

# CITY of NOVI CITY COUNCIL

Agenda Item 1  
July 19, 2010

**SUBJECT:** Approval to award a contract for design engineering services for the South Lake Drive/Old Novi Rd/13 Mile Intersection Improvements to Orchard, Hiltz & McCliment, Inc. (OHM) for a not-to-exceed design fee of \$12,797.

**SUBMITTING DEPARTMENT:** Department of Public Services, Engineering Division *BTC*

**CITY MANAGER APPROVAL:** *[Signature]* *RZ*

EXPENDITURE REQUIRED	\$12,797
AMOUNT BUDGETED	\$152,000 (Eng and Construction)
APPROPRIATION REQUIRED	N/A
LINE ITEM NUMBER	204-204.00-863.106

## BACKGROUND INFORMATION:

The existing traffic signal at the South Lake Drive/Old Novi Road/13 Mile Road intersection was installed in 1986 at a time when traffic counts on South Lake Drive were as high as 7,400 vehicles per day. The City has constructed two new roads in the northern part of the City since that time that have diverted traffic away from this intersection, including the "new" Novi Road alignment between 12-1/2 Mile Road and 13 Mile in the late 1990s and the construction of West Park Drive in early 2000s. The traffic volumes on South Lake Drive have since decreased to 2,600 vehicles per day.

A traffic study was completed for this intersection in 2009 by the City's traffic consultant, Birchler Arroyo. The study (attached) found the existing traffic signal to be unwarranted based on existing and future anticipated traffic volumes, as well as other traffic design parameters. The study recommended that the intersection be improved to increase the level of service (an indicator of the time delay to proceed through the intersection), and to allow for improved turning movements through the intersection. Based on this study, improvements proposed to this intersection include the removal of the existing unwarranted traffic signal, replacing the signal with all-way stop sign control, partial reconstruction of the South Lake Drive approach to better accommodate large vehicles (e.g. school buses and fire trucks), and other minor improvements that may be required following further study of the intersection during preliminary design.

A grant application was recently submitted by staff for the construction of a roundabout at this intersection; however, the application was not selected for funding. As such, the recommended improvements to remove the traffic signal, improve the turning movements in the intersection, and install a three-way stop is being pursued as approved in the 2010-11 Capital Improvement Program. The improvements to this intersection will be coordinated with planned improvements to the City's Landings Property and the general

alignment of the intersection will remain unchanged. As with other construction projects of this nature, a public information meeting will be held to solicit public input as part of the design development process, especially from neighboring homeowners associations and businesses.

OHM's engineering fees are based on the fixed fee schedule established in the Agreement for Professional Engineering Services for Public Projects. The design fees for this project will be \$12,797, which is 10.15% of the remaining budget for construction of \$126,073 (original budget of \$152,000 less \$12,797 for design engineering, and \$13,130 anticipated for construction engineering). The construction phase engineering fees will be awarded at the time of construction award and will be based on the contractor's bid price and the fee percentage established in the Agreement for Professional Engineering Services for Public Projects. A draft of the Supplemental Professional Engineering Services Agreement for this project is enclosed and includes the project scope and schedule.

OHM has recently completed engineering services for the federally funded roads project (Meadowbrook Road and Nine Mile Road), and our current 2010 road capital preventative maintenance program. The project is anticipated to begin in the fall 2010 and be completed in spring 2011.

**RECOMMENDED ACTION:** Approval to award a contract for design engineering services for the South Lake Drive/Old Novi Rd/13 Mile Intersection Improvements to Orchard, Hiltz & McCliment, Inc. (OHM) for a not-to-exceed design fee of \$12,797.

	1	2	Y	N
<b>Mayor Landry</b>				
<b>Mayor Pro Tem Gatt</b>				
<b>Council Member Crawford</b>				
<b>Council Member Fischer</b>				

	1	2	Y	N
<b>Council Member Margolis</b>				
<b>Council Member Mutch</b>				
<b>Council Member Staudt</b>				

**MAP INTERPRETATION NOTICE**

Map information depicted is not intended to replace or substitute for any official or primary source. This map was intended to meet National Map Accuracy Standards and use the most recent, accurate sources available to the people of the City of Novi. Boundary measurements and area calculations are approximate and should not be construed as survey measurements performed by a licensed Michigan Surveyor as defined in Michigan Public Act 132 of 1970 as amended. Please contact the City GIS Manager to confirm source and accuracy information related to this map.

# City Of Novi



## South Lake Dr/Old Novi Rd/13 Mile Rd Intersection Improvements Location Map



**SUPPLEMENTAL PROFESSIONAL ENGINEERING SERVICES AGREEMENT**

**SOUTH LAKE DRIVE/OLD NOVI ROAD/13 MILE ROAD  
INTERSECTION IMPROVEMENTS**

This Agreement shall be considered as made and entered into as of the date of the last signature hereon, and is between the City of Novi, 45175 W. Ten Mile Road, Novi, MI 48375-3024, hereafter, "City," and Orchard, Hiltz & McCliment, Inc., whose address is 34000 Plymouth Road, Livonia, Michigan 48150, hereafter, "Consultant."

**RECITALS:**

This Agreement shall be supplemental to, and hereby incorporates the terms and conditions of the AGREEMENT FOR PROFESSIONAL ENGINEERING SERVICES FOR PUBLIC PROJECTS, and attached exhibits, entered into between the City and the Consultant on September 24, 2009.

The project includes the design and the preparation of plans and specifications improvements to the intersection of South Lake Drive/Old Novi Road/13 Mile Road. The improvements will include the removal of the existing unwarranted traffic signal, replacing the signal with all-way stop sign control, partial reconstruction of the South Lake Drive approach to better accommodate large vehicles (e.g. school buses), and other minor improvements that may be required following further study of the intersection during design.

NOW, THEREFORE, in consideration of the foregoing, the City and Consultant agree as follows:

**Section 1. Professional Engineering Services.**

For and in consideration of payment by the City as provided under the "Payment for Engineering Services" section of this Agreement, Consultant shall perform the work described in the manner provided or required by the following Scope of Services, which is attached to and made a part of this Agreement as Exhibit A, all of said services to be done in a competent, efficient, timely, good and workmanlike manner and in compliance with all terms and conditions of this Agreement.

Exhibit A                      Scope of Services

**Section 2. Payment for Professional Engineering Services.**

1. Basic Fee.

- a. Design Phase Services: The Consultant shall complete the design phase services as described herein for a lump sum fee of \$12,797, which is 10.15% of the estimated construction cost (\$126,073) as indicated on the design and

construction engineering fee curve provided in Exhibit B of the Agreement for Professional Engineering Services for Public Projects.

- b. Construction Phase Services will be awarded at the time of construction award, should it occur.

2. Payment Schedule for Professional Engineering Services Fee.

Consultant shall submit monthly statements for professional engineering services rendered. The statements shall be based on Consultant's estimate of the proportion of the total services actually completed for each task as set forth in Exhibit A at the time of billing. The City shall confirm the correctness of such estimates, and may use the City's own engineer for such purposes. The monthly statements should be accompanied by such properly completed reporting forms and such other evidence of progress as may be required by the City. Upon such confirmation, the City shall pay the amount owed within 30 days.

Final billing under this agreement shall be submitted in a timely manner but not later than three (3) months after completion of the services. Billings for work submitted later than three (3) months after completion of services will not be paid. Final payment will be made upon completion of audit by the City.

3. Payment Schedule for Expenses.

All expenses required to complete the scope of services described herein, including but not limited to costs related to mileage, vehicles, reproduction, computer use, etc., shall be included in the basic fee and shall not be paid separately. However, as compensation for expenses that are not included in the standard scope of services, when incurred in direct connection with the project, and approved by the City, the City shall pay the Consultant its actual cost times a factor of 1.15.

**Section 4. Ownership of Plans and Documents; Records.**

1. Upon completion or termination of this agreement, all documents prepared by the Consultant, including tracings, drawings, estimates, specifications, field notes, investigations, studies, etc., as instruments of service shall become the property of the City.

2. The City shall make copies, for the use of the Consultant, of all of its maps, records, laboratory tests, or other data pertinent to the work to be performed by the Consultant under this Agreement, and also make available any other maps, records, or other materials available to the City from any other public agency or body.

3. The Consultant shall furnish to the City, copies of all maps, records, field notes, and soil tests that were developed in the course of work for the City and for which compensation has been received by the Consultant.

**Section 5. Termination.**

1. This Agreement may be terminated by either party upon 7- days' prior written notice to the other party in the event of substantial failure by the other party to fulfill its obligations under this agreement through no fault of the terminating party.

2. This Agreement may be terminated by the City for its convenience upon 90 days' prior written notice to the Consultant.

3. In the event of termination, as provided in this Article, the Consultant shall be paid as compensation in full for services performed to the date of that termination, an amount calculated in accordance with Section 2 of this Agreement. Such amount shall be paid by the City upon the Consultant's delivering or otherwise making available to the City, all data, drawings, specifications, reports, estimates, summaries, and that other information and materials as may have been accumulated by the Consultant in performing the services included in this Agreement, whether completed or in progress.

**Section 6. Disclosure.**

The Consultant affirms that it has not made or agreed to make any valuable gift whether in the form of service, loan, thing, or promise to any person or any of the person's immediate family, having the duty to recommend, the right to vote upon, or any other direct influence on the selection of consultants to provide professional engineering services to the City within the two years preceding the execution of this Agreement. A campaign contribution, as defined by Michigan law shall not be considered as a valuable gift for the purposes of this Agreement.

**Section 7. Insurance Requirements.**

1. The Consultant shall maintain at its expense during the term of this Agreement, the following insurance:

- A. Worker's Compensation insurance relative to all Personnel engaged in performing services pursuant to this Agreement, with coverage not less than that required by applicable law.
- B. Comprehensive General Liability insurance with maximum bodily injury limits of \$1,000,000 (One Million Dollars) each occurrence and/or aggregate and minimum Property Damage limits of \$1,000,000 (One Million Dollars) each occurrence and/or aggregate.
- C. Automotive Liability insurance covering all owned, hired, and non-owned vehicles with Personal Protection insurance to comply with the provisions of the Michigan No Fault Insurance Law including Residual Liability insurance with minimum bodily injury limits of \$1,000,000 (One Million Dollars) each occurrence and/or aggregate minimum property damage limits of \$1,000,000 (One Million Dollars) each occurrence and/or aggregate.
- D. The Consultant shall provide proof of Professional Liability coverage in the amount of not less than \$1,000,000 (One Million Dollars) per occurrence and/or aggregate, and Environmental Impairment coverage.

2. The Consultant shall be responsible for payment of all deductibles contained in any insurance required hereunder.

3. If during the term of this Agreement changed conditions or other pertinent factors should in the reasonable judgment of the City render inadequate insurance limits, the Consultant will furnish on demand such additional coverage as may reasonably be required under the circumstances. All such insurance shall be effected at the Consultant's expense, under valid and enforceable policies, issued by the insurers of recognized responsibility which are well-rated by national rating organizations and are acceptable to the City.

4. All policies shall name the Consultant as the insured and shall be accompanied by a commitment from the insurer that such policies shall not be canceled or reduced without at least thirty (30) days prior notice to the City.

With the exception of professional liability, all insurance policies shall name the City of Novi, its officers, agents, and employees as additional insured. Certificates of Insurance evidencing such coverage shall be submitted to Sue Morianti, Purchasing Manager, City of Novi, 45175 West Ten Mile Road, Novi, MI 48375-3024 prior to commencement of performance under this Agreement and at least fifteen (15) days prior to the expiration dates of expiring policies.

5. If any work is sublet in connection with this Agreement, the Consultant shall require each subconsultant to effect and maintain at least the same types and limits of insurance as fixed for the Consultant.

6. The provisions requiring the Consultant to carry said insurance shall not be construed in any manner as waiving or restricting the liability of the Consultant under this Agreement.

**Section 8. Indemnity and Hold Harmless.**

A. The Consultant agrees to indemnify and hold harmless the City, its elected and appointed officials and employees, from and against any and all claims, demands, suits, losses and settlements, including actual attorney fees incurred and all costs connected therewith, for any damages which may be asserted, claimed or recovered against the City by reason of personal injury, death and/or property damages which arises out of or is in any way connected or associated with the actions or inactions of the Consultant in performing or failing to perform the work.

The Consultant agrees that it is its responsibility and not the responsibility of the City to safeguard the property and materials used in performing this Agreement. Further, this Consultant agrees to hold the City harmless for any loss of such property and materials used pursuant to the Consultant's performance under this Agreement.

**Section 9. Nondiscrimination.**

The Consultant shall not discriminate against any employee, or applicant for employment because of race, color, sex, age or handicap, religion, ancestry, marital status, national origin, place of birth, or sexual preference. The Consultant further covenants that it will comply with the Civil Rights Act of 1973, as amended; and the Michigan Civil Rights Act of 1976 (78. Stat.

252 and 1976 PA 4563) and will require a similar covenant on the part of any consultant or subconsultant employed in the performance of this Agreement.

**Section 10. Applicable Law.**

This Agreement is to be governed by the laws of the State of Michigan and the City of Novi Charter and Ordinances.

**Section 11. Approval; No Release.**

Approval of the City shall not constitute nor be deemed release of the responsibility and liability of Consultant, its employees, associates, agents and subconsultants for the accuracy and competency of their designs, working drawings, and specifications, or other documents and services; nor shall that approval be deemed to be an assumption of that responsibility by the City for any defect in the designs, working drawings and specifications or other documents prepared by Consultant, its employees, subconsultants, and agents.

After acceptance of final plans and special provisions by the City, Consultant agrees, prior to and during the construction of this project, to perform those engineering services as may be required by City to correct errors or omissions on the original plans prepared by Consultant and to change the original design as required.

**Section 12. Compliance With Laws.**

This Contract and all of Consultants professional services and practices shall be subject to all applicable state, federal and local laws, rules or regulations, including without limitation, those which apply because the City is a public governmental agency or body. Consultant represents that it is in compliance with all such laws and eligible and qualified to enter into this Agreement.

**Section 13. Notices.**

Written notices under this Agreement shall be given to the parties at their addresses on page one by personal or registered mail delivery to the attention of the following persons:

City: Rob Hayes, P.E., Director of Public Services and Maryanne Cornelius, Clerk, with a copy to Thomas R. Schultz, City Attorney

Consultant: James Stevens, PE

**Section 14. Waivers.**

No waiver of any term or condition of this Agreement shall be binding and effective unless in writing and signed by all parties, with any such waiver being limited to that circumstance only and not applicable to subsequent actions or events.



**Section 15. Inspections, Notices, and Remedies Regarding Work.**

During the performance of the professional services by Consultant, City shall have the right to inspect the services and its progress to assure that it complies with this Agreement. If such inspections reveal a defect in the work performed or other default in this Agreement, City shall provide Consultant with written notice to correct the defect or default within a specified number of days of the notice. Upon receiving such a notice, Consultant shall correct the specified defects or defaults within the time specified. Upon a failure to do so, the City may terminate this Agreement by written notice and finish the work through whatever method it deems appropriate, with the cost in doing so being a valid claim and charge against Consultant; or, the City may preserve the claims of defects or defaults without termination by written notice to Consultant.

All questions which may arise as to the quality and acceptability of work, the manner of performance and rate of progress of the work, and the interpretation of plans and specifications shall be decided by the City. All questions as to the satisfactory and acceptable fulfillment of the terms of this agreement shall be decided by the City.

**Section 16. Delays.**

No charges or claims for damages shall be made by the Consultant for delays or hindrances from any cause whatsoever during the progress of any portions of the services specified in this agreement, except as hereinafter provided.

In case of a substantial delay on the part of the City in providing to the Consultant either the necessary information or approval to proceed with the work, resulting, through no fault of the Consultant, in delays of such extent as to require the Consultant to perform its work under changed conditions not contemplated by the parties, the City will consider supplemental compensation limited to increased costs incurred as a direct result of such delays. Any claim for supplemental compensation must be in writing and accompanied by substantiating data.

When delays are caused by circumstances or conditions beyond the control of the Consultant as determined by the City, the Consultant shall be granted an extension of time for such reasonable period as may be mutually agreed upon between the parties, it being understood, however, that the permitting of the Consultant to proceed to complete the services, or any part of them, after the date to which the time of completion may have been extended, shall in no way operate as a waiver on the part of the City of any of its rights herein set forth.

**Section 17. Assignment.**

No portion of the project work, heretofore defined, shall be sublet, assigned, or otherwise disposed of except as herein provided or with the prior written consent of the City. Consent to sublet, assign, or otherwise dispose of any portion of the services shall not be construed to relieve the Consultant of any responsibility for the fulfillment of this agreement.

**Section 18. Dispute Resolution.**

The parties agree to try to resolve any disputes as to professional engineering services or otherwise in good faith. In the event that the parties cannot resolve any reasonable dispute, the

parties agree to seek alternative dispute resolution methods agreeable to both parties and which are legally permissive at the time of the dispute. The parties agree to use their best efforts to resolve any good faith dispute within 90 (ninety) days notice to the other party. In the event the parties cannot resolve that dispute as set forth above, they may seek such remedies as may be permitted by law.

WITNESSES

Orchard, Hiltz & McCliment, Inc.

\_\_\_\_\_

\_\_\_\_\_

By: Vytautas P. Kaunelis, PE  
Its: Principal

The foregoing \_\_\_\_\_ was acknowledged before me this \_\_\_\_\_ day of \_\_\_\_\_,  
20\_\_\_\_, by \_\_\_\_\_ on behalf of \_\_\_\_\_

\_\_\_\_\_

Notary Public  
\_\_\_\_\_ County, Michigan  
My Commission Expires: \_\_\_\_\_

WITNESSES

CITY OF NOVI

\_\_\_\_\_

\_\_\_\_\_

By:  
Its:

The foregoing \_\_\_\_\_ was acknowledged before me this \_\_\_\_\_ day of \_\_\_\_\_,  
20\_\_\_\_, by \_\_\_\_\_ on behalf of the City of Novi.

Notary Public  
Oakland County, Michigan  
My Commission Expires: \_\_\_\_\_

## EXHIBIT A - SCOPE OF SERVICES

Consultant shall provide the City professional engineering services in all phases of the Project to which this Agreement applies as hereinafter provided. These services will include serving as the City's professional engineering representative for the Project, providing professional engineering consultation and advice and furnishing customary civil, structural, mechanical and electrical engineering services and customary engineering services incidental thereto, as described below.

### A. **Basic Services.**

[see attached]

### B. **Performance.**

1. The Consultant agrees that, immediately upon the execution of this Agreement, it will enter upon the duties prescribed in this agreement, proceed with the work continuously, and make the various submittals on or before the dates specified in the attached schedule. The City is not liable and will not pay the Consultant for any services rendered before written authorization is received by the Consultant.
2. The Consultant shall submit, and the City shall review and approve a timeline for submission of plans and/or the completion of any other work required pursuant to this Scope of Services. The Consultant shall use its best efforts to comply with the schedule approved by the City.
3. If any delay is caused to the Consultant by order of the City to change the design or plans; or by failure of the city to designate right-of-way, or to supply or cause to be supplied any data not otherwise available to the Consultant that is required in performing the work described; or by other delays due to causes entirely beyond the control of the Consultant; then, in that event, the time schedules will be adjusted equitably in writing, as mutually agreed between the City and the Consultant at the moment a cause for delay occurs.
4. Since the work of the Consultant must be coordinated with the activities of the City (including firms employed by and governmental agencies and subdivisions working with the City), the Consultant shall advise the City in advance, of all meetings and conferences between the Consultant and any party, governmental agency, political subdivision, or third party which is necessary to the performance of the work of the Consultant.

## **EXHIBIT A - Scope of Services**

### **S. Lake Drive/Old Novi Road/13 Mile Intersection Improvements**

Orchard, Hiltz & McCliment, Inc. is pleased to provide engineering services to the City of Novi. We understand that the City wishes to remove the traffic signal at the intersection of S. Lake Drive, Old Novi, and 13 Mile Road. The intersection will be converted into a three-way stop. In addition minor geometric improvements will be made to the radii on the inbound right turn on to S. Lake Road. ADA sidewalk upgrades will be completed and the pavement surface throughout the intersection will be rehabilitated.

The scope of engineering services shall include the following tasks:

1. Conduct a site visit and offer recommendations for the proposed improvements (ADA upgrades, geometric improvements, and pavement surface rehab).
2. Attend one meeting with City staff to finalize the specific improvements.
3. Prepare a preliminary opinion of probable construction costs for the selected improvements and adjust as necessary based upon available budget.
4. Coordinate with the City's Geotechnical Engineer on soil borings if applicable.
5. Perform Topographical survey of the project area as necessary based upon the selected improvements. At a minimum it is anticipated that survey will be required for the new radii onto S. Lake Drive and for the ADA improvements. Additional improvements will be completed via a "log" format which will include standard plans and specifications with details of various construction methods intended to be utilized.
6. Attend one meeting with the City to review the preliminary design and "log" documents and address any requested revisions.
7. Coordinate with the Road Commission for Oakland County and DTE for the removal of the traffic signal.
8. Prepare final design and "log" format plans, specifications and bidding documents.
9. Assist the City with advertising and soliciting bids, printing and distributing bidding documents to interested bidders, attend the bid opening, tabulate and review the bids, check contractor references and provide a recommendation of the award of the project construction to a qualified contractor.

The following services are not anticipated to be required for this project and have not included:

1. Permit or application fees
2. Coordination or design for utility relocations or repairs
3. Remediation or removal of contaminated or hazardous soils or materials

We can perform any of these above-mentioned services. In the event any of these services are required, an addendum to the supplemental engineering agreement will be submitted for your approval prior to performing said services.

Tentative Schedule:

1. Design completed by September 1, 2010
2. Bids received by late-September
3. Construction to begin in October or April 2011.

January 9, 2009

Brian T. Coburn, P.E.  
Engineering Department  
City of Novi  
45175 W. Ten Mile Road  
Novi, MI 48375  
[bcoburn@cityofnovi.org](mailto:bcoburn@cityofnovi.org)



**Subject: Traffic Study Report for Intersection of Old Novi, 13 Mile, and South Lake**

Dear Mr. Coburn:

We have completed our study of the above intersection (see Figures 1-2, below), conducted per our City-approved proposal of December 2, 2008. This report summarizes our recommendations, data collection, analytical findings, and field observations.

### **Recommendations**

1. The existing unwarranted traffic signal should either be removed or operated in flashing mode (red in all three directions) at all times. The cycling operation of the signal should be replaced by all-way STOP signs, and the stop bar on the northeast-bound Old Novi Road approach moved somewhat closer to the intersection (by an amount to be determined under #3, below).
2. South Lake Drive near Old Novi / 13 Mile should be redesigned and partially reconstructed to better accommodate large vehicles having a legitimate need to turn onto South Lake Dr. from both the east and south (e.g., school buses). This might involve flaring out the northern curb and removing the off-tracking apron, and/or tapering the south end of the boulevard island.
3. To properly design for larger vehicles, a survey should be done of the road edges and existing lane striping within 150 ft of the intersection in all directions. We would then be in a better position to sketch our recommended design changes. (The 2003 reconstruction plan for South Lake Drive, prepared by others, shows only the South Lake Drive leg of the intersection.)

### **Data Collection**

Both traffic volume and crash data were obtained. Volume data include the results of manual counts done by Birchler Arroyo Associates during the 7:00-9:00 a.m. and 4:00-6:00 p.m. peak periods on Wednesday, December 10, 2008 (detailed in Appendix A). Also, to check on recent traffic volume trends, hourly two-way counts for Old Novi Road were retrieved from the SEMCOG data base (see appendix Figure A-1).

Crash data were provided by the Traffic Improvement Association (TIA) for the latest available three calendar years, 2005-2007. These detailed data appear in Appendix B, along with our summary of the 19 reported crashes (Table B-1).



BIGLER ARROYO  
ASSOCIATES, INC.



Figure 1. Vertical Aerial



**BA**  
**W**  
**B**  
**IRCHLER ARROYO**  
**ASSOCIATES, INC.**



**Figure 2. Birdseye Aerial**

## Current and Future Peak-Hour Traffic Volumes

Figure 3 shows the intersection's current movement volumes during the AM and PM peak hours, which were found to be 7:30-8:30 a.m. and 4:45-5:45 p.m. These counts yield two-way volumes on Old Novi Road just south of the intersection of 105 vehicles and 217 vehicles, respectively.

Table 1 compares, for selected hours, the current two-way volumes on Old Novi Road to the May 2004 volumes reported by SEMCOG. Note that *the volumes observed in 2004 have decreased some 20-25%*. This may reflect a reduction in cut-through traffic using Old Novi Road leaving and returning to South Lake Drive, likely due to such factors as the completion of the full-service I-96 / Beck Road interchange as well as the traffic-calming reconstruction of South Lake Drive.

**Table 1. Two-Way Volumes on Old Novi Road**

Hour Starting	Dec 08	May 04 <sup>2</sup>	Dec 08 : May 04
7:00 am	99	147	0.67
7:30 am <sup>1</sup>	105	-	0.75 (avg.)
8:00 am	96	115	0.83
4:00 pm	182	227	0.80
4:45 pm <sup>1</sup>	217	-	0.80 (avg.)
5:00 pm	221	278	0.79

<sup>1</sup> Peak hour in Dec 08

<sup>2</sup> From SEMCOG website

With respect to the design year of 2028, we believe that it is reasonable to assume that a modest rate of positive traffic growth will replace the recent decline noted above. For this study, we are assuming an average annual growth of 1%. Compounded annually over 20 years, this means that 2028 volumes could exceed current volumes by 22%. Figure 4 reflects such an adjustment.

## Traffic Signal Warrants

Of the eight signal installation warrants appearing in the 2005 *Michigan Manual of Uniform Traffic Control Devices*, the one we have generally found to be most easily met is the peak-hour volume warrant, officially Part B of "Warrant 3, Peak Hour" (excerpted in Appendix C). Warrant 3 has two parts, with Part B dealing only with peak-hour volumes and Part A dealing with both cumulative peak-hour delay and the associated volumes. Only one of the two parts of Warrant 3 must be met for the warrant to be met, and only one warrant of the total of eight must be met to permit (but not require) a cycling signal.

Figure 3 indicates that the highest two-way peak-hour volume on the "major" road at this intersection is now 374 vehicles in the PM peak hour (total of the NEB and SWB approaches). *Since the applicable warrant chart in Appendix C begins at 400 vehicles, the signal is clearly unwarranted.*





**BIRCHLER ARROYO  
ASSOCIATES, INC.**



**Legend**  
 X / Y, where:  
 X = 7:30-8:30 AM  
 Y = 4:45-5:45 PM

**Figure 3. Current Peak-Hour Traffic Volumes**



BISCHLER ARROYO  
ASSOCIATES, INC.



Legend

X / Y, where:  
X = 7:30-8:30 AM  
Y = 4:45-5:45 PM

<sup>†</sup> Current (Dec 08)  
volumes increased  
1% / year, compounded  
annually (or multiplied  
by a factor of 1.22).

Figure 4. Forecasted 2028 Peak-Hour Volumes<sup>†</sup>

## Current and Future Levels of Service

*Synchro 7* capacity analysis software was used to predict average vehicular delays, associated levels of service, and queue lengths. As briefly explained at the beginning of Appendix D, the level of service (LOS) for a traffic movement, approach, or intersection is a letter grade between A and F, assigned by the analysis software based on the average delay per vehicle predicted in a computer simulation. An overall level of service of D or better is typically sought in an urban or suburban area.

Table 2 summarizes the LOS results obtained from our analysis of the intersection. The first block of the table presents the current operation, which overall is LOS C in the AM peak hour and LOS D in the PM peak hour. While these levels are normally considered acceptable, the D in the PM is largely due to LOS F for northeast-bound left turns onto South Lake Drive, which must yield to the higher volume of southwest-bound right turns from 13 Mile (there is no left-turn signal phase).

**Table 2. Levels of Service at Old Novi / 13 Mile / South Lake:  
Existing Signal v. Alternative All-Way Stop Control<sup>1</sup>**

Approach <sup>2</sup>	Movement <sup>3</sup>	AM Peak Hour			PM Peak Hour		
		Volume (veh)	Avg. Delay (sec/veh)	LOS	Volume (veh)	Avg. Delay (sec/veh)	LOS
<b>Current (2008) Traffic – With Signal</b>							
Overall Intersection		295	26.4	C	510	38.6	D
SEB	L + R	175	26.3	C	136	35.8	D
NEB	L	10	30.7	C	70	106.1	F
	T	11	25.0	C	74	24.3	C
SWB	T + R	99	26.4	C	230	25.4	C
<b>Current (2008) Traffic – With All-Way Stop in Lieu of Signal</b>							
Overall Intersection		295	8.6	A	510	8.7	A
SEB*	L + R	175	9.1	A	136	9.3	A
NEB*	L	10	7.2	A	70	7.7	A
	T	11	6.1	A	74	6.9	A
SWB*	T + R	99	8.0	A	230	9.1	A
<b>Future (2028) Traffic – With All-Way Stop</b>							
Overall Intersection		359	9.1	A	621	9.5	A
EB*	L + R	213	9.8	A	165	10.2	B
NEB*	L	12	7.3	A	85	8.2	A
	T	13	6.2	A	90	7.3	A
SWB*	T + R	121	8.3	A	281	10.2	B

<sup>1</sup> Level of service (LOS) based on average delay per vehicle, the latter computed with *Synchro 7.0* software based on the *Highway Capacity Manual*, Special Report 209, Transportation Research Board, 2000. See Appendix D for details.

<sup>2</sup> SEB = southeast-bound (S. Lake), NEB = northeast-bound (Old Novi), and SWB = southwest-bound (13 Mile). \* denotes STOP sign control.

<sup>3</sup> L = left turn, T = through movement, and R = right turn.

The second block of Table 2 shows that *the replacement of the existing cycling traffic signal by all-way STOP sign control would improve current peak-hour LOS rather dramatically, to an A in both peak hours*. The third block of the table shows that all-way stop control would continue to provide LOS A under the traffic volumes projected to year 2028.

### Recent Crash History

As indicated in appendix Table C-1, the annual intersection crash frequency in 2005, 2006, and 2007 was 11, 7, and 1, respectively. While crash frequencies typically vary significantly from year to year at lower-volume intersections such as this one, the downward trend in this case is rather remarkable. Clearly, decreasing traffic volumes would be one contributing factor, but it remains unclear what other factors may be at play.

The average annual crash frequency in 2005-2007 was 6.33 crashes per year. Assuming that the total PM peak-hour traffic volume now entering the intersection is 10.2% of the daily volume as it was in 2004 (per Figure A-1), the average daily volume now entering the intersection is 5,000 vehicles. Further assuming that the current entering volume is the best available estimate of the average entering volume in 2005-2007, the resulting average crash rate in those years was 3.5 crashes per million vehicles. Applying procedures and test values found in the 2<sup>nd</sup> edition of the *SEMOG Traffic Safety Manual*, we find that this is *not* a "high-crash" intersection (the average observed crash rate of 3.5 was less than the critical crash rate for this type of intersection of 4.0).

Furthermore, we are of the opinion that neither our crash summary (Table C-1) nor the TIA summary tables (also in Appendix C) show any significant crash patterns that may indicate the need for a particular form of safety mitigation. There was only one crash resulting in incapacitating injury (level A), and it involved a single vehicle operated after dark by an alcohol-affected driver. In addition, there were only three other crashes involving "possible" injury (level C).

### Field Observations

Under the current two-phase signal operation, all left turns from northeast-bound Old Novi Road must yield to traffic on southwest-bound 13 Mile Road. This means that 70 left turns in the PM peak hour must yield to 230 oncoming vehicles on 13 Mile, most of the latter (83%) turning right. As shown above, Synchro predicts that this results in relatively long delays for the left turns.

Observations by our traffic count supervisor suggest that the desire of those left-turn drivers to minimize their delays sometimes results in left turns starting before oncoming traffic fully clears the intersection, apparently reflecting the assumption that oncoming traffic will invariably turn right. Cases were noted where southwest-bound through drivers used their left-turn signals, either due to the curve (Figures 5-6) or to show that they were *not* turning right.

Figures 7 and 8 confirm that larger vehicles turning right into South Lake Drive are unable to do so without encroaching on areas behind the curb-and-gutter. An off-tracking apron, not shown in the original reconstruction plan, was later added to accommodate these turns (also note the gray traffic



**Figure 5. Northeast-bound Old Novi Road**



**Figure 6. Southwest-bound 13 Mile Road**



**Figure 7. Southeast-bound South Lake Drive**



**Figure 8. Off-Tracking Apron at Entrance to South Lake Drive**

wear on, and even north of, the apron shown in Figure 2). Even with the apron, we noted numerous marks and gouges in the north curb of the island (look closely at Figure 8).

We suspect that larger vehicles turning left onto South Lake Drive also have to use the apron and/or "swing wide" and encroach on the northeast-bound lane as they begin their turn. *Our preliminary use of design-vehicle turning templates on an approximately scaled aerial photo indicates likely problems for larger vehicles entering South Lake from both the east and south.*

### Conclusions

From the above, it is clear that a cycling traffic signal at this location is no longer warranted. Since the reduced traffic volumes do not warrant a signal, we also believe that they do not warrant a large capital investment (such as the possible installation of a roundabout). The intersection should be controlled by all-way STOP signs. At the City's option, the existing signal hardware could be retained indefinitely, with the signals placed in full-time flashing-red mode as a way of alerting drivers to the stop requirement.

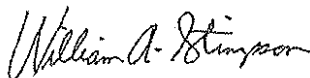
It also appears to be appropriate to refine the intersection's design to better accommodate legitimate design vehicles (e.g., school buses). In the next construction season, we believe that the City should strive to widen the entering throat of South Lake Drive, by flaring the north curb and/or tapering the end of the boulevard island. Accompanied by all-way STOP signs, the wider entering throat for South Lake should not increase the road's appeal as a potential cut-through route.

Please let us know if you have any questions or comments regarding this report. As indicated in Recommendation #3 (above), we would be glad to further assist you with the preparation of a conceptual redesign of the South Lake Drive side of the intersection.

Sincerely,  
BIRCHLER ARROYO ASSOCIATES, INC.



Rodney L. Arroyo, AICP  
Vice President



William A. Stimpson, P.E.  
Director of Traffic Engineering

APPENDIX A:  
TRAFFIC COUNTS



**TRAFFIC STUDY OF OLD NOVI RD / 13 MILE RD / SOUTH LAKE DR**  
**AM Turning-Movement Count - All Traffic**  
 Wednesday, December 10, 2008

**Cumulative Turning-Movement Counts**

15 MINUTES ENDING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
7:15	26	10	4	9	1	2	52
7:30	45	23	11	13	2	9	103
7:45	83	34	24	25	4	12	182
8:00	126	45	35	40	5	14	265
8:15	162	53	46	52	7	18	338
8:30	186	57	61	62	12	20	398
8:45	215	63	74	69	16	22	459
9:00	248	68	85	83	16	26	526

**Turning-Movement Counts by 15-Minute Interval**

15 MINUTES ENDING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
7:15	26	10	4	9	1	2	52
7:30	19	13	7	4	1	7	51
7:45	38	11	13	12	2	3	79
8:00	43	11	11	15	1	2	83
8:15	36	8	11	12	2	4	73
8:30	24	4	15	10	5	2	60
8:45	29	6	13	7	4	2	61
9:00	33	5	11	14	0	4	67
TOTAL	248	68	85	83	16	26	526

**Hourly Total**

HOUR BEGINNING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
7:00	126	45	35	40	5	14	265
7:15	136	43	42	43	6	16	286
7:30	141	34	50	49	10	11	295
7:45	132	29	50	44	12	10	277
8:00	122	23	50	43	11	12	261

**AM Peak Hour**

HOUR BEGINNING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
7:30	141	34	50	49	10	11	295
PHF (Peak-Hour Factor)	0.82	0.77	0.83	0.82	0.50	0.69	0.89
	0.81		0.95		0.75		
Percent Large Vehicles	2.1%	0.0%	6.0%	6.1%	20.0%	0.0%	3.7%

**TRAFFIC STUDY OF OLD NOVI RD / 13 MILE RD / SOUTH LAKE DR**  
**PM Turning-Movement Count - All Traffic**  
 Wednesday, December 10, 2008

**Cumulative Turning-Movement Counts**

15 MINUTES ENDING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
4:15	11	2	9	34	17	11	84
4:30	32	9	24	66	40	30	201
4:45	47	13	31	93	49	42	275
5:00	83	17	42	141	66	57	406
5:15	109	28	48	201	85	77	548
5:30	127	39	59	235	102	97	659
5:45	149	47	70	284	119	116	785
6:00	158	53	82	322	140	128	883

**Turning-Movement Counts by 15-Minute Interval**

15 MINUTES ENDING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
4:15	11	2	9	34	17	11	84
4:30	21	7	15	32	23	19	117
4:45	15	4	7	27	9	12	74
5:00	36	4	11	48	17	15	131
5:15	26	11	6	60	19	20	142
5:30	18	11	11	34	17	20	111
5:45	22	8	11	49	17	19	126
6:00	9	6	12	38	21	12	98
TOTAL	158	53	82	322	140	128	883

**Hourly Total**

HOUR BEGINNING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
4:00	83	17	42	141	66	57	406
4:15	98	26	39	167	68	66	464
4:30	95	30	35	169	62	67	458
4:45	102	34	39	191	70	74	510
5:00	75	36	40	181	74	71	477

**PM Peak Hour**

HOUR BEGINNING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
4:45	102	34	39	191	70	74	510
PHF (Peak-Hour Factor)	0.71	0.77	0.89	0.80	0.92	0.93	0.90
	0.85		0.87		0.92		
Percent Large Vehicles	0.0%	0.0%	0.0%	0.5%	0.0%	1.4%	0.4%

**TRAFFIC STUDY OF OLD NOVI RD / 13 MILE RD / SOUTH LAKE DR**  
**AM Turning-Movement Count - Large Vehicles Only**  
 Wednesday, December 10, 2008

**Cumulative Turning-Movement Counts**

15 MINUTES ENDING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
7:15	0	0	0	0	0	0	0
7:30	1	0	0	0	0	0	1
7:45	3	0	1	0	0	0	4
8:00	3	0	2	3	0	0	8
8:15	4	0	3	3	1	0	11
8:30	4	0	3	3	2	0	12
8:45	5	1	3	4	3	0	16
9:00	7	1	4	7	3	2	24

**Turning-Movement Counts by 15-Minute Interval**

15 MINUTES ENDING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
7:15	0	0	0	0	0	0	0
7:30	1	0	0	0	0	0	1
7:45	2	0	1	0	0	0	3
8:00	0	0	1	3	0	0	4
8:15	1	0	1	0	1	0	3
8:30	0	0	0	0	1	0	1
8:45	1	1	0	1	1	0	4
9:00	2	0	1	3	0	2	8
TOTAL	7	1	4	7	3	2	24

**Hourly Total**

HOUR BEGINNING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
7:00	3	0	2	3	0	0	8
7:15	4	0	3	3	1	0	11
7:30	3	0	3	3	2	0	11
7:45	2	1	2	4	3	0	12
8:00	4	1	2	4	3	2	16

\* Peak hour for overall traffic:

3 school buses SEB LT, 3 school buses SWB RT, & 2 SU trucks NEB LT.

**AM Peak Hour**

HOUR BEGINNING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
8:00	4	1	2	4	3	2	16
PHF (Peak-Hour Factor)	0.50	0.25	0.50	0.33	0.75	0.25	0.50
	0.63		0.38		0.63		

**TRAFFIC STUDY OF OLD NOVI RD / 13 MILE RD / SOUTH LAKE DR**  
**PM Turning-Movement Count - Large Vehicles Only**  
 Wednesday, December 10, 2008

**Cumulative Turning-Movement Counts**

15 MINUTES ENDING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
4:15	0	0	0	3	0	0	3
4:30	1	0	0	3	1	0	5
4:45	1	0	0	4	1	0	6
5:00	1	0	0	4	1	0	6
5:15	1	0	0	4	1	0	6
5:30	1	0	0	5	1	1	8
5:45	1	0	0	5	1	1	8
6:00	1	0	0	5	1	1	8

**Turning-Movement Counts by 15-Minute Interval**

15 MINUTES ENDING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
4:15	0	0	0	3	0	0	3
4:30	1	0	0	0	1	0	2
4:45	0	0	0	1	0	0	1
5:00	0	0	0	0	0	0	0
5:15	0	0	0	0	0	0	0
5:30	0	0	0	1	0	1	2
5:45	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0
<b>TOTAL</b>	1	0	0	5	1	1	8

**Hourly Total**

HOUR BEGINNING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
4:00	1	0	0	4	1	0	6
4:15	1	0	0	1	1	0	3
4:30	0	0	0	2	0	1	3
4:45	0	0	0	1	0	1	2
5:00	0	0	0	1	0	1	2

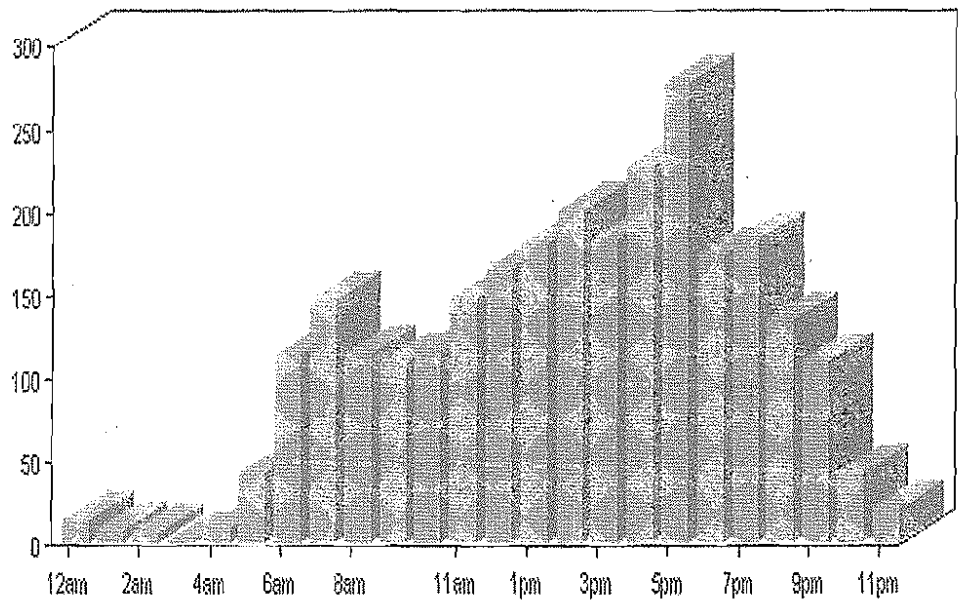
@ 4:00: 1 bus SEB LT, 3 buses & UPS trk SWB RT, & 1 bus NEB LT.

\* Peak hour for overall traffic:  
1 UPS truck SWB RT.

**PM Peak Hour**

HOUR BEGINNING	SEB South Lake		SWB 13 Mile		NEB Old Novi		TOTAL
	LT	RT	TH	RT	LT	TH	
4:00	1	0	0	4	1	0	6
PHF (Peak-Hour Factor)	0.25	#DIV/0!	#DIV/0!	0.33	0.25	#DIV/0!	0.50
	0.25		0.33		0.25		

Date of Count : 5/17/2004 to 5/18/2004  
 Day of Week : Monday  
 County : Oakland  
 Community : Novi  
 PR Number : 621910  
 From Mile Point : 0.000  
 To Mile Point : 0.445  
 24 Hour Count : 2,736



Hour	Count	Hour	Count	Hour	Count
12 am - 1 am	14	8 am - 9 am	115	4 pm - 5 pm	227
1 am - 2 am	8	9 am - 10 am	110	5 pm - 6 pm	278
2 am - 3 am	7	10 am - 11 am	116	6 pm - 7 pm	174
3 am - 4 am	3	11 am - 12 pm	149	7 pm - 8 pm	183
4 am - 5 am	10	12 pm - 1 pm	166	8 pm - 9 pm	134
5 am - 6 am	42	1 pm - 2 pm	181	9 pm - 10 pm	109
6 am - 7 am	115	2 pm - 3 pm	202	10 pm - 11 pm	43
7 am - 8 am	147	3 pm - 4 pm	182	11 pm - 12 am	21

$$K = \frac{278}{2,736} = 0.102$$

Figure A-1. Two-Way Traffic Volumes in 2004 on Old Novi Road (SEMCOG)

**APPENDIX B:**  
**CRASH DATA**

**Table B-1. Summary of 2005-2007 Crashes at Old Novi / 13 Mile / South Lake**

#	Date	Location	Crash Type						Condition		Severity (# of Persons)						
			Angle		Head-On		Side Swipe		Rear	Other	Light	Weather	K	A	B	C	O
			Dir 1	Dir 2	Straight	LT	Dir 1	Dir 2									
1	1-18-05	Driveway 30' S of 13 Mile					SB	SB			Day	Dry					3
2	2-05-05	Driveway 15' W of Old Novi							Backed into WB		Dark	Dry					4
3	3-29-05	Center of intersection							Hit rear of WB		Day	Dry					2
4	6-06-05	SLD 15' NW of Old Novi								<< NB H-O LT?	Day	Dry					3
5	6-25-05	13 Mile 60' E of Old Novi								Non-collison	Dark	Dry	1				2
6	7-03-05	Old Novi 25' S of 13 Mile							Hit rear of NB		Day	Dry					5
7	7-18-05	13 Mile 10' E of Old Novi							Hit rear of WB		Day	Wet					2
8	8-05-05	Old Novi 10' N of 13 Mile	EBL	NBT							Day	Dry			1	1	
9	9-08-05	13 Mile 10' W of Old Novi	WB	SB							Day	Dry					2
10	10-11-05	Old Novi 1' S of SLD							Hit rear of EB		Day	Dry			1	2	
11	12-31-05	13 Mile 75' NE of Old Novi	EB	WB							Dark	Snowy					4
12	1-22-06	Old Novi 10' N of 13 Mile							Hit rear of SB		Dark	Dry					4
13	1-27-06	Center of intersection				EB					Day	Dry					1
14	2-03-06	Old Novi 50' N of 13 Mile							Hit rear of SB		Dawn	Wet					3
15	4-28-06	13 Mile 100' E of Old Novi							3 WB vehicles		Day	Dry			2	3	
16	5-03-06	13 Mile 3' E of Old Novi				EB					Dark	Dry					2
17	9-25-06	Old Novi 10' NE of 13 Mile	SB	NB							Day	Dry					2
18	10-03-06	Center of intersection.								< 4 veh all 3 dir.	Day	Dry					5
19	10-04-07	SLD 12' NW of 13 Mile								Backed into NB	Dark	Dry					2
Total # of Persons											0	1	0	4	52		

**Intersection Crash Report**  
 William Stimpson (Old Novi, 13 Mile Rd, South Lake Dr)  
 Dates: 01/01/2005 - 12/31/2007  
 Roads: Old Novi Rd / S (0 - 0.04)  
 13 Mile Rd / W (1.98 - 2.06)

Criteria:  
**TIA Traffic Crash Analysis Tool**

Report Printed On 12/17/2008

**#1 Location:** NOVI (0.01) 30 feet S of 13 MILE **Crash ID:** 5887920  
**Crash Date:** 01/18/2005 **Day:** Tue **Hour:** 1pm **Weather:** clear **Roadway:** dry **Light:** day  
**Injuries K:** 0 **Inj A:** 0 **Inj B:** 0 **Inj C:** 0 **Inj O:** 3 **How:** ss-same  
**CVT:** NOVI **Area:** drivwy at inter **HBD:** N **Drugs:** N **Complaint No:** 05003583

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	S	change lanes	veh in transpt	none	none	none	fail to yield	car	lftside
2	S	go straight	veh in transpt	none	none	none	none	car	rtside

**#2 Location:** 13MILE (2.03) 15 feet W of NOVI **Crash ID:** 5928917  
**Crash Date:** 02/05/2005 **Day:** Sat **Hour:** 7pm **Weather:** clear **Roadway:** dry **Light:** dark/unltd  
**Injuries K:** 0 **Inj A:** 0 **Inj B:** 0 **Inj C:** 0 **Inj O:** 4 **How:** rr-end  
**CVT:** NOVI **Area:** drivwy at inter **HBD:** N **Drugs:** N **Complaint No:** 057090

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	E	backing	veh in transpt	none	none	none	improp backing	car	ctrrear
2	W	stop on road	veh in transpt	none	none	none	none	car	ctrfrnt

**#3 Location:** W 13 MILE RD (2.03) 0 feet X of NOVI RD **Crash ID:** 6008782  
**Crash Date:** 03/29/2005 **Day:** Tue **Hour:** 4pm **Weather:** clear **Roadway:** dry **Light:** day  
**Injuries K:** 0 **Inj A:** 0 **Inj B:** 0 **Inj C:** 0 **Inj O:** 2 **How:** rr-end  
**CVT:** NOVI **Area:** inter other **HBD:** N **Drugs:** N **Complaint No:** 0516236

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	W	go straight	loss of control	veh in transpt	none	none	unable to stop	car	ctrfrnt
2	W	stop on road	veh in transpt	none	none	none	none	pickup	ctrrear

**#4 Location:** S LAKE DR (1.36) 15 feet NW of NOVI RD **Crash ID:** 6074294  
**Crash Date:** 06/06/2005 **Day:** Mon **Hour:** 3pm **Weather:** clear **Roadway:** dry **Light:** day  
**Injuries K:** 0 **Inj A:** 0 **Inj B:** 0 **Inj C:** 0 **Inj O:** 3 **How:** other  
**CVT:** NOVI **Area:** unkn **HBD:** N **Drugs:** N **Complaint No:** 0529362

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	N	left turn	veh in transpt	none	none	none	unknown	car	ctrfrnt
2	S	go straight	veh in transpt	none	none	none	unknown	car	lftside

**#5 Location:** E 13 MILE RD (2.02) 60 feet E of NOVI RD **Crash ID:** 6062228  
**Crash Date:** 06/25/2005 **Day:** Sat **Hour:** 0am **Weather:** clear **Roadway:** dry **Light:** dark/unltd  
**Injuries K:** 0 **Inj A:** 1 **Inj B:** 0 **Inj C:** 0 **Inj O:** 2 **How:** other  
**CVT:** NOVI **Area:** strght.unrel **HBD:** Y **Drugs:** N **Complaint No:** 0533081

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	E	go straight	othr noncollisn	none	none	none	unknown	car	none



#6 Location: N NOVI RD (0.01) 25 feet S of 13 MILE RD Crash ID: 6075044  
 Crash Date: 07/03/2005 Day: Sun Hour: 2pm Weather: clear Roadway: dry Light: day  
 Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 0 Inj O: 5 How: rr-end  
 CVT: NOVI Area: inter other HBD: N Drugs: N Complaint No: 0534841

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	N	start on road	veh in transpt	none	none	none	unable to stop	car	ctrfrnt
2	N	stop on road	veh in transpt	none	none	none	none	car	ctrrear

#7 Location: 13 MILE RD (2.03) 10 feet E of NOVI RD Crash ID: 6074268  
 Crash Date: 07/18/2005 Day: Mon Hour: 5pm Weather: cloudy Roadway: wet Light: day  
 Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 0 Inj O: 2 How: rr-rt  
 CVT: NOVI Area: strght.unrel HBD: N Drugs: N Complaint No: 0537990

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	W	right turn	veh in transpt	none	none	none	unable to stop	pickup	ctrfrnt
2	W	stop on road	veh in transpt	none	none	none	none	car	ctrrear

#8 Location: NOVI (0.00) 10 feet N of 13 MILE RD Crash ID: 6079565  
 Crash Date: 08/05/2005 Day: Fri Hour: 2pm Weather: cloudy Roadway: dry Light: day  
 Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 1 Inj O: 1 How: angle  
 CVT: NOVI Area: w/i intersection HBD: N Drugs: N Complaint No: 0541452

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	E	left turn	veh in transpt	none	none	none	fail to yield	pickup	rtfrnt
2	N	go straight	veh in transpt	none	none	none	none	van	ctrfrnt

#9 Location: 13 MILE RD (2.03) 10 feet W of NOVI RD Crash ID: 6143915  
 Crash Date: 09/08/2005 Day: Thu Hour: 1pm Weather: clear Roadway: dry Light: day  
 Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 0 Inj O: 2 How: angle  
 CVT: NOVI Area: w/i intersection HBD: N Drugs: N Complaint No: 0547970

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	W	go straight	veh in transpt	none	none	none	disrgd traf ctl	car	rtrear
2	S	go straight	veh in transpt	none	none	none	none	car	ctrfrnt

#10 Location: NOVI RD (0.00) 1 feet SW of S LAKE DR Crash ID: 6153228  
 Crash Date: 10/11/2005 Day: Tue Hour: 3pm Weather: cloudy Roadway: dry Light: day  
 Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 1 Inj O: 2 How: rr-end  
 CVT: NOVI Area: w/i intersection HBD: N Drugs: N Complaint No: 05054634

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	E	go straight	veh in transpt	none	none	none	unable to stop	van	ctrfrnt
2	E	stop on road	veh in transpt	none	none	none	none	car	ctrrear

#11 Location: 13 MILE (2.02) 75 feet NE of NOVI RD Crash ID: 6228836  
 Crash Date: 12/31/2005 Day: Sat Hour: 1am Weather: snow Roadway: snowy Light: dark/lt  
 Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 0 Inj O: 4 How: angle

CVT: NOVI Area: inter other HBD: N Drugs: N Complaint No: 0571913

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	E	right turn	loss of control	x center/median	veh in transpt	none	too fast	car	ctrfrnt
2	W	stop on road	veh in transpt	none	none	none	none	pickup	ctrfrnt

#12 Location: NOVI (0.00) 10 feet N of 13 MILE Crash ID: 6254482

Crash Date: 01/22/2006 Day: Sun Hour: 2am Weather: clear Roadway: dry Light: dark/ltd  
Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 0 Inj O: 4 How: rr-end  
CVT: NOVI Area: inter other HBD: N Drugs: N Complaint No: 2155306

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	S	stop on road	veh in transpt	none	none	none	none	pickup	rtrear
2	S	go straight	ran off road/r	none	none	none	negl drving	car	ctrfrnt

#13 Location: N NOVI (0.00) 0 feet X of 13 MILE Crash ID: 6255714

Crash Date: 01/27/2006 Day: Fri Hour: 3pm Weather: clear Roadway: dry Light: day  
Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 0 Inj O: 1 How: ho-lt  
CVT: NOVI Area: w/i intersection HBD: N Drugs: N Complaint No: 0626430

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	E	left turn	veh in transpt	none	none	none	none	pickup	rtside
2	N	go straight	veh in transpt	none	none	none	none	smtruck	ctrfrnt

#14 Location: S NOVI RD (0.00) 50 feet N of 13 MILE RD Crash ID: 6261750

Crash Date: 02/03/2006 Day: Fri Hour: 8am Weather: rain Roadway: wet Light: dawn  
Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 0 Inj O: 3 How: rr-lt  
CVT: NOVI Area: strght.unrel HBD: N Drugs: N Complaint No: 067953

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	S	go straight	veh in transpt	none	none	none	unable to stop	pickup	rtfrnt
2	S	slow/stop on rd	veh in transpt	none	none	none	none	car	lftrear

#15 Location: 13 MILE RD (2.01) 100 feet E of NOVI RD Crash ID: 6332080

Crash Date: 04/28/2006 Day: Fri Hour: 6pm Weather: clear Roadway: dry Light: day  
Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 2 Inj O: 3 How: rr-end  
CVT: NOVI Area: inter other HBD: N Drugs: N Complaint No: 0627662

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	W	go straight	parked vehicle	none	none	none	unable to stop	van	ctrfrnt
2	W	stop on road	veh in transpt	none	none	none	none	car	ctrfrnt
3	UN	unknown	none	none	none	none	none	unkn	unkn

#16 Location: 13 MILE RD (2.03) 3 feet E of NOVI RD Crash ID: 6334341

Crash Date: 05/03/2006 Day: Wed Hour: 11pm Weather: clear Roadway: dry Light: dark/unltd  
Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 0 Inj O: 2 How: ho-lt  
CVT: NOVI Area: w/i intersection HBD: N Drugs: N Complaint No: 0629237

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
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1	E	go straight	veh in transpt	none	none	none	disrgd traf cti	car	ctrfrnt
2	E	left turn	veh in transpt	none	none	none	none	car	ctrfrnt

#17 Location: NOVI RD (0.00) 10 feet NE of 13 MILE Crash ID: 6448954  
 Crash Date: 09/25/2006 Day: Mon Hour: 2pm Weather: clear Roadway: dry Light: day  
 Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 0 Inj O: 2 How: angle  
 CVT: NOVI Area: w/i intersection HBD: N Drugs: N Complaint No: 0664520

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	S	unknown	none	none	none	none	none	car	rtslide
2	N	unknown	none	none	none	none	none	car	ctrfrnt

#18 Location: NOVI RD (0.00) 0 feet X of 13 MILE RD Crash ID: 6455943  
 Crash Date: 10/03/2006 Day: Tue Hour: 4pm Weather: clear Roadway: dry Light: day  
 Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 0 Inj O: 5 How: other  
 CVT: NOVI Area: w/i intersection HBD: N Drugs: N Complaint No: 0666249

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	E	left turn	veh in transpt	none	none	none	fail to yield	van	rtfrnt
2	N	go straight	veh in transpt	separ of units	veh in transpt	none	none	pickup	lftfrnt
3	W	stop on road	veh in transpt	separ of units	veh in transpt	none	none	car	lftfrnt
4	W	stop on road	veh in transpt	none	none	none	none	car	ctrfrnt

#19 Location: S LAKE DR (1.36) 12 feet NW of W 13 MILE RD Crash ID: 6786231  
 Crash Date: 10/04/2007 Day: Thu Hour: 9pm Weather: clear Roadway: dry Light: dark/ltl  
 Injuries K: 0 Inj A: 0 Inj B: 0 Inj C: 0 Inj O: 2 How: other  
 CVT: NOVI Area: drivwy at inter HBD: N Drugs: Y Complaint No: 0759905

Unit No	Veh Dir	Action Prior	Event 1	Event 2	Event 3	Event 4	Haz Action	Veh Type	Damage
1	S	backing	veh in transpt	none	none	none	other	van	ctrrear
2	N	stop on road	veh in transpt	none	none	none	none	car	rtrear

Time Period	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Unknown	Totals
12a - 1a	0	0	0	0	0	0	1	0	1
1a - 2a	0	0	0	0	0	0	1	0	1
2a - 3a	1	0	0	0	0	0	0	0	1
3a - 4a	0	0	0	0	0	0	0	0	0
4a - 5a	0	0	0	0	0	0	0	0	0
5a - 6a	0	0	0	0	0	0	0	0	0
6a - 7a	0	0	0	0	0	0	0	0	0
7a - 8a	0	0	0	0	0	0	0	0	0
8a - 9a	0	0	0	0	0	1	0	0	1
9a - 10a	0	0	0	0	0	0	0	0	0
10a - 11a	0	0	0	0	0	0	0	0	0
11a - 12p	0	0	0	0	0	0	0	0	0
12p - 1p	0	0	0	0	0	0	0	0	0
1p - 2p	0	0	1	0	1	0	0	0	2
2p - 3p	1	1	0	0	0	1	0	0	3
3p - 4p	0	1	1	0	0	1	0	0	3
4p - 5p	0	0	2	0	0	0	0	0	2
5p - 6p	0	1	0	0	0	0	0	0	1
6p - 7p	0	0	0	0	0	1	0	0	1
7p - 8p	0	0	0	0	0	0	1	0	1
8p - 9p	0	0	0	0	0	0	0	0	0
9p - 10p	0	0	0	0	1	0	0	0	1
10p - 11p	0	0	0	0	0	0	0	0	0
11p - 12a	0	0	0	1	0	0	0	0	1
Unknown	0	0	0	0	0	0	0	0	0
<b>Totals</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>1</b>	<b>2</b>	<b>4</b>	<b>3</b>	<b>0</b>	<b>19</b>

### Crash Type

Count	Type
4	angle
0	head on
2	ho-lt
4	other
6	rr-end
1	rr-lt
1	rr-rt
0	single
0	ss-opp
1	ss-same
0	unknown
<b>Totals: 19</b>	

### Light Condition

Count	Type
3	dark/lt
3	dark/unltd
1	dawn
12	day
0	dusk
0	other
0	unkn
<b>Totals: 19</b>	

### Weather

Count	Type
12	clear
1	cloudy
0	fog/smke
3	rain
0	sev wind
0	sleet
3	snow
0	unkn
0	unkn
<b>Totals: 19</b>	

### Road Condition

Count	Type
0	debris
16	dry
0	icy
0	muddy
0	slushy
1	snowy
0	unkn
0	unkn
2	wet
<b>Totals: 19</b>	

### Vehicle Type

Count	Type
25	car
0	go-cart
0	mcycle
0	moped
0	orv/atv
0	other
8	pickup
1	smtruck
0	snowmobile
0	truck/bus
1	unkn
5	van
<b>Totals: 40</b>	

### Crashes By Month

Count	Type
3	January
2	February
1	March
1	April
1	May
2	June
2	July
1	August
2	September
3	October
0	November
1	December
<b>Totals: 19</b>	

### Hazardous Action

Count	Type
2	disrgd traf ctl
3	fail to yield
1	improp backing
0	improp lane use
0	improp passing
0	improp turn
0	improp/no signl
0	left of center
1	negl driving
22	none
1	other
0	reck driving
1	too fast
0	too slow
6	unable to stop
3	unknown
0	wrong way
<b>Totals: 40</b>	

### Crash Severity

	FATAL	A	B	C	No Inj	Total
Persons	0	1	0	4	52	57
Crashes	0	1	0	3	15	19

### Alcohol in Crashes

	FATAL	PI	PD	Total
Drinking	0	1	0	1
Not Drinking	0	3	15	18
<b>Total</b>	<b>0</b>	<b>4</b>	<b>15</b>	<b>19</b>

**APPENDIX C:**

**PEAK-HOUR SIGNAL WARRANT +  
GUIDELINES FOR MULTIWAY STOP APPLICATIONS**  
*(Excerpts from 2005 Michigan Manual of Uniform Traffic Control Devices)*

**Guidance:**

The combination of Conditions A and B is intended for application at locations where Condition A is not satisfied and Condition B is not satisfied and should be applied only after an adequate trial of other alternatives that could cause less delay and inconvenience to traffic has failed to solve the traffic problems.

**Standard:**

The need for a traffic control signal shall be considered if an engineering study finds that both of the following conditions exist for each of any 8 hours of an average day:

- A. The vehicles per hour given in both of the 80 percent columns of Condition A in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection; and
- B. The vehicles per hour given in both of the 80 percent columns of Condition B in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection.

These major-street and minor-street volumes shall be for the same 8 hours for each condition; however, the 8 hours satisfied in Condition A shall not be required to be the same 8 hours satisfied in Condition B. On the minor street, the higher volume shall not be required to be on the same approach during each of the 8 hours.

**Option:**

If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 70 km/h or exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, the traffic volumes in the 56 percent columns in Table 4C-1 may be used in place of the 80 percent columns.

**Section 4C.03 Warrant 2, Four-Hour Vehicular Volume****Support:**

The Four-Hour Vehicular Volume signal warrant conditions are intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal.

**Standard:**

The need for a traffic control signal shall be considered if an engineering study finds that, for each of any 4 hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) all fall above the applicable curve in Figure 4C-1 for the existing combination of approach lanes. On the minor street, the higher volume shall not be required to be on the same approach during each of these 4 hours.

**Option:**

If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 70 km/h or exceeds 40 mph or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 4C-2 may be used in place of Figure 4C-1.

**Section 4C.04 Warrant 3, Peak Hour (Combines previous Warrants 10, 11)****Support:**

The Peak Hour signal warrant is intended for use at a location where traffic conditions are such that for a minimum of 1 hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street.

**Standard:**

This signal warrant shall be applied only in unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.

The need for a traffic control signal shall be considered if an engineering study finds that the criteria in either of the following two categories are met:

- A. If all three of the following conditions exist for the same 1 hour (any four consecutive 15-minute periods) of an average day:
  1. The total stopped time delay experienced by the traffic on one minor-street approach (one direction only) controlled by a STOP sign equals or exceeds: 4 vehicle-hours for a one-lane approach; or 5 vehicle-hours for a two-lane approach, and

2. The volume on the same minor-street approach (one direction only) equals or exceeds 100 vehicles per hour for one moving lane of traffic or 150 vehicles per hour for two moving lanes, and .
  3. The total entering volume serviced during the hour equals or exceeds 650 vehicles per hour for intersections with three approaches or 800 vehicles per hour for intersections with four or more approaches.
- B. The plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4C-3 for the existing combination of approach lanes.

**Option:**

If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 70 km/h or exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 4C-4 may be used in place of Figure 4C-3 to satisfy the criteria in the second category of the Standard.

### **Section 4C.05 Warrant 4, Pedestrian Volume**

**Support:**

The Pedestrian Volume signal warrant is intended for application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street.

**Standard:**

The need for a traffic control signal at an intersection or midblock crossing shall be considered if an engineering study finds that both of the following criteria are met:

- A. The pedestrian volume crossing the major street at an intersection or midblock location during an average day is 100 or more for each of any 4 hours or 190 or more during any 1 hour; and
- B. There are fewer than 60 gaps per hour in the traffic stream of adequate length to allow pedestrians to cross during the same period when the pedestrian volume criterion is satisfied. Where there is a divided street having a median of sufficient width for pedestrians to wait, the requirement applies separately to each direction of vehicular traffic.

The Pedestrian Volume signal warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 90 m (300 ft), unless the proposed traffic control signal will not restrict the progressive movement of traffic.

If this warrant is met and a traffic control signal is justified by an engineering study, the traffic control signal shall be equipped with pedestrian signal heads conforming to requirements set forth in Chapter 4E.

**Guidance:**

If this warrant is met and a traffic control signal is justified by an engineering study, then:

- A. If at an intersection, the traffic control signal should be traffic-actuated and should include pedestrian detectors.
- B. If at a nonintersection crossing, the traffic control signal should be pedestrian-actuated, parking and other sight obstructions should be prohibited for at least 30 m (100 ft) in advance of and at least 6.1 m (20 ft) beyond the crosswalk, and the installation should include suitable standard signs and pavement markings.
- C. Furthermore, if installed within a signal system, the traffic control signal should be coordinated.

**Option:**

The criterion for the pedestrian volume crossing the major roadway may be reduced as much as 50 percent if the average crossing speed of pedestrians is less than 1.2 m/sec (4 ft/sec).

A traffic control signal may not be needed at the study location if adjacent coordinated traffic control signals consistently provide gaps of adequate length for pedestrians to cross the street, even if the rate of gap occurrence is less than one per minute.

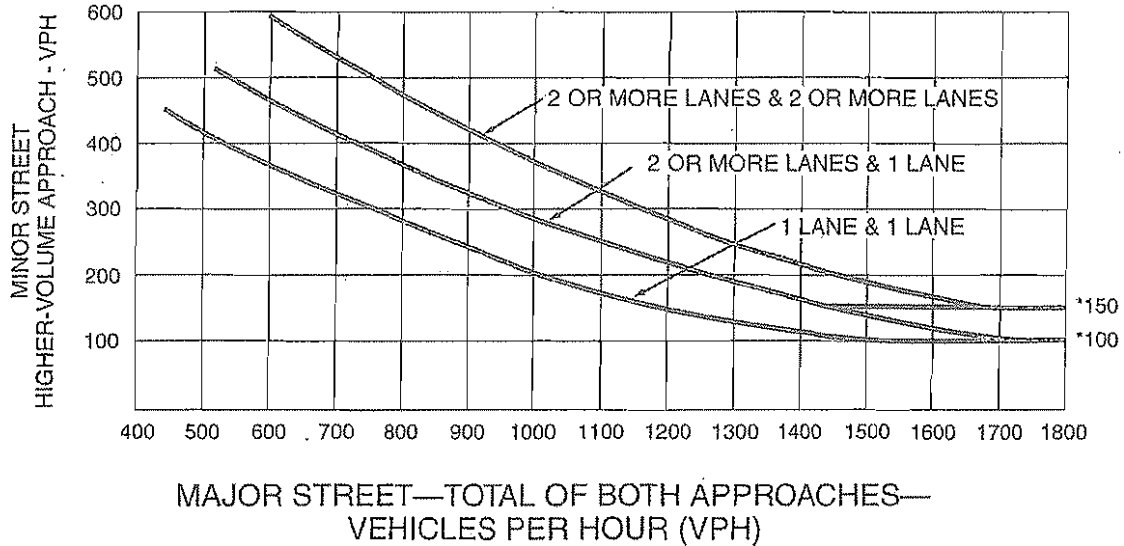
### **Section 4C.06 Warrant 5, School Crossing**

**Support:**

The School Crossing signal warrant is intended for application where the fact that school children cross the major street is the principal reason to consider installing a traffic control signal.



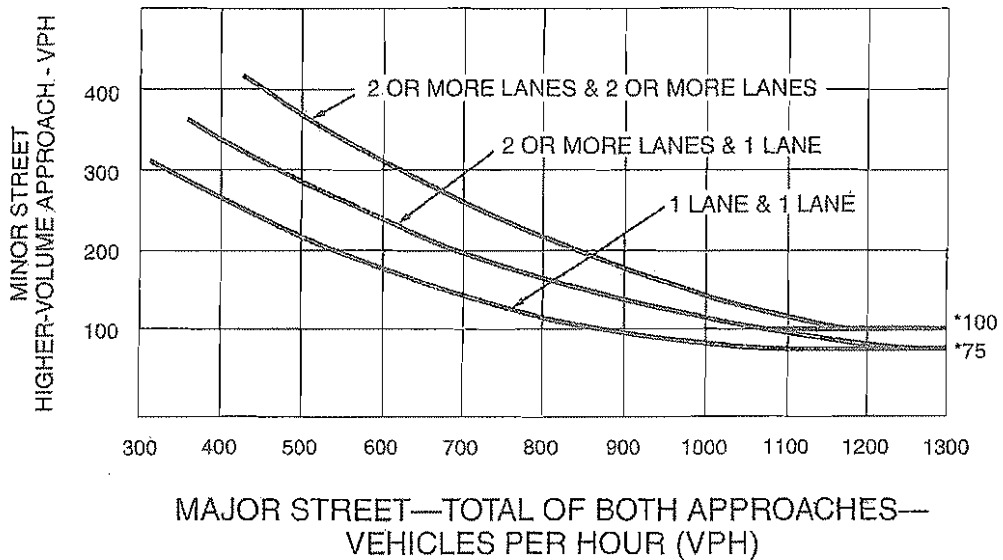
Figure 4C-3. Warrant 3, Peak Hour



\*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Figure 4C-4. Warrant 3, Peak Hour (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



\*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

Once the decision has been made to install two-way stop control, the decision regarding the appropriate street to stop should be based on engineering judgment. In most cases, the street carrying the lowest volume of traffic should be stopped.

A STOP sign should not be installed on the major street unless justified by a traffic engineering study.

Support:

The following are considerations that might influence the decision regarding the appropriate street upon which to install a STOP sign where two streets with relatively equal volumes and/or characteristics intersect:

- A. Stopping the direction that conflicts the most with established pedestrian crossing activity or school walking routes;
- B. Stopping the direction that has obscured vision, dips, or bumps that already require drivers to use lower operating speeds;
- C. Stopping the direction that has the longest distance of uninterrupted flow approaching the intersection; and
- D. Stopping the direction that has the best sight distance to conflicting traffic.

The use of the STOP sign at highway-railroad grade crossings is described in Section 8B.08. The use of the STOP sign at highway-light rail transit grade crossings is described in Section 10C.04.

### **Section 2B.06 STOP Sign Placement**

Standard:

The STOP sign shall be installed on the right side of the approach to which it applies. When the STOP sign is installed at this required location and the sign visibility is restricted, a Stop Ahead sign (see Section 2C.29) shall be installed in advance of the STOP sign.

The STOP sign shall be located as close as practical to the intersection it regulates, while optimizing its visibility to the road user it is intended to regulate.

STOP signs and YIELD signs shall not be mounted on the same post.

Guidance:

Other than a DO NOT ENTER sign, no sign should be mounted back-to-back with a STOP sign in a manner that obscures the shape of the STOP sign.

Support:

Section 2A.16 contains additional information about separate and combined mounting of other signs with STOP signs.

Guidance:

Stop lines, when used to supplement a STOP sign, should be located at the point where the road user should stop (see Section 3B.16).

If only one STOP sign is installed on an approach, the STOP sign should not be placed on the far side of the intersection.

Where two roads intersect at an acute angle, the STOP sign should be positioned at an angle, or shielded, so that the legend is out of view of traffic to which it does not apply.

Where there is a marked crosswalk at the intersection, the STOP sign should be installed in advance of the crosswalk line nearest to the approaching traffic.

Option:

At wide-throat intersections or where two or more approach lanes of traffic exist on the signed approach, observance of the stop control may be improved by the installation of an additional STOP sign on the left side of the road and/or the use of a stop line. At channelized intersections, the additional STOP sign may be effectively placed on a channelizing island.

Support:

Figure 2A-2 shows examples of some typical placements of STOP signs.

### **Section 2B.07 Multiway Stop Applications**

Support:

Multiway stop control can be useful as a safety measure at intersections if certain traffic conditions exist. Safety concerns associated with multiway stops include pedestrians, bicyclists, and all road users expecting other road users to stop. Multiway stop control is used where the volume of traffic on the intersecting roads is approximately equal.

The restrictions on the use of STOP signs described in Section 2B.05 also apply to multiway stop applications.

**Guidance:**

The decision to install multiway stop control should be based on an engineering study.

The following criteria should be considered in the engineering study for a multiway STOP sign installation:

- A. Where traffic control signals are justified, the multiway stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.
- B. A crash problem, as indicated by 5 or more reported crashes in a 12-month period that are susceptible to correction by a multiway stop installation. Such crashes include right- and left-turn collisions as well as right-angle collisions.
- C. Minimum volumes:
  1. The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day, and
  2. The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour, but
  3. If the 85th-percentile approach speed of the major-street traffic exceeds 65 km/h or exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the above values.
- D. Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.

**Option:**

Other criteria that may be considered in an engineering study include:

- A. The need to control left-turn conflicts;
- B. The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes;
- C. Locations where a road user, after stopping, cannot see conflicting traffic and is not able to reasonably safely negotiate the intersection unless conflicting cross traffic is also required to stop; and
- D. An intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multiway stop control would improve traffic operational characteristics of the intersection.

**Section 2B.08 YIELD Sign (R1-2)****Standard:**

The **YIELD (R1-2) sign** (see Figure 2B-1) shall be a downward-pointing equilateral triangle with a wide red border and the legend **YIELD** in red on a white background.

**Support:**

The **YIELD** sign assigns right-of-way to traffic on certain approaches to an intersection. Vehicles controlled by a **YIELD** sign need to slow down or stop when necessary to avoid interfering with conflicting traffic.

**Section 2B.09 YIELD Sign Applications****Option:**

**YIELD** signs may be used instead of **STOP** signs if engineering judgment indicates that one or more of the following conditions exist:

- A. When the ability to see all potentially conflicting traffic is sufficient to allow a road user traveling at the posted speed, the 85th-percentile speed, or the statutory speed to pass through the intersection or to stop in a reasonably safe manner.
- B. If controlling a merge-type movement on the entering roadway where acceleration geometry and/or sight distance is not adequate for merging traffic operation.
- C. The second crossroad of a divided highway, where the median width at the intersection is 9 m (30 ft) or greater. In this case, a **STOP** sign may be installed at the entrance to the first roadway of a divided highway, and a **YIELD** sign may be installed at the entrance to the second roadway.
- D. An intersection where a special problem exists and where engineering judgment indicates the problem to be susceptible to correction by the use of the **YIELD** sign.

**Standard:**

A **YIELD (R1-2) sign** shall be used to assign right-of-way at the entrance to a roundabout intersection.

**APPENDIX D:**  
**LEVEL OF SERVICE ANALYSES**

## INTERSECTION LEVELS OF SERVICE

Intersection capacity analyses were conducted using *Synchro 7* software, based on methodologies contained in the *Highway Capacity Manual (HCM, Transportation Research Board, 2000)*. The primary objective is to determine level of service, a qualitative measure of the "ease" of traffic flow based on average vehicular delay. Analytical models are used to estimate the average delay per vehicle for specific movements, minor approaches – and in the case of all-way stop-controlled and signalized intersections – major approaches and the overall intersection as well. These models account for lane configuration, grade, type of traffic control, traffic volume and composition, and other traffic flow parameters.

Level of service (LOS) is expressed using a letter grading scale, with A being the highest level and F being the lowest level. The following two tables define LOS, in terms of average delay per vehicle, for signalized and unsignalized intersections, respectively. Intersections include junctions of driveways and roads as well as roads and roads.

**Level of Service Criteria for Signalized Intersections**

Level of Service	Control Delay per Vehicle (seconds)
A	≤ 10
B	> 10 and ≤ 20
C	> 20 and ≤ 35
D	> 35 and ≤ 55
E	> 55 and ≤ 80
F	> 80

**Level of Service Criteria for Unsignalized Intersections**

Level of Service	Control Delay per Vehicle (seconds)
A	≤ 10
B	> 10 and ≤ 15
C	> 15 and ≤ 25
D	> 25 and ≤ 35
E	> 35 and ≤ 50
F	> 50

According to the *Highway Capacity Manual*, level of service at a two-way stop-controlled intersection is defined only for minor movements (i.e., minor approach left and right turns and major approach left turns). LOS is not defined for the intersection as a whole, since the majority of vehicles pass through the intersection without stopping and thus experience negligible delay.

It is important to realize how *HCM* methodology computes average approach delay and average intersection delay at a one- or two-way-stop-controlled intersection where left turns from the major road share a single lane with through (and possibly right-turning) traffic. In applying the equations for weighted average delay, the methodology assumes zero delay for major-road through and right-turning traffic (believing them to be negligible), but then divides by the total approach (or intersection volume). Hence, the resulting average delay per vehicle is generally significantly lower than what the average left-turn delay per left-turn vehicle would be if, in fact, the latter was actually reported by the software (it is not). Caution should therefore be used in interpreting the reported average delay per vehicle on approaches and at intersections having shared (left-through or left-through-right) lanes on the major road.

HCM Signalized Intersection Capacity Analysis  
 3: South Lake Dr & 13 Mile Rd

1/6/2009



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations	TT		T	T	T	
Volume (vph)	141	34	10	11	50	49
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.7		6.0	6.0	6.0	
Lane Util. Factor	1.00		1.00	1.00	1.00	
Frt	0.97		1.00	1.00	0.93	
Flt Protected	0.96		0.95	1.00	1.00	
Satd. Flow (prot)	1842		1583	2000	1761	
Flt Permitted	0.96		0.18	1.00	1.00	
Satd. Flow (perm)	1842		303	2000	1761	
Peak-hour factor, PHF	0.81	0.81	0.75	0.75	0.95	0.95
Adj. Flow (vph)	174	42	13	15	53	52
RTOR Reduction (vph)	10	0	0	0	39	0
Lane Group Flow (vph)	206	0	13	15	66	0
Heavy Vehicles (%)	2%	0%	20%	0%	6%	6%
Turn Type			custom			
Protected Phases	6				8	
Permitted Phases			4	4		
Actuated Green, G (s)	26.3		22.0	22.0	22.0	
Effective Green, g (s)	26.3		22.0	22.0	22.0	
Actuated g/C Ratio	0.30		0.25	0.25	0.25	
Clearance Time (s)	5.7		6.0	6.0	6.0	
Lane Grp Cap (vph)	551		76	500	440	
v/s Ratio Prot	c0.11				c0.04	
v/s Ratio Perm			c0.04	0.01		
v/c Ratio	0.37		0.17	0.03	0.15	
Uniform Delay, d1	24.4		25.9	24.9	25.7	
Progression Factor	1.00		1.00	1.00	1.00	
Incremental Delay, d2	1.9		4.8	0.1	0.7	
Delay (s)	26.3		30.7	25.0	26.4	
Level of Service	C		C	C	C	
Approach Delay (s)	26.3			27.7	26.4	
Approach LOS	C			C	C	

Intersection Summary			
HCM Average Control Delay	26.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.24		
Actuated Cycle Length (s)	88.0	Sum of lost time (s)	17.7
Intersection Capacity Utilization	26.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis  
 3: South Lake Dr & 13 Mile Rd

1/7/2009



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations	↵		↵	↑	↵	
Sign Control	Stop			Stop	Stop	
Volume (vph)	141	34	10	11	50	49
Peak Hour Factor	0.81	0.81	0.75	0.75	0.95	0.95
Hourly flow rate (vph)	174	42	13	15	53	52

Direction, Lane #	SE 1	NE 1	NE 2	SW 1
Volume Total (vph)	216	13	15	104
Volume Left (vph)	174	0	0	53
Volume Right (vph)	0	0	15	52
Hadj (s)	0.19	0.34	-0.70	-0.09
Departure Headway (s)	4.5	5.3	4.2	4.4
Degree Utilization, x	0.27	0.02	0.02	0.13
Capacity (veh/h)	778	659	818	773
Control Delay (s)	9.1	7.2	6.1	8.0
Approach Delay (s)	9.1	6.6		8.0
Approach LOS	A	A		A

Intersection Summary			
Delay		8.6	
HCM Level of Service		A	
Intersection Capacity Utilization	23.3%		ICU Level of Service A
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis  
 3: South Lake Dr & 13 Mile Rd

1/7/2009



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations	⇐		⇐	⇐	⇐	
Sign Control	Stop			Stop	Stop	
Volume (vph)	172	41	12	13	61	60
Peak Hour Factor	0.81	0.81	0.75	0.75	0.95	0.95
Hourly flow rate (vph)	212	51	16	17	64	63

Direction, Lane #	SE-1	NE-1	NE-2	SW-1
Volume Total (vph)	263	16	17	127
Volume Left (vph)	212	0	0	64
Volume Right (vph)	0	0	17	63
Hadj (s)	0.19	0.34	-0.70	-0.09
Departure Headway (s)	4.5	5.4	4.3	4.5
Degree Utilization, x	0.33	0.02	0.02	0.16
Capacity (veh/h)	766	642	790	747
Control Delay (s)	9.8	7.3	6.2	8.3
Approach Delay (s)	9.8	6.7		8.3
Approach LOS	A	A		A

Intersection Summary			
Delay		9.1	
HCM Level of Service		A	
Intersection Capacity Utilization	27.6%		ICU Level of Service
Analysis Period (min)		15	A



HCM Signalized Intersection Capacity Analysis  
 3: South Lake Dr & 13 Mile Rd

1/7/2009



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations	Y		N	↑	↓	
Volume (vph)	102	34	70	74	39	191
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.7		6.0	6.0	6.0	
Lane Util. Factor	1.00		1.00	1.00	1.00	
Frt	0.97		1.00	1.00	0.89	
Flt Protected	0.96		0.95	1.00	1.00	
Satd. Flow (prot)	1863		1900	1980	1761	
Flt Permitted	0.96		0.14	1.00	1.00	
Satd. Flow (perm)	1863		276	1980	1761	
Peak-hour factor, PHF	0.85	0.85	0.92	0.92	0.87	0.87
Adj. Flow (vph)	120	40	76	80	45	220
RTOR Reduction (vph)	13	0	0	0	153	0
Lane Group Flow (vph)	147	0	76	80	112	0
Heavy Vehicles (%)	0%	0%	0%	1%	0%	1%
Turn Type			custom			
Protected Phases	6				8	
Permitted Phases			4	4		
Actuated Green, G (s)	19.3		29.0	29.0	29.0	
Effective Green, g (s)	19.3		29.0	29.0	29.0	
Actuated g/C Ratio	0.20		0.31	0.31	0.31	
Clearance Time (s)	5.7		6.0	6.0	6.0	
Lane Grp Cap (vph)	378		84	604	538	
v/s Ratio Prot	c0.08				c0.06	
v/s Ratio Perm			c0.28	0.04		
v/c Ratio	0.39		0.90	0.13	0.21	
Uniform Delay, d1	32.8		31.7	23.9	24.5	
Progression Factor	1.00		1.00	1.00	1.00	
Incremental Delay, d2	3.0		74.4	0.5	0.9	
Delay (s)	35.8		106.1	24.3	25.4	
Level of Service	D		F	C	C	
Approach Delay (s)	35.8			64.2	25.4	
Approach LOS	D			E	C	

Intersection Summary			
HCM Average Control Delay		38.6	HCM Level of Service D
HCM Volume to Capacity ratio		0.51	
Actuated Cycle Length (s)		95.0	Sum of lost time (s) 17.7
Intersection Capacity Utilization		38.9%	ICU Level of Service A
Analysis Period (min)		15	
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis  
 3: South Lake Dr & 13 Mile Rd

1/7/2009



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations	↙		↘	↗	↔	↘
Sign Control	Stop			Stop	Stop	
Volume (vph)	102	34	70	74	39	191
Peak Hour Factor	0.85	0.85	0.92	0.92	0.87	0.87
Hourly flow rate (vph)	120	40	76	80	45	220

Direction, Lane #	SE 1	NE 1	NE 2	SW 1
Volume Total (vph)	160	76	80	264
Volume Left (vph)	120	0	0	45
Volume Right (vph)	0	0	80	220
Hadj (s)	0.15	0.00	-0.68	-0.45
Departure Headway (s)	5.0	5.3	4.6	4.2
Degree Utilization, x	0.22	0.11	0.10	0.31
Capacity (veh/h)	684	645	736	803
Control Delay (s)	9.3	7.7	6.9	9.1
Approach Delay (s)	9.3	7.3		9.1
Approach LOS	A	A		A

Intersection Summary

Delay		8.7		
HCM Level of Service		A		
Intersection Capacity Utilization		34.2%	ICU Level of Service	A
Analysis Period (min)		15		

HCM Unsignalized Intersection Capacity Analysis  
 3: South Lake Dr & 13 Mile Rd

1/7/2009



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations	↙		↙	↕	↘	
Sign Control	Stop			Stop	Stop	
Volume (vph)	124	41	85	90	48	233
Peak Hour Factor	0.85	0.85	0.92	0.92	0.87	0.87
Hourly flow rate (vph)	146	48	92	98	55	268

Direction, Lane #	SE 1	NE 1	NE 2	SW 1
Volume Total (vph)	194	92	98	323
Volume Left (vph)	146	0	0	55
Volume Right (vph)	0	0	98	268
Hadj (s)	0.15	0.00	-0.68	-0.45
Departure Headway (s)	5.2	5.5	4.8	4.4
Degree Utilization, x	0.28	0.14	0.13	0.39
Capacity (veh/h)	652	615	697	770
Control Delay (s)	10.2	8.2	7.3	10.2
Approach Delay (s)	10.2	7.8		10.2
Approach LOS	B	A		B

Intersection Summary

Delay		9.5		
HCM Level of Service		A		
Intersection Capacity Utilization		39.4%	ICU Level of Service	A
Analysis Period (min)		15		