

**TRAFFIC STUDY OF
THE INTERSECTION OF
BARKER ROAD (CTH Y)
AND WATERTOWN ROAD**

**TOWN OF BROOKFIELD
WAUKESHA COUNTY
WISCONSIN**

**SOUTHEASTERN WISCONSIN
REGIONAL PLANNING COMMISSION**

KENOSHA COUNTY

Leon T. Dreger
Thomas J. Gorlinski
Sheila M. Siegler

MILWAUKEE COUNTY

Daniel J. Diliberti
William Ryan Drew
Patrick Marchese

OZAUKEE COUNTY

Leroy A. Bley
Thomas H. Buestrin,
Treasurer
Elroy J. Schreiner

RACINE COUNTY

David B. Falstad, Chairman
Martin J. Itzin
Jean M. Jacobson,
Secretary

WALWORTH COUNTY

John D. Ames
Anthony F. Balestrieri
Allen L. Morrison,
Vice-Chairman

WASHINGTON COUNTY

Lawrence W. Hillman
Daniel S. Schmidt
Patricia A. Strachota

WAUKESHA COUNTY

Duane H. Bluemke
Robert F. Hamilton
Paul G. Vrakas

**SOUTHEASTERN WISCONSIN REGIONAL
PLANNING COMMISSION STAFF**

Kurt W. Bauer, PE, AICP, RLS Executive Director
Philip C. Evenson, AICP Assistant Director
Kenneth R. Yunker, PE Assistant Director
Robert P. Biebel, PE Chief Environmental Engineer
Leland H. Kreblin, RLS Chief Planning Illustrator
Elizabeth A. Larsen Administrative Officer
Donald R. Martinson, PE Chief Transportation Engineer
John R. Meland Chief Economic Development Planner
Thomas D. Patterson Geographic Information Systems Manager
Bruce P. Rubin Chief Land Use Planner
Roland O. Tonn, AICP Chief Community Assistance Planner

Special acknowledgement is due Mr. Francisco Rivera Dominguez, Civil Engineer III, Wisconsin Department of Transportation, for his contribution to the preparation of this report.

**MEMORANDUM REPORT
NUMBER 105**

**TRAFFIC STUDY OF THE INTERSECTION OF
BARKER ROAD (CTH Y) AND WATERTOWN ROAD**

**TOWN OF BROOKFIELD
WAUKESHA COUNTY, WISCONSIN**

Prepared by the

**Southeastern Wisconsin Regional Planning Commission
P. O. Box 1607
Old Courthouse
916 N. East Avenue
Waukesha, Wisconsin 53187-1607**

The preparation of this publication was financed in part through a joint planning grant from the Wisconsin Department of Transportation and the U. S. Department of Transportation, Federal Highway and Federal Transit Administrations.

March 1995

**Inside Region \$2.50
Outside Region \$5.00**

(This page intentionally left blank)

SEWRPC Staff Memorandum

TRAFFIC STUDY OF THE INTERSECTION OF BARKER ROAD (CTH Y) AND WATERTOWN ROAD FOR THE TOWN OF BROOKFIELD IN WAUKESHA COUNTY

INTRODUCTION

On June 18, 1993 the Town of Brookfield requested that the Regional Planning Commission staff conduct a traffic study of the intersection of Barker Road and Watertown Road. The location of this intersection is shown on Map 1. The study was to determine if present traffic conditions warranted the installation of traffic signals. This staff memorandum presents the findings and recommendations of the requested study.

INTERSECTION OF BARKER ROAD AND WATERTOWN ROAD

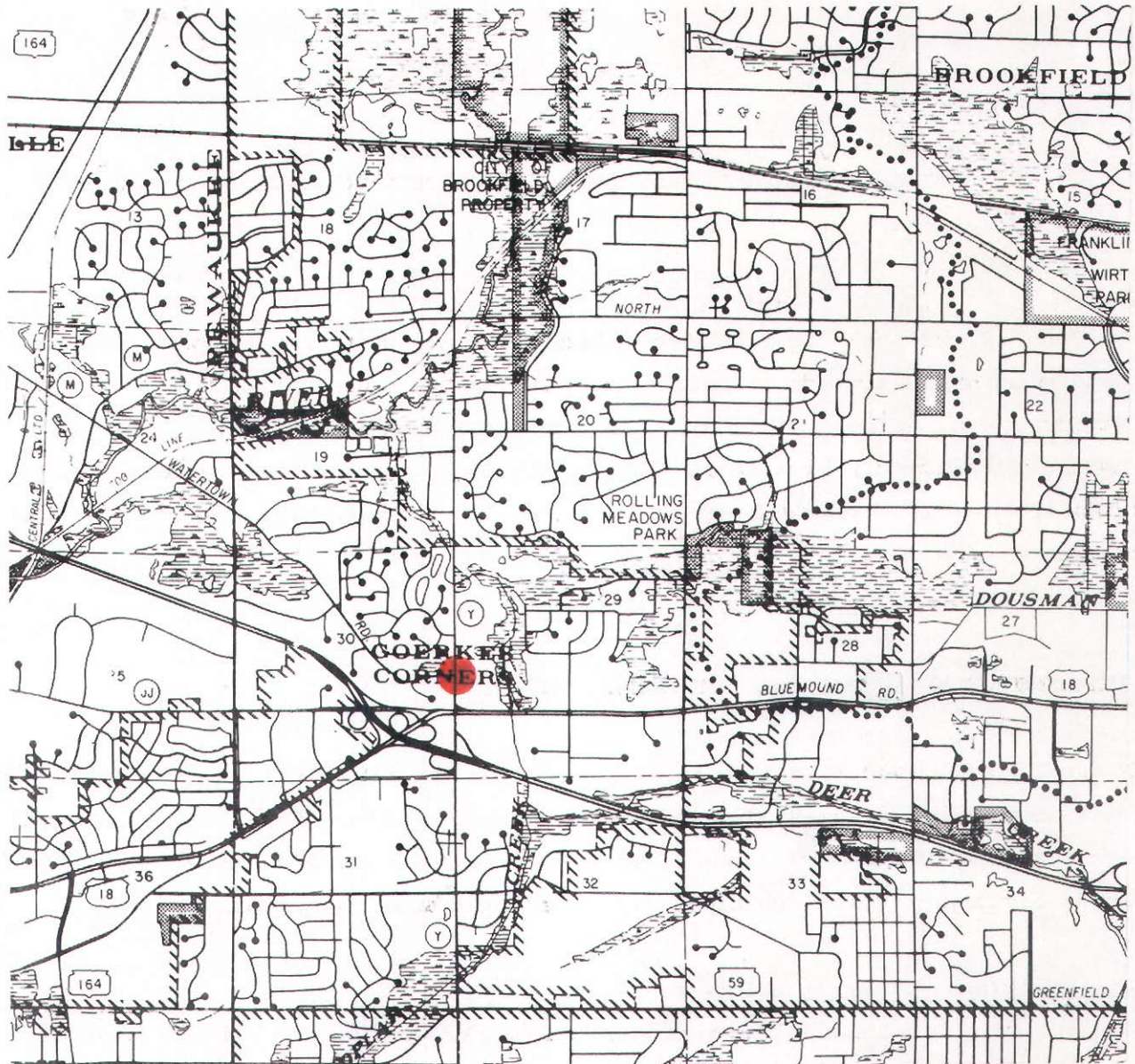
Central to the identification of existing traffic problems is the collection of data concerning roadway physical and operational characteristics, including average weekday traffic volumes, peak hour traffic volumes and turning movements, and a history of motor vehicle accident patterns and frequencies.

Jurisdictional Classification

The jurisdictional classification of a facility determines the unit of government which has the responsibility for the design, construction, maintenance, and operation of each segment of street and highway within a community. Barker Road at its intersection with Watertown Road is a county trunk highway. Therefore, any actions taken that would substantially alter the use or capacity of the intersection of Barker Road and Watertown Road would require the approval of Waukesha County.

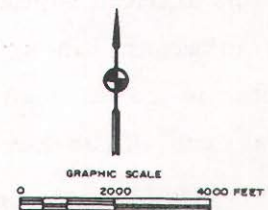
Map 1

LOCATION OF BARKER ROAD (CTH Y) AND WATERTOWN ROAD INTERSECTION
IN THE TOWN OF BROOKFIELD



LEGEND

 Intersection Location



Source: SEWRPC

Watertown Road, at its intersection with Barker Road, is a local street under the jurisdiction of the Town of Brookfield.

Intersection Physical and Operational Characteristics

The intersection of Barker Road (CTH Y) and Watertown Road is a "three-legged", or "T", intersection. Both facilities are constructed to an urban cross-section with curb and gutter and storm sewer at the intersection. North of the intersection, Barker Road is constructed as a rural roadway without curb or gutter and with an open ditch drainage system.

Barker Road, north of Watertown Road has a pavement width that varies from about 54 feet just north of its intersection with Watertown Road, to about 24 feet at a point approximately 400 feet north of Watertown Road.

Barker Road, south of Watertown Road, is constructed as a divided highway with twin 28 foot pavements and a median approximately 6 foot wide. The northbound approach of Barker Road at its intersection with Watertown Road provides two through traffic lanes and an exclusive left-turn lane. The southbound approach provides two traffic lanes, one exclusively for through traffic and one serving through and right turning traffic. The posted speed limit on Barker Road is 35 miles per hour.

Watertown Road, west of Barker Road has an existing pavement width of 44 feet. The eastbound intersection approach has an exclusive left- and an exclusive right-turn lane. The posted speed limit on Watertown Road is 40 miles per hour. Traffic at the intersection of Barker Road and Watertown Road is controlled by a stop sign on the Watertown Road approach.

Three driveways are located in the vicinity of the intersection, that is, within 200 feet of the intersection. Two driveways intersect the east side of Barker Road, one about 147 feet north of the Watertown Road, and the second one located about 178 feet south of the intersection. The third driveway is located approximately 115 feet south of the intersection, on the west of Barker Road.

Traffic Volumes

In July of 1993, the Commission staff conducted a 24-hour machine traffic counts at the intersection of Barker Road (CTH Y) and Watertown Road. The average weekday traffic counts on Barker Road were approximately 18,800 vehicles per average weekday just north of Watertown Road; and about 9,360 vehicles per average weekday on Watertown Road just west of Barker Road.

The Commission staff also conducted manual turning movement counts at the intersection from 6:00 a.m. to 8:00 p.m. This time period included the morning and afternoon peak traffic hours and accounted for approximately 87 percent of the 24-hour average weekday traffic volume. These count data were necessary to evaluate the current intersection operating conditions. Figure 1 shows the turning movement counts observed at the intersection of Barker Road and Watertown Road during: 1) the a.m. peak hour; and, 2) the p.m. peak hour. Also shown are the estimated 24-hour turning movement volumes.

It should be noted that a significant percentage of the eastbound traffic turns right onto Barker Road. During the p.m. peak hour, approximately 380 vehicles, or about 86 percent of the total eastbound traffic streams turns right. A substantial percentage of the northbound Barker Road traffic stream is involved in a turning movement during p.m. peak hour. Approximately 295 vehicles, or 33 percent of the total p.m. peak hour northbound traffic turns left. This pattern of turning movements exists throughout the day. Collectively, about 35 percent of the total vehicles entering this intersection are engaging in turning movements.

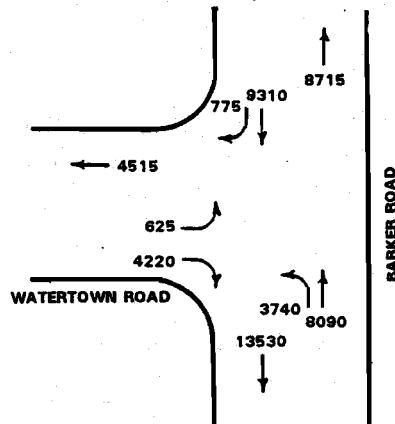
Traffic Accidents

The incidence and pattern of traffic accidents can provide an other indication of the operating characteristics of an intersection. A three-year, six month motor vehicle accident history--January 1990 through June 1993--for the intersection of Barker Road (CTH Y) and Watertown Road was collected and analyzed. As shown on Table 1, a total of four accidents occurred at the intersection during the three-year, six month period analyzed, with two accidents in 1990, no accidents in 1991, one in 1992, and one in the first six months of 1993. None of the four accidents reported involved a fatality, and, one involved

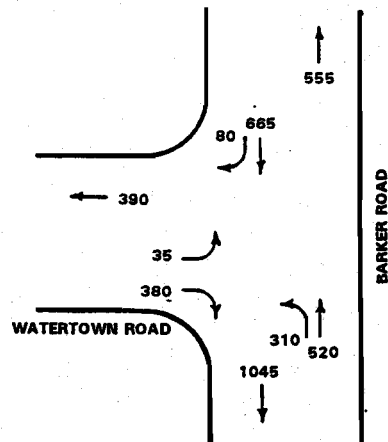
Figure 1

**TURNING MOVEMENT TRAFFIC VOLUMES AT
BARKER ROAD (CTH Y) AND WATERTOWN ROAD: 1993**

Estimated Average Weekday Turning Movement Volumes



Morning Peak Hour Turning Movement Volumes:
7:15 a.m. to 8:15 a.m.



Evening Peak Hour Turning Movement Volumes:
4:15 p.m. to 5:15 p.m.

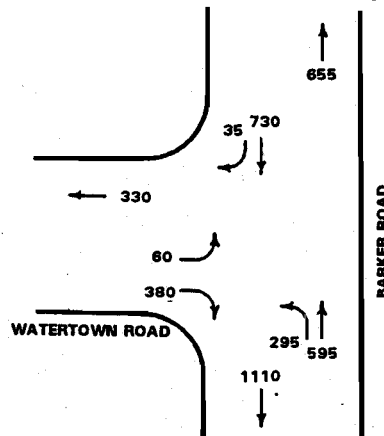


Table 1

**INCIDENCE AND SEVERITY OF MOTOR VEHICLES
AT THE INTERSECTION OF BARKER ROAD
AND WATERTOWN ROAD
JULY, 1993**

Time Period	Accident Type			Total Accidents
	Injury	Fatality	Property Damage	
1990	0	0	2	2
1991	0	0	0	0
1992	1	0	0	1
1st. half 1993	0	0	1	1
Total	1	0	3	4

Source: SEWRPC

personal injuries. Collision diagrams for the intersection are presented in Appendix A to this memorandum.

Because of the low number of accidents occurring at the intersection and the lack of an identifiable pattern of accidents, it may be concluded that no significant traffic safety problems exist at this location. This is confirmed by accident rates that ranged from a high of about 0.25 accidents per million vehicles entering the intersection to virtually zero accidents per million vehicles entering the intersection during the three and one half year time period analyzed.

Vehicular Queues

Although the incidence of accidents and the accident rates during the last three and one half years indicates that the intersection of Barker Road (CTH Y) and Watertown Road operates safely, substantial vehicular queues were observed on the eastbound approach during the peak hours. Maximum queue lengths of 20 vehicles and 5 vehicles were observed in the right turn lane and left turn lanes respectively on this approach during the p.m. peak hour. Average vehicular delay during the p.m. peak hour was observed to be about 57 seconds and 58 seconds for right and left turning vehicles respectively.

Queues of up to 9 vehicles were also observed waiting to execute a northbound left turn from Barker Road. Which queues of vehicles making this left turn tended to form and dissipate fairly quickly, the average delay incurred by these vehicles was observed to be about 21 seconds.

Also, vehicular queues on the southbound approach to the intersection of the Blue Mound Road (USH 18) and Barker Road were observed extending back to and through the Watertown Road and Barker Road intersection, although such queues did only occur infrequently. Such occurrences have a substantial negative impact on operations of the intersection of Watertown Road and Barker Road as only the operation of northbound through vehicles at the intersection would not be interrupted.

Operating Speeds

A spot speed study of Barker Road (CTH Y) vehicular traffic was conducted by the Commission staff at the intersection of Barker Road and Watertown Road on August 31, 1993, during non-peak traffic hours. The purpose of this study was to establish the 85th percentile speed of the traffic stream. The 85th percentile speed--the speed at or below which 85 percent of the traffic was observed to be traveling--may be considered to be the speed at which motorists perceive to be safe and reasonable for the roadway segment being traveled.

The 85th percentile speed of northbound vehicles on Barker road was observed to be approximately 41.3 miles per hour. In comparison, the 85th percentile speed of the southbound vehicles on Barker Road was observed to be approximately 37.8 miles per hour. The 85th percentile speed of the northbound and southbound traffic streams combined was observed to be about 40.3 miles per hour, which may be compared to the posted speed limit of 55 miles per hour.

TRAFFIC SIGNAL INSTALLATION ANALYSIS

The installation of a traffic signal requires that one or more of the warrants set forth in the Manual on Uniform Traffic Control Devices¹ 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 considered, and signal installation should be recommended only if the signal installation may be expected to improve the operation of the intersection. Five warrants for signal installation were evaluated for the intersection; four of the warrants are related to traffic volumes and the fifth was related to the accident experience of the intersection.

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

The first warrant considered--the minimum vehicular volume warrant--is satisfied if the sum of the current traffic volumes on the major street approaches and the corresponding volumes on the minor street approach meet or exceed specified minimum volume requirements for any eight hours of an average weekday. The minimum volume requirements at this intersection are 600 vehicles per hour on the major street and 200 vehicles per hour on the minor street.^{2,3} The minimum volume requirement to satisfy this warrant is met on Barker Road for each of the highest eight hours. However, on Watertown Road only six of the highest eight hours meet the minimum volume requirements for this warrant. The minimum vehicular volume warrant analysis is shown on Table 2. Thus, it may be concluded that the minimum vehicular volume warrant is not met.

The second warrant considered--the interruption of continuous traffic warrant--is satisfied when the traffic volume on Barker Road exceeds 900, and when the traffic volume on Watertown Road exceeds 100 vehicles per hour for the same eight hours. This warrant is met on both Barker Road and Watertown Road. The interruption of continuous traffic warrant analysis is shown on Table 2. Thus, it may be concluded that the interruption of continuous traffic warrant is met.

The third warrant considered--the peak hour warrant--is satisfied when the plotted point representing vehicles per hour for both north and south approaches on Barker Road and the corresponding vehicles per hour on Watertown Road for one hour (any four consecutive 15-minute periods) of an average day falls above the

²Because right turns on red are permitted under Wisconsin Statutes, some agencies responsible for traffic operations consider only one-half of the volume making right turns when comparing approach volumes to the warrants. This policy may be waived in certain situations such as intersections with severely restricted sight distance. The Commission staff, in recognition of this policy, included only half the right turning volume on the southbound and eastbound approaches in its analysis of the volume related warrants.

³The Manual On Uniform Traffic Control Devices allows a reduction to 70 percent of the volume thresholds under this warrant when the 85th percentile speed of the major street traffic exceeds 40 miles per hour. Although the observed 85th percentile speed mostly exceeds 40 miles per hour on Barker Road (CTH Y), the Commission staff did not include such a reduction in its analysis of this warrant because the observed 85th percentile speed only marginally exceeds 40 miles per hour and because of the proximity of the traffic signals at Blue Mound Road (USH 18) and Barker Road.

Table 2

**COMPARISON OF OBSERVED APPROACH VOLUMES DURING THE HIGHEST EIGHT HOURS
OF AN AVERAGE WEEKDAY AT THE INTERSECTION OF BARKER ROAD (CTH Y) AND
WATERTOWN ROAD TO SELECTED TRAFFIC SIGNAL WARRANTS**

SIGNAL WARRANT 1 - MINIMUM VEHICULAR VOLUME

Minimum Vehicular Volumes	Number of Traffic Lanes		Traffic Volume Warrants		Observed Volumes By Hour								
	Major Street	Minor Street	Major Street Sum Both Approaches	Minor Street Highest Approach		1	2	3	4	5	6	7	8
	1	1	500	150	Major								
	2 or More	1	600	150	Street	1493	1611	1217	1389	1273	1162	1514	1591
	2 or More	2 or More	600	200	Minor								
	1	2 or More	500	200	Street	225	210	209	231	175	194	211	200

SIGNAL WARRANT 2 - INTERRUPTION OF CONTINUOUS TRAFFIC

Interruption Of Continuous Traffic	Number of Traffic Lanes		Traffic Volume Warrants		Observed Volumes By Hour								
	Major Street	Minor Street	Major Street Sum Both Approaches	Minor Street Highest Approach		1	2	3	4	5	6	7	8
	1	1	750	75	Major								
	2 or More	1	900	75	Street	1493	1611	1217	1389	1273	1162	1514	1591
	2 or More	2 or More	900	100	Minor								
	1	2 or More	750	100	Street	225	210	209	231	175	194	211	200

Note: All right turn movements have been reduced by 50 percent.

Source: SEWRPC

curve in Figure 2, and vehicular delay on the minor street--Watertown Road--exceeds five hours during the peak hour. This warrant is met, as Barker Road and Watertown Road traffic volumes exceed the warrant volumes, and the estimated p.m. peak hour vehicular delay is approximately seven hours. Thus, it may be concluded that the peak hour volume warrant is met.

The fourth warrant considered--the four hour volume warrant--is satisfied when each of any four hours of an average day, the plotted points representing the vehicles per hour on the major street (total of other approaches) and the corresponding vehicles per hour on the higher volume minor street approach (one direction only) all fall above the curve in Figure 3 for the existing combination of approach lanes. This warrant is met, both Barker Road and Watertown Road traffic volumes exceed the warrant volumes. Thus, it may be concluded that the four hour volume warrant is met.

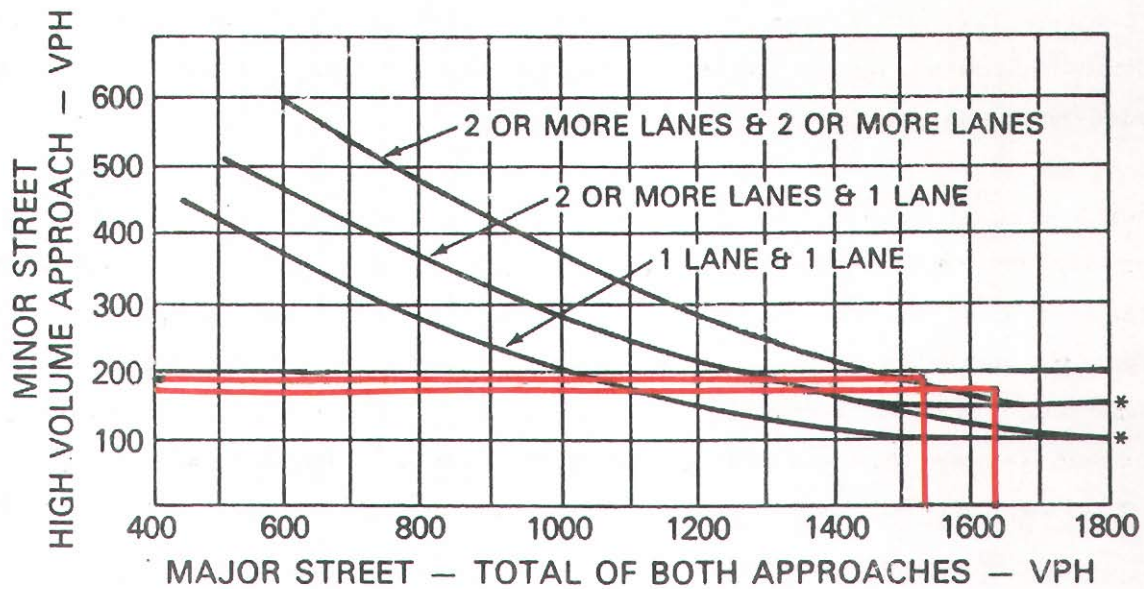
The fifth warrant considered--accident experience warrant--considers the number and type of traffic accidents which have occurred at the intersection. This warrant is satisfied when: adequate trial of less restrictive remedies with satisfactory observance and enforcement has failed to reduce the accident frequency; and five or more accidents of a type susceptible to correction by the installation of traffic signals have occurred within a 12 month period. This warrant is not met, as analyses of the three-year, six month accident history indicates that two or fewer accidents have occurred in any 12 month period.

Analysis of the existing traffic volumes of the Barker Road (CTH Y) and Watertown Road intersection approaches as well as historic traffic accident data at that intersection indicate that three of the five considered warrants for the installation of traffic signals are met. These warrants are: 1) the interruption of continuous traffic warrant; 2) the peak hour volume warrant; and, 3) the four hour volume warrant. Therefore, it may be concluded that a traffic signal installation is warranted at this intersection.

The advantages of the installation of a traffic signal at this intersection include: 1) the provision of gaps at regular intervals to accommodate demands of left- and right-turn movements at the intersection; 2) an attendant in delay

Figure 2

PEAK HOUR VOLUME WARRANT



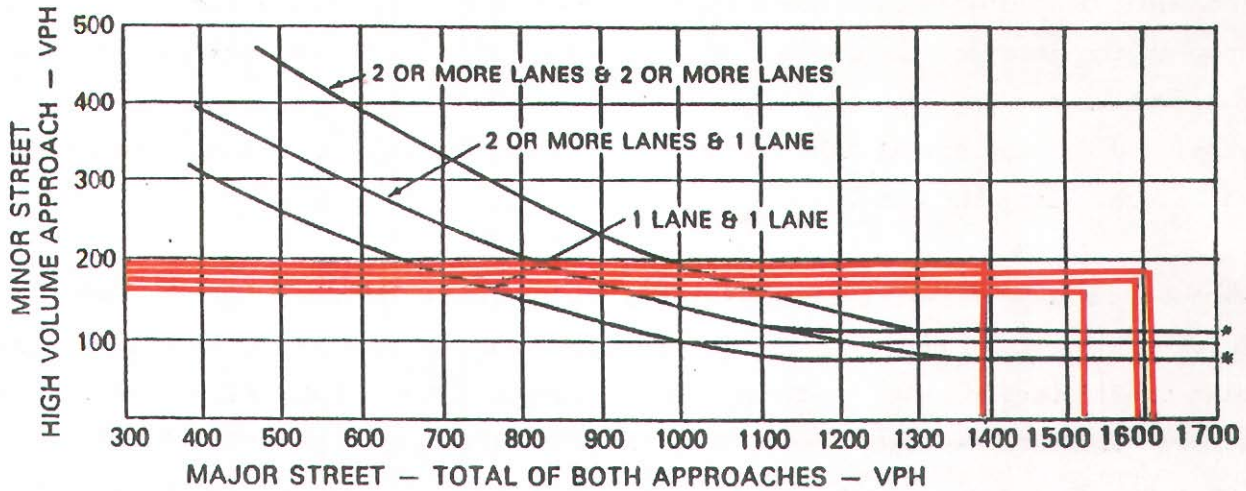
*NOTE: 150 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACH WITH TWO OR MORE LANES AND 100 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACHING WITH ONE LANE.

Hour		Vehicular Volumes		Remarks
		Major Street Sum Both Approaches	Minor Street Highest Approach	
7:15 a.m.	- 8:15 a.m.	1530	191	Peak A.M. Hour
4:15 p.m.	- 5:15 p.m.	1634	188	Peak P.M. Hour

Note: All right turn movements have been reduced by 50 percent

Figure 3

FOUR HOUR VOLUME WARRANT



*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.

Hour		Vehicular Volumes		Remarks
		Major Street Sum Both Approaches	Minor Street Highest Approach	
12:00 a.m.	- 1:00 p.m.	1389	190	Falls Above Curve
3:00 p.m.	- 4:00 p.m.	1514	157	Falls Above Curve
4:00 p.m.	- 5:00 p.m.	1591	148	Falls Above Curve
5:00 p.m.	- 6:00 p.m.	1611	168	Falls Above Curve

Note: All right turn movements have been reduced by 50 percent

incurred by motorists on the eastbound approach and in the northbound left turn lane; and, 3) a modest reduction overall in delay at this intersection. The disadvantages of the installation of a traffic signal at this intersection include: 1) delay may be incurred by motorists who previously did not have to stop at the intersection; 2) signalization may be expected to increase the fuel consumption and pollutant emissions of those vehicles which are now required to stop; and, 3) the installation of traffic signal at this intersection may cause additional rear end accidents.

Because it may be expected that total delay incurred by motorists at this intersection would decrease if traffic signals are installed it is recommended that consideration be given to such installation. Town of Brookfield officials should work with Waukesha County to pursue installation of the traffic signals. The installation should include traffic actuation and interconnection with the traffic signals at the Blue Mound Road (USH 18) and Barker Road (CTH Y) intersection to ensure that the operation of the traffic signals at this intersection is coordinated with the operation of the traffic signals at Barker Road and Watertown Road.

SUMMARY

On June 18, 1993, Town of Brookfield officials requested that the Southeastern Wisconsin Region Planning Commission conduct a traffic study to determine the need for traffic signals at the intersection of Barker Road (CTH Y) and Watertown Road.

Barker Road, at its intersection with Watertown Road, is constructed as a divided highway with twin pavements and a median. The northbound approach provides with two through traffic lanes and an exclusive left-turn lane. The southbound approach provides with two traffic lanes one of which is exclusively for through traffic and one of which serves through and right turning traffic. Parking is not allowed in the vicinity of the intersection. Watertown Road is constructed to a four-lane undivided urban cross-section with curb and gutter. This intersection approach has exclusive left- and right-turn lanes.

The Commission staff conducted 24-hour machine traffic counts at the intersection of Barker Road and Watertown Road in August of 1993. Average weekday traffic counts on Barker Road, north of Watertown Road, were approximately 18,000 vehicles per average weekday; and approximately 9,360 vehicles per average weekday on Watertown Road just west of Barker Road.

The Commission staff also conducted manual turning movements counts at the intersection from 6:00 a.m. to 8:00 p.m. It should be noted during the evening hour of peak traffic flow, approximately 380 vehicles, or about 86 percent of the total eastbound traffic stream turns right. Approximately 295 vehicles, or 33 percent of the total northbound p.m. peak hour traffic turns left.

A three-year, six month traffic accident history for the intersection of Barker Road and Watertown Road was compiled to provide an indication of the operating efficiency of the intersection. The history indicated that four accidents occurred at the intersection in the three-year, six month study period: two in 1990, none in 1991, one in 1992, and one in the first half of 1993.

Substantial vehicular queues were observed on the eastbound approach during the peak hours. Maximum queue of 20 vehicles and 5 vehicles were observed in the right turn lane and left turn lane respectively on this approach during the p.m. peak hour. Average vehicular delay was observed to be about 57 seconds and 58 seconds for right and left turning vehicles respectively. A maximum of 9 vehicles were also observed waiting to execute a northbound left turn. The average delay incurred by these vehicles was observed to be about 21 seconds.

The Commission staff conducted a spot speed study on Barker Road, at its intersection with Watertown Road, during non peak hours. Results from this analyses shows that the 85th percentile speed is about 40.3 miles per hour. While this does exceed the Manual On Uniform Traffic Control Devices (MUTCD) 40 miles per hour criterion which permits a reduction in the volume thresholds under the Minimum Vehicular Volume and Interruption of Continuous Traffic warrants, this reduction in warrant volumes was not utilized because the observed 85th percentile speed only marginally exceeds 40 miles per hour and because of the proximity of other traffic signals at Blue Mound Road (USH 18) at Barker Road.

Analysis of the existing traffic count data indicated that the volumes at this intersection meet the "minimum vehicular volume" warrant for the major street for eight hours; but that only six out of the eight hours meet the minimum vehicular volume requirements for this warrant. Further analyses of the same traffic count data indicates that the "interruption of continuous flow" warrant for the installation of traffic signals is met.

Because it may be expected that total delay incurred by motorists at this intersection would decrease if traffic signals are installed, it is recommended that consideration be given to such installation. The installation should include traffic actuation and interconnection with the traffic signals at the Blue Mound Road and Barker Road intersection to ensure that the operation of the traffic signals at this intersection is coordinated with the operation of the traffic signals at the Barker Road and Watertown Road intersection.

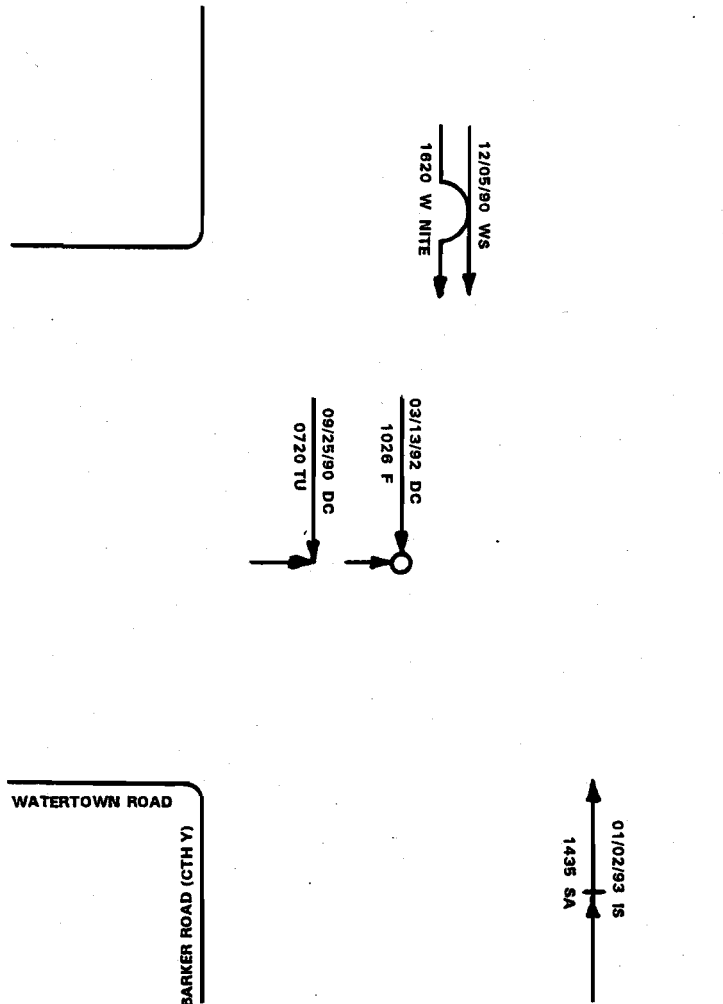
APPENDIX

(This page intentionally left blank)

Appendix A

COLLISION DIAGRAM Southeastern Wisconsin Regional Planning Commission

INTERSECTION BARKER ROAD (CTH Y) and WATERTOWN ROAD
 PERIOD Three and One-half Years From January 1, 1990 To June 30, 1993
 MUNICIPALITY Town of Brookfield Prepared by REB Sheet 1 of 1



SHOW FOR EACH ACCIDENT	LEGEND		SUMMARY			
1. TIME, DAY, AND DATE. 2. PAVEMENT: D - DRY; I - ICY; W - WET. 3. WEATHER: C - CLEAR; F - FOG; R - RAIN; SL - SLEET; S - SNOW. 4. NITE - IF BETWEEN DUSK AND DAWN.	SYMBOLS	TYPES OF COLLISION	TYPE	DAY	NIGHT	TOTAL
	MOVING VEHICLE	REAR END HEAD ON SIDESWIPE OUT-OF-CONTROL LEFT TURN RIGHT ANGLE	FATAL	0	0	0
	BACKING VEHICLE		PEDESTRIAN INJURY	0	0	0
	NONINVOLVED VEHICLE		OTHER INJURY	1	0	1
	PEDESTRIAN		PROPERTY DAMAGE ONLY	2	1	3
	DEER		TOTAL	3	1	4
	PARKED VEHICLE					
	FIXED OBJECT					
FATAL ACCIDENT						
INJURY ACCIDENT						