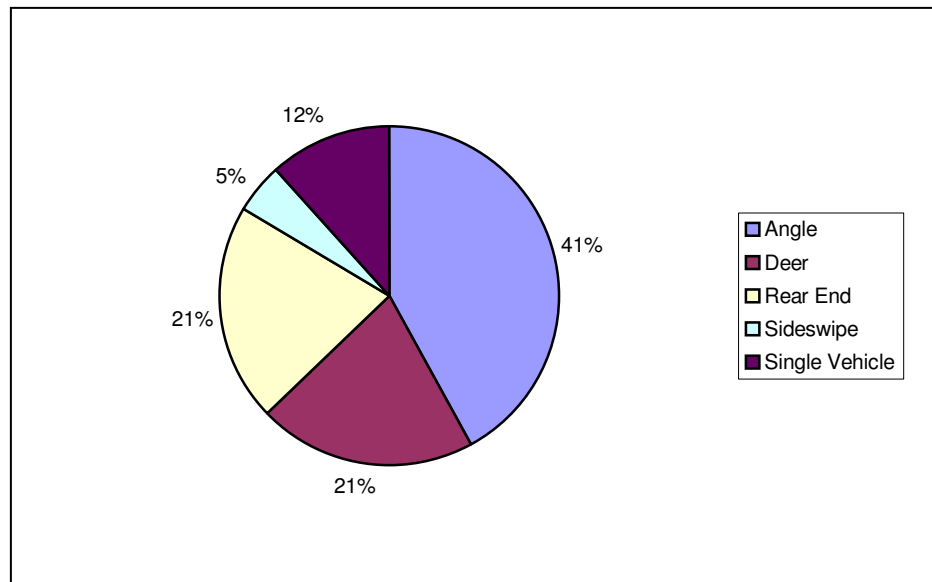


Figure 3 - Crash Type (not including city data)

Crashes Specific to Roadway Geometry and Traffic Controls

Table 2 - Accidents on Dry Pavements presents the crash statistics that occurred on dry pavements. It is these crashes that are of particular interest to this study because the cause of any may be directly related to the geometry of the roadway, intersection layouts or traffic control device operations. Those crashes that are not deemed directly related to roadway or intersection conditions, while remaining important for determining gross crash statistics, are more related to uncontrollable environmental and human factors.

Table 2 - Accidents on Dry Pavements

	1999	2000	2001	2002	2003	2004*	Total	12-Month Average
Total Crashes	9	3	7	10	12	2	43	7.70
Injury Crashes	3	0	2	2	3	0	10	1.79
Injuries	3	0	2	4	4	0	15	2.69
Property Damage Crashes	6	3	5	8	8	2	33	5.91
Single Vehicle	2	0	1	1	1	0	5	0.90
Multi Vehicle	7	3	6	9	11	2	38	6.81
Citations Issued	6	3	6	7	10	1	33	5.91
Clear Sky	4	3	4	6	3	2	22	3.94
Cloudy Sky	5	0	2	4	9	0	20	3.58
Daylight	8	3	5	10	10	1	37	6.63
Darkness	1	0	2	1	2	1	7	1.25

* Through July of 2004

Of the 43 remaining crashes, ten (10) personal injury accidents occurred, injuring a total of 15 persons. Multi-vehicle crashes represented 88 percent of the total collisions. Citations were issued to at least one (1) driver in 75 percent of the crashes. Clear skies occurred during 51 percent of the crashes and daylight conditions occurred during 86 percent of the crashes.

Crash Rates

The 24-hour average volume along N. Maple Road is approximately 4500 vehicles. Over a year's time, a total of 1.9 million vehicles would, on the average, travel along N. Maple Road. Volumes are higher near the M-14 interchange and near Miller Road, and less near Huron River Drive. The roadway section is approximately 1.14 miles in length. The net 12-month average crash frequency (7.70 crashes per year - Table 2) represents a crash rate of 411 crashes per 100 million vehicle miles of travel. In Washtenaw County, between 2000 and 2002 the average crash rate was 374 crashes per 100 million vehicle miles of travel. Thus, the average crash rate along N. Maple Road is approximately 10 percent higher than the average rate in Washtenaw County. If the total number of crashes that occurred from all causes, as listed in Table 1, is considered then the crash rate becomes 746 crashes per 100 million vehicle miles of travel, which is larger than the county-wide average. It is apparent that there are areas along N. Maple Road that experience crash rates at a higher frequency than is considered average in Washtenaw County. Notably, the intersection of Maple Road and Miller experienced 46 percent of all of the crashes that were included in this analysis.

Crash Severity

Of the 78 crashes along N. Maple Road, nearly 20 percent resulted in some degree of personal injury. A total of 23 persons received injuries that either required medical attention at the scene, or at a physician's office. In the seven county area that comprises the Southeast Michigan Council of Governments (SEMCOG) approximately 23 percent of all crashes involve some type of injury.

There was a single fatal crash occurring along N. Maple Road. The UD-10 for this crash indicates that the crash occurred at 6:15 a.m. at the area where N. Maple Road curves, approximately 175 feet north of Whippoorwill Road. The single vehicle involved did not negotiate the curve, and crashed into a structure under construction on the west side of N. Maple Road. The UD-10 reports that the single operator may have been operating a motor vehicle while under the influence of a substance and driving while impaired.

SPECIAL EVENT TRAFFIC OPERATIONS ANALYSIS

Information provided by the Athletic Department of AAPS indicates that the Huron High School / Pioneer High School Friday football game may attract 1400 vehicles parked on-site. With three (3) AAPS high schools, it is assumed that two-thirds of this value will attend games in the future. Therefore, for the new Maple Road High School, a value of $1400 \times 0.67 = 938$ (say 940) vehicles. In a manner similar to the regular school day, these vehicle trips were assigned to the public road system. The time periods analyzed were 6:15 - 7:15 PM and 9:00 - 10:00 PM. Manual counts were taken at the two (2) Maple Road intersections with the M-14 ramps. Then the pre-special event and the post-special event volumes were added to the existing volumes. The final totals are shown in Plan Sheets 19 and 20. A LOS analysis was then conducted (see appendix). Results indicate that an acceptable LOS will be achieved except for the outbound (westbound) movement at the main access intersection with Maple Road during the 9:00 - 10:00 PM hour which will be congested.

SUMMARY - SIGNALIZED INTERSECTION OPTION

It is concluded that with the addition of newly-projected high school traffic, peak-hour traffic operations will continue at an acceptable level of service with selected traffic control and roadway geometric modifications (shown in Plan Sheet 18). No changes are called for at the northerly seven (7) intersections. At the two (2) M-14 ramp intersections, additional laneage is recommended on both ramps, as well as Maple Road itself along with signal control. At the Maple/Miller intersection, an additional eastbound lane on the Miller approach is one of several potential solutions that will maintain a good LOS for traffic operations.

ROUNDAABOUT INTERSECTION PLAN

G. DLZ - ROUNDAABOUT LITERATURE SAFETY REVIEW

(see attached)

H. DLZ - ROUNDAABOUT OPERATIONAL ANALYSIS

(see attached)

I. DLZ - INTERSECTION ALTERNATIVE COMPARISON REPORT

(see attached)