TRAFFIC STUDY OF THE INTERSECTION OF N. PORT WASHINGTON ROAD (CTH W) AND W. HIGHLAND ROAD FOR THE CITY OF MEQUON: **JUNE 1995 FOLLOWING THE OPENING OF ST. MARY'S HOSPITAL**

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CITY OF MEQUON OZAUKEE COUNTY WISCONSIN

ORANDUM REPORT

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NO 113

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CITY OF MEQUON OZAUKEE COUNTY, WISCONSIN

Prepared by the

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SEWRPC Memorandum Report No. 113

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INTRODUCTION

On February 25, 1991, the City of Mequon requested that the Wisconsin Department of Transportation consider a traffic control signal installation and traffic channelization project at the N. Port Washington Road/W. Highland Road intersection under the Hazard Elimination Program. On June 25, 1991, the Department responded, advising the City of Mequon that Federal funding under the Hazard Elimination Program would not be available for the project as the warrants were not met for the installation of new traffic signals at this intersection. In a letter dated March 24, 1992, the City of Mequon requested the Regional Planning Commission staff to conduct a traffic study of the N. Port Washington Road/W. Highland Road intersection. On May 19, 1993, a preliminary draft of a SEWRPC Memorandum report entitled, Traffic Study of The Intersection of N. Port Washington Road (CTH W) and W. Highland Road for the City of Mequon, presenting the findings and recommendations of the requested study was transmitted to the City of Mequon for its review. That study confirmed that the traffic engineering warrants for the installation of signals at this intersection were not met.

In a letter dated October 8, 1993, the City requested the traffic count and traffic accident data be updated subsequent to the then anticipated relocation of St. Mary's Hospital from the City of Port Washington to a new location on N. Port Washington Road approximately 0.3 miles north of W. Highland Road in the City of Mequon in 1994. The letter requested that sufficient time be allowed to elapse following the opening of the hospital to permit the attendant travel patterns through the subject intersection to stabilize. Saint Mary's Hospital opened at its new location in April of 1994; and, accordingly, the Commission

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staff reevaluated the traffic conditions at the intersection in the spring of 1995.

INTERSECTION OF PORT WASHINGTON ROAD (CTH W) AND W. HIGHLAND ROAD

Central to the identification of existing traffic problems is the collection of data concerning existing roadway physical and operational characteristics, average annual daily traffic volumes, peak hour traffic volumes and turning movements, and a history of motor vehicle accident patterns and frequencies.

Jurisdictional Classification

North Port Washington Road (CTH W) at its intersection with W. Highland Road is a county trunk highway. As such, any actions taken that would substantially alter the use or capacity of the intersection of N. Port Washington Road and W. Highland Road would require the concurrence of the Ozaukee County Highway Commission.

West Highland Road, at its intersection with N. Port Washington Road, is a local trunk highway under the jurisdiction of the City of Mequon. The planned jurisdiction of W. Highland Road, under the currently adopted Ozaukee County Jurisdictional Highway System Plan, is as a county trunk highway.

Intersection Physical and Operational Characteristics

The intersection of N. Port Washington Road (CTH W) and W. Highland Road is a "four-legged" intersection. Both intersecting roadways are constructed to rural cross-sections. N. Port Washington Road north of W. Highland Road has an existing pavement width of 30 feet with 7 foot gravel shoulders and a posted speed limit of 45 miles per hour. A commercial driveway entrance is located approximately 170 feet north of the intersection on the east side of the roadway. The shoulder adjacent to the southbound lane has been paved to accommodate southbound vehicles making right turns onto W. Highland Road, and the shoulder adjacent to the northbound lane has been paved to accommodate westbound vehicles on W. Highland Road which turn right onto N. Port Washington Road.

North Port Washington Road south of W. Highland Road has an existing pavement width of 30 feet with 8 foot gravel shoulders and a posted speed limit of 45 miles per hour. A commercial driveway entrance is located approximately 225 feet south of the intersection on the west side of the roadway. The shoulder adjacent to the northbound lane has been paved to accommodate northbound vehicles making right turns onto W. Highland Road.

West Highland Road, west of N. Port Washington Road has an existing pavement width of 25 feet with 3 foot gravel shoulders and a posted speed of 35 miles per hour. A commercial driveway entrance is located approximately 95 feet west of the intersection on the south side of the roadway and a private driveway located approximately 125 feet west of the intersection on the north side of the roadway.

West Highland Road, east of N. Port Washington Road has an existing pavement width of 22 feet with 5 foot gravel shoulders and a posted speed of 35 miles per hour. There are no commercial or private driveways on W. Highland Road between N. Port Washington Road and IH 43. The configuration of the existing intersection is shown in Figure 1.

The sight distances from the stop lines on the approaches to this intersection are adequate, although vegetation located in the northwest quadrant of this intersection restricts visibility from the southbound and westbound approaches until the motorists arrives at the stop line.

While traffic at the intersection of N. Port Washington Road and W. Highland Road was controlled by stop signs on the W. Highland Road approaches only at the time of the original study in 1992, stop signs were installed on the N. Port Washington Road approaches in August of 1994. Thus, all approaches to the intersection are currently stop sign controlled. Advance signing, warning of the stop sign control is posted on each intersection approach.

Traffic Volumes

In order to evaluate the potential need for traffic control signals at this intersection under current operating conditions, the Commission staff updated the 1992 manual turning movement counts and the 24 hour machine traffic counts in

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Source: SEWRPC.

Figure 1

March, and May and June of 1995, respectively. As in 1992, data were collected from 6:00 a.m. to 6:00 p.m. This time period included both the morning and evening peak hours of traffic flow. For comparative purposes both the 1992 and the 1995 morning and evening peak hour manual turning movement counts are shown in Figure 2 along with the estimated 1992 and 1995 average weekday turning movement volumes.

Based upon the 24-hour machine traffic counts, approximately 9,650 vehicles entered the intersection on an average weekday in 1992. By 1995, approximately 12,160 vehicles entered the intersection on an average weekday, an increase of about 26 percent compared to 1992. Based upon the 12-hour manual turning movement counts, the number of vehicles entering the intersection between 6:00 a.m. and 6:00 p.m. was 6,610 in 1992. This number had increased to approximately 9,350 in 1995, or by about 41 percent.

The 1995 manual turning movement count data indicated that turning movements accounted for about 60 percent of all movements at this intersection between 6:00 a.m. to 6:00 p.m. During the morning peak hour, more than 63 percent of all vehicles were observed turning with the north- and southbound left-turn at 75 and 85 vehicles, respectively. The eastbound right-turn represented the highest turning movement observed during the morning peak hour at 210 vehicles. During the afternoon peak hour, more than 59 percent of all vehicles were observed turning with the north- and southbound left-turn at 260 and 25 vehicles, respectively. The northbound left-turn represented the highest turning movement observed during the evening peak hour. Finally, it may be noted that the number of vehicles turning left from the northbound approach exceeded 100 vehicles per hour six times, and exceeded 200 vehicles per hour twice during the count period.

Traffic Accidents

The incidence and pattern of traffic accidents can provide an indication of the efficiency and operating characteristics of an intersection. A three-year and three month motor vehicle accident history from January 1, 1992 to march 31,1995 for the intersection of N. Port Washington Road (CTH W) and W. Highland Road was collected and analyzed. As shown in Table 1, a total of 11 accidents occurred at the intersection during the three-year and three-month period concerned, with

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Figure 2 (continued)



Source: SEWRPC

Table 1

INCIDENCE AND SEVERITY OF MOTOR VEHICLE ACCIDENTS AT THE INTERSECTION OF PORT WASHINGTON ROAD (CTH W) AND HIGHLAND ROAD BETWEEN JANUARY 1, 1992 AND MARCH 31, 1995^a

Year	Injury	Property Damage	Total
January 1 to December 31, 1992	0	1	1
January 1 to December 31, 1993	1	1	2
January 1 to December 31, 1994	4 ^ь	36	7 ⁶
January 1 to March 31, 1995	0	1	1
Total	5⁵	6⁵	11 ^b

* Any accident occurring within 150 feet of the intersection was considered an intersection accident.

^b In August, 1994 the traffic control at this intersection was modified from two-way stop sign control to four-way stop sign control. Two of the injury accidents and one of the property damage accidents which occurred in 1994, occurred subsequent to the change in traffic control to four-way stop. All other accidents occurred when the Highland Road intersection approaches were stop sign controlled and the Port Washington Road intesection approaches were uncontrolled.

Source: Wisconsin Department of Transportation, Division of Motor Vehicles, and SEWRPC.

one accident in 1992, two in 1993, and seven in 1994, and one in the first three months of 1995. None of the accidents involved a fatality. One of the accidents in 1993, and four in 1991, however, involved personal injuries.

Analysis of the three-year and three-month accident history data for the intersection concerned indicates that ten of the 11 accidents, or 91 percent, were multiple vehicle accidents, and the eleventh accident involved a single vehicle leaving the roadway. Seven of the ten accidents, or 70 percent, were right-angle collisions; two were rear-end collisions; one was a left-turn collision; and the eleventh accident was a single vehicle accident wherein the vehicle left the roadway.

TRAFFIC SIGNALIZATION

A potential traffic management action investigated by the Commission staff is the installation of traffic signals at the intersection of N. Port Washington Road (CTH W) and W. Highland Road. The installation of a traffic signal requires that one or more of the warrants set forth in the <u>Manual On Uniform Traffic Control</u> <u>Devices</u>¹ be met. It should be noted that, although meeting one of the warrants is a necessary condition for traffic signal installation, meeting the warrant should not be considered a mandate for installation. The impacts of the signal installation must be evaluated and implementation considered only if the operation of the intersection is thereby improved. Because of the traffic volumes and pattern of angle collisions at this intersection, the staff considered five warrants. Four of these warrants are related to traffic volumes and the fifth is related to the accident experience of the intersection.

The first warrant considered--the minimum vehicular volume warrant--is satisfied if the sum of the current traffic volumes on the major approaches and the corresponding volumes on the higher volume minor street approach meet or exceed

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¹U.S. Department of Transportation, Federal Highway Administration, "Warrants for the Installation of Traffic Control Signals," <u>Manual On Uniform Traffic Control</u> <u>Devices</u>, 1988.

specified minimum volume requirements for any eight hours of an average weekday.² The minimum volume requirements at this intersection are 500 vehicles per hour on the N. Port Washington Road approaches and 150 vehicles per hour on the higher volume W. Highland Road approach. This warrant is not met, as the sum of the approach traffic volumes on both N. Port Washington Road approaches meet or exceed the warrant volume in only five of eight hours. However, the warrant is very nearly met, as the traffic volume within those three hours is at 93 to 96 percent of the warrant traffic volume. The findings of this analysis are summarized in Table 2.

The second warrant considered--the interruption of continuous traffic warrant--is satisfied when the traffic volume on N. Port Washington Road--measured as the total on both approaches--exceeds 750 vehicles per hour for any eight hours, and when the traffic volume on W. Highland Road--measured as the highest volume approach only--exceeds 75 vehicles per hour for the same eight hours. This warrant is not met, as N. Port Washington Road traffic volumes meet or exceed the warrant volume during only three hours. The findings of this analysis are summarized in Table 2.

The third warrant considered--the peak hour volume warrant--is satisfied when the number of vehicles per hour on N. Port Washington Road--measured as the total on both approaches--and the corresponding vehicles per hour on W. Highland Road-measured as the total on the highest volume approach only--for any one hour--or any four consecutive 15-minute periods--of an average day are above the applicable curve in Figure 3. As shown in Figure 3, this warrant is not met, as the point of intersection of the corresponding traffic volumes falls below the

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² Because right turns on red are permitted under Wisconsin Statutes, the Commission staff, along with many other public works and traffic engineering agencies in Southeastern Wisconsin, generally utilizes only one-half of the observed right turning volume when conducting traffic volume signal warrant analyses. However, because the substantial right turning volume from the eastbound approach would be opposed by the substantial southbound through volume particularly during the peak periods, it is unlikely that sufficient gaps would exist in the southbound traffic stream to permit one-half of the eastbound right turning volume to execute the turn on the red. Thus the full right turning volume on all approaches was utilized in the conduct of all volume related traffic signal warrant analyses conducted under the study.

Table 2

TRAFFIC SIGNAL VOLUME WARRANT ANALYSIS AT THE INTERSECTION OF N. PORT WASHINGTON ROAD--CTH W--AND W. HIGHLAND ROAD IN THE CITY OF MEQUON

SIGNAL WARRANT 1--MINIMUM VEHICULAR VOLUME

NUME	SER OF											
TRAFFIC	LANES	MINIMUM VEHICULAR VOLUMES		OBSERVED TRAFFIC COUNTS			DLUMES					
		MAJOR STREET	MINOR STREET		HOUR NUMBER							
MAJOR	MINOR	SUM OF BOTH	HIGHEST		1	2	3	4	5	6	7	8
STREET	STREET	APPROACHES	APPROACH									
1	1	500	150	MAJOR	783	690	609	531	507	482	472	463
2 OR MORE	1	600	150	STREET								
2 OR MORE	2 OR MORE	600	200	MINOR	162	178	193	305	203	171	191	192
1	2 OR MORE	500	200	STREET								

SIGNAL WARRANT 2--INTERRUPTION OF CONTINUOUS TRAFFIC

NUMB	ER OF											
TRAFFIC LANES		MINIMUM VEHIC	OBSERVED TRAFFIC COUNTS									
		MAJOR STREET	MINOR STREET	HOUR NUMBER								
MAJOR	MINOR	SUM OF BOTH	HIGHEST		1	2	3	4	5	6	7	8
STREET	STREET	APPROACHES	APPROACH									1
1	1	750	75	MAJOR	783	690	609	531	507	482	472	463
2 OR MORE	1	900	75	STREET								
2 OR MORE	2 OR MORE	900	100	MINOR	162	178	193	305	203	171	191	192
1	2 OR MORE	750	100	STREET								

Source: SEWRPC

Figure 3

PEAK HOUR VOLUME WARRANT ANALYSIS OF THE INTERSECTION OF N. PORT WASHINGTON ROAD AND W. HIGHLAND ROAD IN THE CITY OF MEQUON



*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 APPROACHING WITH ONE LANE.

	Vehicular	Volumes	
Peak Hour	Major Street Sum of Both Approaches	Minor Street Highest Approach	Remarks
7:00 a.m 8:00 a.m.	531	305	The warrant is not met as the point of inter- section falls below the "1 lane & 1 lane" curve.
4:30 p.m 5:30 p.m.	765	175	The warrant is not met as the point of inter- section falls below the "1 lane & 1 lane" curve.

Source: Manual on Uniform Traffic Control Devices and SEWRPC

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single lane/single lane warrant curve in both of the morning and evening peak hours.

The fourth warrant considered--the four hour volume warrant--is satisfied when, during each of any four hours of an average day, the number of vehicles per hour on N. Port Washington Road--measured as the total on both approaches--and the corresponding number of vehicles per hour on the higher volume W. Highland Road approach--measured as the total on the highest volume approach only--are all above the curve in Figure 4 for the existing combination of approach lanes. As shown in Figure 4, this warrant is not met, as the point of intersection of the corresponding traffic volumes for each of four hours falls above the single lane/single lane warrant curve in only two of the four highest hours.

The fifth warrant considered--the accident experience warrant--considers the number and type of traffic accidents which have occurred at the intersection. This warrant is satisfied when: adequate trial of less restrictive remedies with satisfactory observance and enforcement has failed to reduce the accident frequency; and five or more accidents of a type susceptible to correction by the installation of traffic signals have occurred within a 12-month period³; and there exists a volume of vehicular and pedestrian traffic not less than 80 percent of the requirements specified either in the Minimum Vehicular Volume warrant or the Interruption of Continuous Traffic warrant; and the signal installation will not seriously disrupt progressive traffic flow.

The one traffic accident in 1992 at the intersection can be considered to be correctable by the installation of a traffic signal. Both of the accidents in 1993 may be considered to be so correctable; and six of seven accidents occurring in 1994 may be considered to be so correctable. Because six of seven accidents in 1994 were right-angle collisions and thus susceptible to correction through the installation of traffic signals and because the volume requirements of

³ Accident types susceptible to correction by the installation of traffic signals include right-angle collisions; left- and right-turns into sideswipe collisions; and left-turns into head-on collisions as well as vehicular-pedestrian collisions.





FOUR HOUR VOLUME WARRANT ANALYSIS OF THE INTERSECTION OF N. PORT WASHINGTON ROAD AND W. HIGHLAND ROAD IN THE CITY OF MEQUON

*NOTE: 115 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACH WITH TWO OR MORE LANES AND 80 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACHING WITH ONE LANE.

	Vehicular	Volumes	
Four Highest Hours	Major Street Sum of Both Approaches	Minor Street Highest Approach	Remarks
7:00 a.m 8:00 a.m.	531	305	The warrant is met as the point of intersection falls above the "1 lane & 1 lane" curve.
3:00 p.m 4:00 p.m.	609	193	The warrant is not met as the point of inter- section falls below the "1 lane & 1 lane" curve.
4:00 p.m 5:00 p.m.	690	178	The warrant is not met as the point of inter- section falls below the "1 lane & 1 lane" curve.
5:00 p.m 6:00 p.m.	783	162	The warrant is met as the point of intersection falls above the "1 lane & 1 lane" curve.

Source: Manual on Uniform Traffic Control Devices and SEWRPC

minimum vehicular volume warrant are satisfied, the accident experience warrant is met.

However, because the minimum time frame required under this warrant is a 12 month period and fewer than 12 months have elapsed since the conversion of this intersection from two-way to four-way stop sign control, this warrant cannot be fully evaluated at this time. It may be noted, however, that three accidents have occurred since the implementation of the four-way stop sign control. Only two of those accidents--both of which occurred less than one month after the conversion to four-way stop sign control--are susceptible to correction through the installation of traffic signals.

Summary

Because none of the four traffic volume warrants for the installation of traffic signals at this intersection were met as of June, 1995, and because there is insufficient historic traffic accident data available to determine if the accident warrant is met at this time, it may be concluded that a traffic signal installation is not warranted at this intersection at this time. Further, based upon the historic accident data available, it appears that the installation of the multi-way stop signs in August 1994 has reduced the number of traffic accidents at the intersection and, in particular, the types of traffic accidents considered susceptible to correction by the installation of traffic signals. Based upon existing conditions, then, the existing multi-way stop sign control appears to be adequate at this time.

It may be noted that the existing 1995 approach volumes at the intersection very nearly do satisfy the volume warrants under both the minimum volume warrant and the four hour volume warrant. During the three hours in which the N. Port Washington Road approach volumes did not meet or exceed the volume threshold required to satisfy the minimum volume warrant, the observed approach volumes were more than 90 percent of the volume required to satisfy the warrant. Further, total approach volumes during the two hours which did not meet or exceed the volume threshold required to satisfy the four hour volume warrant also very nearly satisfied the warrant. Thus, it is recommended that the traffic volumes at this intersection continue to be monitored, and when the approach volumes do

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satisfy the warrants, that the installation of traffic signals be reconsidered.

EXCLUSIVE LEFT-TURN LANE

The provision of exclusive left-turn lanes should be considered when: 1) the number of left turns on an intersection approach exceeds 10 percent of the approach volume; or, 2) the left-turning volume equals or exceeds 100 vehicles per hour. In 1995, left-turning traffic represented 58 percent of the total traffic volume on the westbound approach of this intersection; 38 percent of the total traffic on the northbound approach; 18 percent of the total traffic on the eastbound approach; and 14 percent of total traffic on the southbound approach. The number of left-turning vehicles on the northbound intersection approach was observed to exceed 100 vehicles per hour in six of the 12 hours during which manual turning movement counts were conducted in 1995. The number of leftturning vehicles on the westbound intersection approach was observed to be 100 vehicles per hour during one hour as well.

The advantage of providing an exclusive left-turn lane north- and southbound on N. Port Washington Road (CTH W) and east- and westbound on W. Highland Road would be the separation the through traffic from the left-turning traffic, thereby reducing delay and improving traffic safety. A potential disadvantage of the provision of a left-turn lanes is the potential need to acquire additional right of way to accommodate their construction.

It is recommended that provision of exclusive left-turn lanes be considered for all four approaches to the intersection of N. Port Washington Road and W. Highland Road as shown in Figure 5. Implementation of this recommendation is estimated to cost approximately \$200,000.

SUMMARY

On October 8, 1993, the City of Mequon requested that the traffic study completed by the Southeastern Wisconsin Regional Planning Commission staff in May of 1993 of the N. Port Washington Road/W. Highland Road intersection be reevaluated after travel patterns at the intersection had stabilized following the relocation of



N. PORT WASHINGTON ROAD--CTH W--AND W. HIGHLAND ROAD INTERSECTION UPON PROVISION OF RECOMMENDED EXCLUSIVE LEFT-TURN LANES

Figure 5

St. Mary's Hospital from the City of Port Washington to N. Port Washington Road just north of W. Highland Road.

North Port Washington Road (CTH W) and W. Highland Road are both constructed to two-lane rural cross-sections. North Port Washington Road is a county trunk highway and, as such, would require Ozaukee County approval of any actions that would substantially alter the use or capacity of the intersection.

Analysis of existing traffic count data indicated that the volumes at this intersection failed to meet any of the four volume warrants which are to be considered for the installation of traffic signals. Because the traffic control at the intersection of N. Port Washington Road and W. Highland Road was modified from two-way to four-way stop sign control in August , 1994, only nine months of accident history was available at the time the updated study was completed. In as much as the accident experience warrant for signalization requires five or more accidents within any 12-month period which could be considered to be susceptible to correction by the installation of traffic signals, and only nine months had elapsed since the change in traffic control at the intersection, this warrant could not be evaluated.

The installation of traffic signals at the intersection of N. Port Washington Road and W. Highland Road is not recommended at this time. This action is not recommended because traffic volumes and accident data presently fail to meet the warrants for such an installation. Further, the installation of four-way stop sign control in August of 1994 appears to have alleviated the traffic safety problem indicated by the occurrence of seven accidents in 1994, six of which were considered to be susceptible to correction through the multi-way stop sign installation. This control is recommended to be retained based upon current conditions.

The provision of exclusive left-turn lanes at all four approaches to the intersection is recommended. This action is recommended because of the high percentage of the approach volumes engaging in a left-turn movement at an estimated cost of about \$200,000. This will eliminate delay for through and right-turning traffic currently caused by left-turning traffic.

* * * *