

**TRAFFIC ENGINEERING
STUDY OF WEST AND
NORTH BEACH ROADS
IN THE VILLAGE OF
OCONOMOWOC LAKE**

**WAUKESHA COUNTY
WISCONSIN**

**SOUTHEASTERN WISCONSIN
REGIONAL PLANNING COMMISSION**

KENOSHA COUNTY

Leon T. Dreger
Francis J. Pitts
Sheila M. Siegler

RACINE COUNTY

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

MILWAUKEE COUNTY

John R. Bolden
Thomas W. Meaux
Jean B. Tyler

WALWORTH COUNTY

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

OZAUKEE COUNTY

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

WASHINGTON COUNTY

Daniel S. Schmidt
Patricia A. Strachota
Frank F. Uttech,
Chairman

WAUKESHA COUNTY

Richard A. Congdon
Robert F. Hamilton
William D. Rogan,
Treasurer

VILLAGE OF OCONOMOWC LAKE OFFICIALS

VILLAGE PRESIDENT

Benn S. DiPasquale

VILLAGE TRUSTEES

Robert T. Clayton
Paul M. Fischer
Reimar F. Frank
Carl R. Gallauer
William C. Meyer
Christopher A. Mortonson

VILLAGE ADMINISTRATOR/CHIEF OF POLICE

Donald G. Wiemer

PUBLIC HEALTH AND SAFETY COMMITTEE

Robert T. Clayton
Benn S. DiPasquale
Gerald L. LaBerge
Joseph L. LaKota
Christopher A. Mortonson

**SOUTHEASTERN WISCONSIN REGIONAL
PLANNING COMMISSION STAFF**

Kurt W. Bauer, PE, AICP, RLSExecutive Director
Philip C. Evenson, AICPAssistant Director
Kenneth R. Yunker, PEAssistant Director
Robert P. Biebel, PEChief Environmental Engineer
John W. ErnstInformation Systems Manager
Leland H. Kreblin, RLSChief Planning Illustrator
Donald R. MartinsonChief Transportation Engineer
John R. MelandChief Economic Development Planner
Bruce P. RubinChief Land Use Planner
Roland O. Tonn, AICPChief Community Assistance Planner
Joan A. ZenkAdministrative Officer

Special acknowledgement is due Mr. Robert E. Beglinger, SEWRPC Principal Engineer, and Mr. David C. Dryer, SEWRPC Engineer, for their contribution to the conduct of this study and the preparation of this report.

**MEMORANDUM REPORT
NUMBER 32**

**TRAFFIC ENGINEERING STUDY OF
WEST AND NORTH BEACH ROADS IN
THE VILLAGE OF OCONOMOWOC LAKE**

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 report 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 Urban Mass Transportation Administrations.

January 1991

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

(This page intentionally left blank)

Memorandum Report No. 32

TRAFFIC ENGINEERING STUDY OF WEST AND NORTH
BEACH ROADS IN THE VILLAGE OF OCONOMOWOC LAKE

INTRODUCTION

On July 27, 1989, the Village of Oconomowoc Lake requested the Commission staff to conduct a traffic engineering study of N. and W. Beach Roads in the Village of Oconomowoc Lake. Over the past several years Village residents and elected officials have become increasingly concerned about the volume of traffic and attendant vehicle speed and safety problems on W. Beach Road between Newport Drive and N. Beach Road, and on N. Beach Road between W. Beach Road and Gifford Road. This memorandum report presents the findings and recommendations of the requested study. The report describes the traffic problems which currently exist, identifies and evaluates alternative traffic engineering actions which may provide some abatement of these existing traffic problems, and recommends traffic engineering measures for implementation.

Existing Conditions

Street and highway systems may be classified in several ways. Two of the more important classification systems are the functional and the jurisdictional classification systems. The functional system provides the basis for organizing, planning, designing, and constructing a street network and includes three classes: 1) arterial streets; 2) collector streets; and 3) land access streets. Arterial streets are those streets and highways primarily intended to serve the movement of through traffic. Some arterial streets, as a secondary function, provide access to abutting property, but access should always be subordinate to their principal function of carrying traffic. Collector and land access streets are sometimes referred together as local, or nonarterial, streets. Collector streets are those streets or highways which are intended to serve as connections between the arterial street network and the land access street system. As a secondary function, collector streets may provide access to abutting properties. Land access streets are those streets which primarily provide access to abutting property. Both N. and W. Beach Roads are

functionally classified as local streets under the Commission's adopted regional transportation system plan.

The jurisdictional classification of a facility identifies the governmental agency responsible for the facility. North and W. Beach Roads are under the jurisdiction of the Village of Oconomowoc Lake and, thus, the Village of Oconomowoc Lake is responsible for the construction, operation, and maintenance of these facilities.

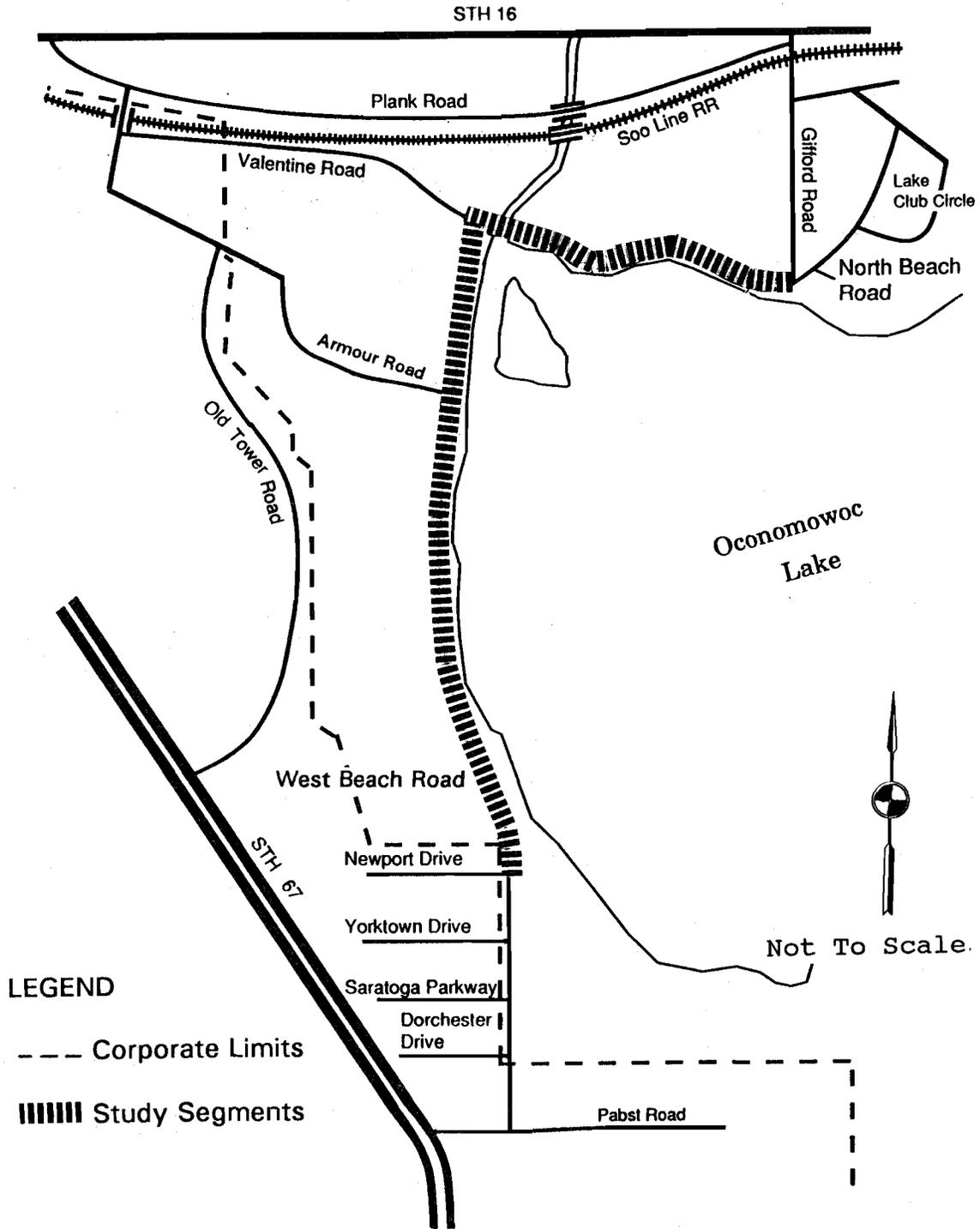
Roadway Physical Characteristics

As shown on Map 1, W. Beach Road is located within the limits of the Village of Oconomowoc Lake from a point approximately 400 feet south of the intersection of Dorchester Drive and W. Beach Road, and extends approximately 4,800 feet north to the intersection formed by W. Beach Road, Valentine Road, and N. Beach Road. Public streets intersecting this segment of W. Beach Road include Dorchester Drive, Saratoga Parkway, Yorktown Drive, Newport Drive, and Armour Road. Traffic is controlled at these intersections by stop signs on the intersecting street approaches, with the exception of the intersection of Armour Road and W. Beach Road where all the intersection approaches are stop sign controlled. Traffic at the intersection formed by Valentine Road, N. Beach Road, and W. Beach Road is stop sign controlled on the W. Beach Road and Valentine Road approaches.

North Beach Road is the east leg of the intersection formed by N. Beach Road, Valentine Road, and W. Beach Road. North Beach Road extends approximately 3,400 feet from this intersection to its intersection with the northern leg of Lake Club Circle. North Beach Road is intersected by Gifford Road and the southern leg of Lake Club Circle. Traffic is controlled at the intersection of Gifford Road and N. Beach Road by stop signs on all approaches.

West Beach Road between Valentine Road and the south Village limits is constructed to a rural two-lane cross-section with no shoulders, and has a pavement width of 20 feet. North Beach Road between W. Beach Road and its intersection with Gifford Road is also constructed to a rural two-traffic-lane cross-section with no shoulders and has a pavement width of 20 feet. There are

LOCATION MAP OF W. AND
N. BEACH ROAD STUDY SEGMENTS: 1989



no sidewalks or pedestrian paths provided on either side of W. or N. Beach Roads and parking is prohibited along the entire length of both N. and W. Beach Roads.

In 1977 the posted speed limit on W. and N. Beach Roads was reduced from 35 miles per hour to 25 miles per hour. In the summer of 1989 the Village Board acted to reduce the posted speed limit from 25 miles per hour to 15 miles per hour from April 15 to October 15 on W. Beach Road from a point just north of Newport Drive to Valentine Drive, and on N. Beach Road between W. Beach Road and Gifford Road. Between October 15 and April 15 the posted speed limit on these two roadways is 25 miles per hour.

In addition to the stop signs on selected intersection approaches, there are a number of other regulatory and warning signs posted along the study segment. The regulatory signing includes the speed limit and trucking prohibition signs. Two warning signs are posted on the north side of N. Beach Road including a sign located approximately 265 feet east of W. Beach Road with the message "Dangerous Intersection," and a second sign located approximately 365 feet east of W. Beach Road with the pictographic message "Turn."

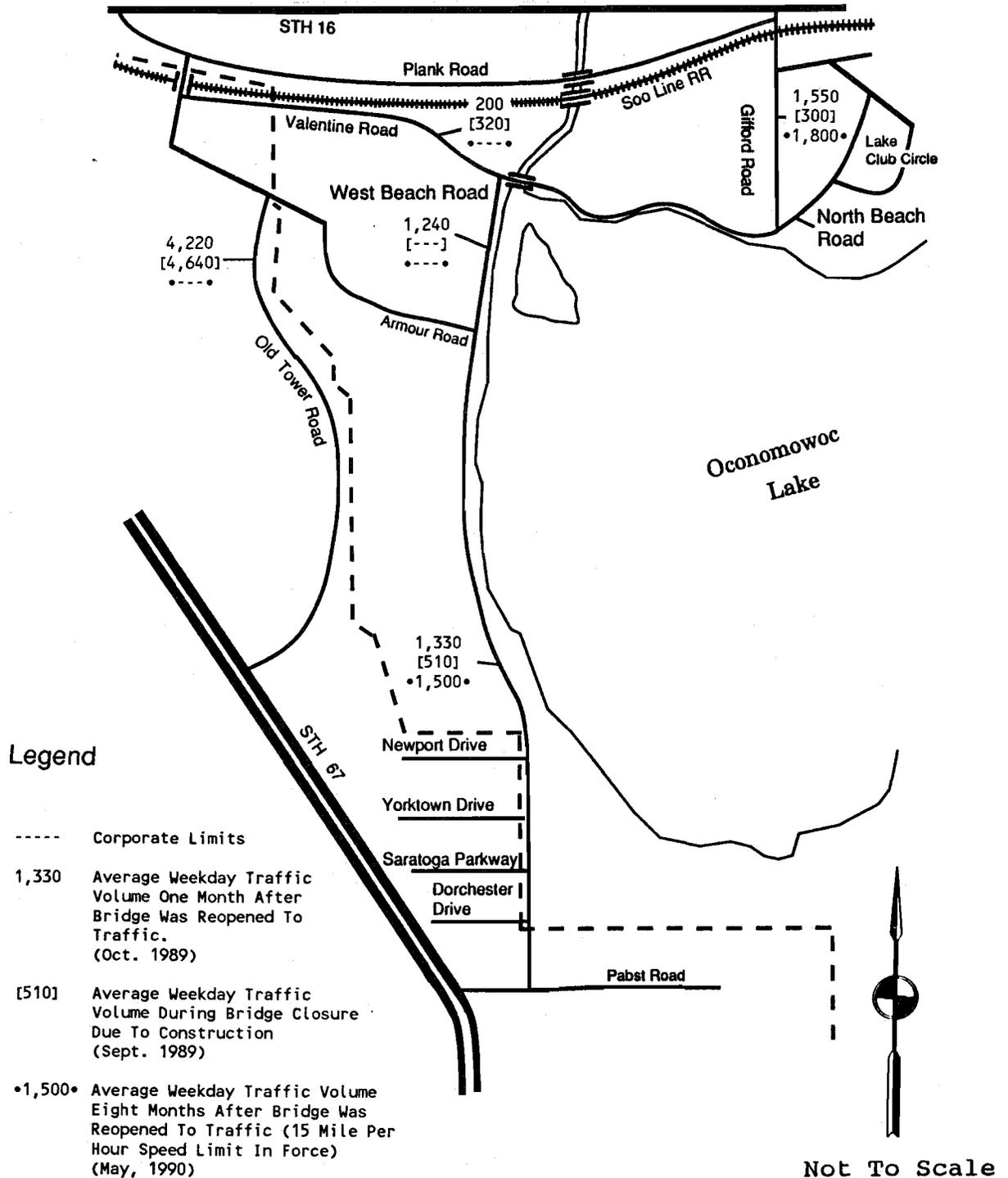
Traffic Volumes

The Commission conducted 24-hour machine traffic counts on W. Beach Road and other selected streets within and near the Village in September 1989 and in October 1989. The N. Beach Road structure over the Oconomowoc River was closed to traffic during September 1989. The October 1989 count was conducted approximately two weeks after the structure was reopened to traffic. Figure 1 shows the traffic count data. The significant increase in traffic counts on W. Beach Road after the opening of the N. Beach Road bridge indicates that through traffic is using N. and W. Beach Roads between STH 16 and STH 67.

On October 24, 1989, the Commission staff conducted a license plate survey at the four locations shown in Figure 2. Data were collected between the hours of 10:00 a.m. and 6:00 p.m. and consisted of recording and comparing the license plate of each vehicle by direction at each survey station, and obtaining and mapping the garaging address of the vehicles identified as through traffic.

Figure 1

24-HOUR AVERAGE WEEKDAY TRAFFIC VOLUME
ON W. AND N. BEACH ROADS DURING AND AFTER
CONSTRUCTION OF THE N. BEACH ROAD BRIDGE

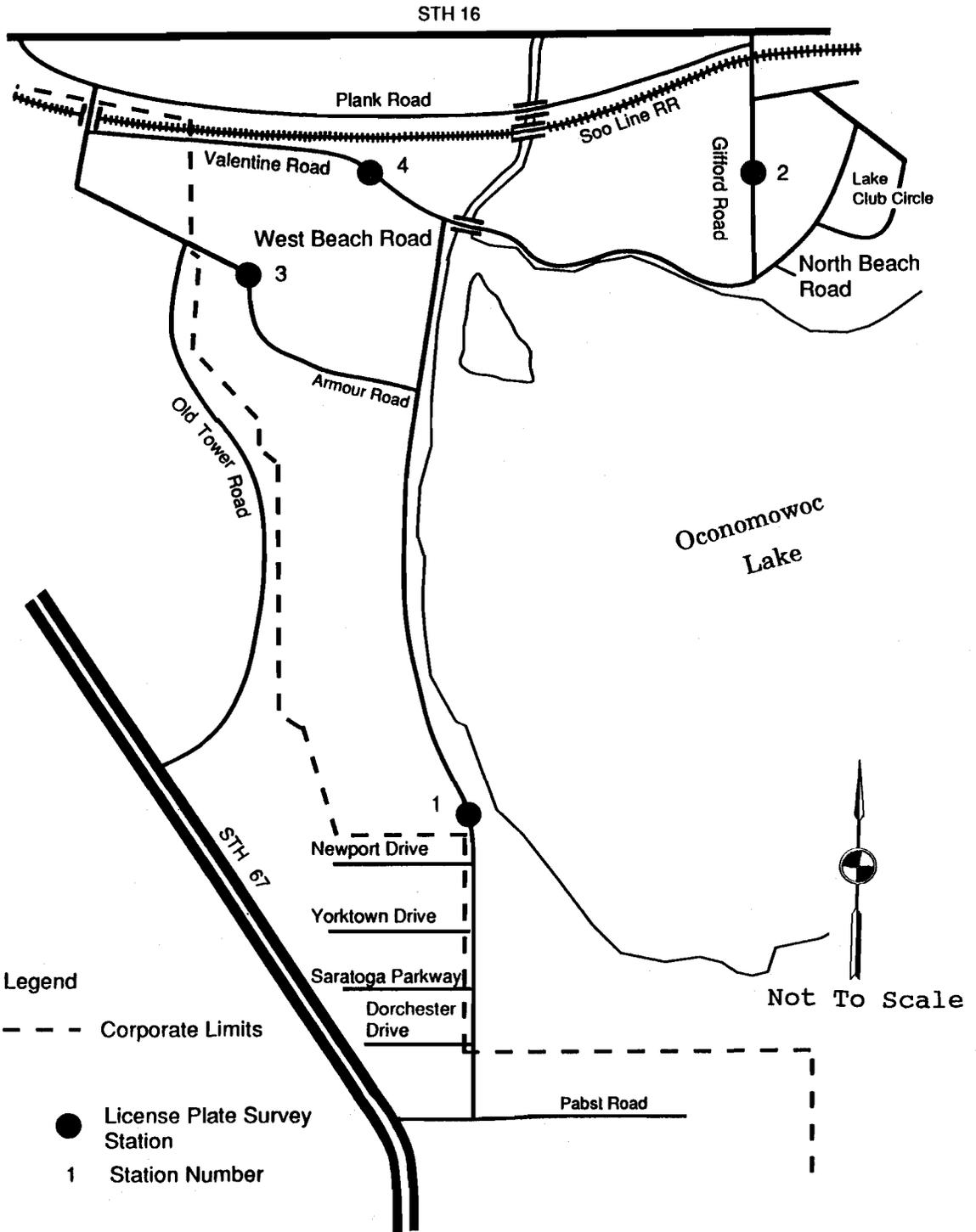


Not To Scale

Source: SEWRPC.

Figure 2

LOCATION OF LICENSE PLATE SURVEY STATIONS
IN THE VILLAGE OF OCONOMOWOC LAKE: 1989



Source: SEWRPC.

This survey was conducted to permit further analysis of the extent of through traffic on Village streets which may be considered through traffic on an average weekday.

As shown in Table 1, through traffic was estimated to account for one-half to two-thirds of the total traffic on an average weekday in October 1989 on W. Beach Road and other selected Village streets. Shown in Table 2 are travel patterns of the vehicles traveling through the Village on an average weekday. Figure 3 shows the travel patterns of the three largest through trip movements within the Village.

The traffic count data collected in October 1989 may be compared to historical average weekday traffic counts on W. and N. Beach Roads and Gifford Road conducted over the period 1971 to 1989, as shown in Table 3. It may be noted that the average weekday traffic estimated from the year 1988 on W. Beach Road are significantly higher than the October 1989 counts conducted shortly after the N. Beach Road bridge was reopened to traffic. Therefore, it may be concluded that, prior to the reconstruction of the N. Beach Road structure, there was more through traffic on W. and N. Beach Roads than that which was observed in October 1989; and that the potential exists for the return of traffic volumes on W. and N. Beach Roads to their historic higher levels. Thus, the evaluation of the traffic control alternatives considered in this report and the assessment of the impacts are based on the historic 1988 traffic count of 2,350 vehicles per average weekday on W. Beach Road, of which approximately 77 percent, or 1,800 vehicles, were estimated to be through traffic.

An additional 24-hour machine traffic count was conducted while the speed limit was posted at 15 miles per hour by the Commission staff in May 1990 to evaluate the potential for such an increase in traffic volumes, as well as the traffic volume impacts of the 15 mile per hour speed limit. As shown in Figure 1, traffic volumes, when compared to the traffic volumes observed in October 1989, have increased by approximately 170 vehicles per average weekday, or 13 percent, on W. Beach Road north of Newport Drive; and by approximately 250 vehicles per average weekday, or an increase of 16 percent, on Gifford Road immediately south of Hewitt's Point Road. The average weekday

Table 1

ESTIMATED 24-HOUR TRAFFIC TOTAL AND THROUGH
TRAFFIC BASED ON THE LICENSE PLATE SURVEY CONDUCTED
IN THE VILLAGE OF OCONOMOWOC LAKE: OCTOBER 1989

Location	Estimated 24-Hour Survey Day Traffic		Percentage of Traffic Traveling Through
	Total	Through	
W. Beach Road.....	1,330	880	66.2
Gifford Road.....	1,550	1,000	64.5
Armour Road.....	840	380	45.2
Valentine Road.....	200	100	50.0

Source: SEWRPC.

Table 2

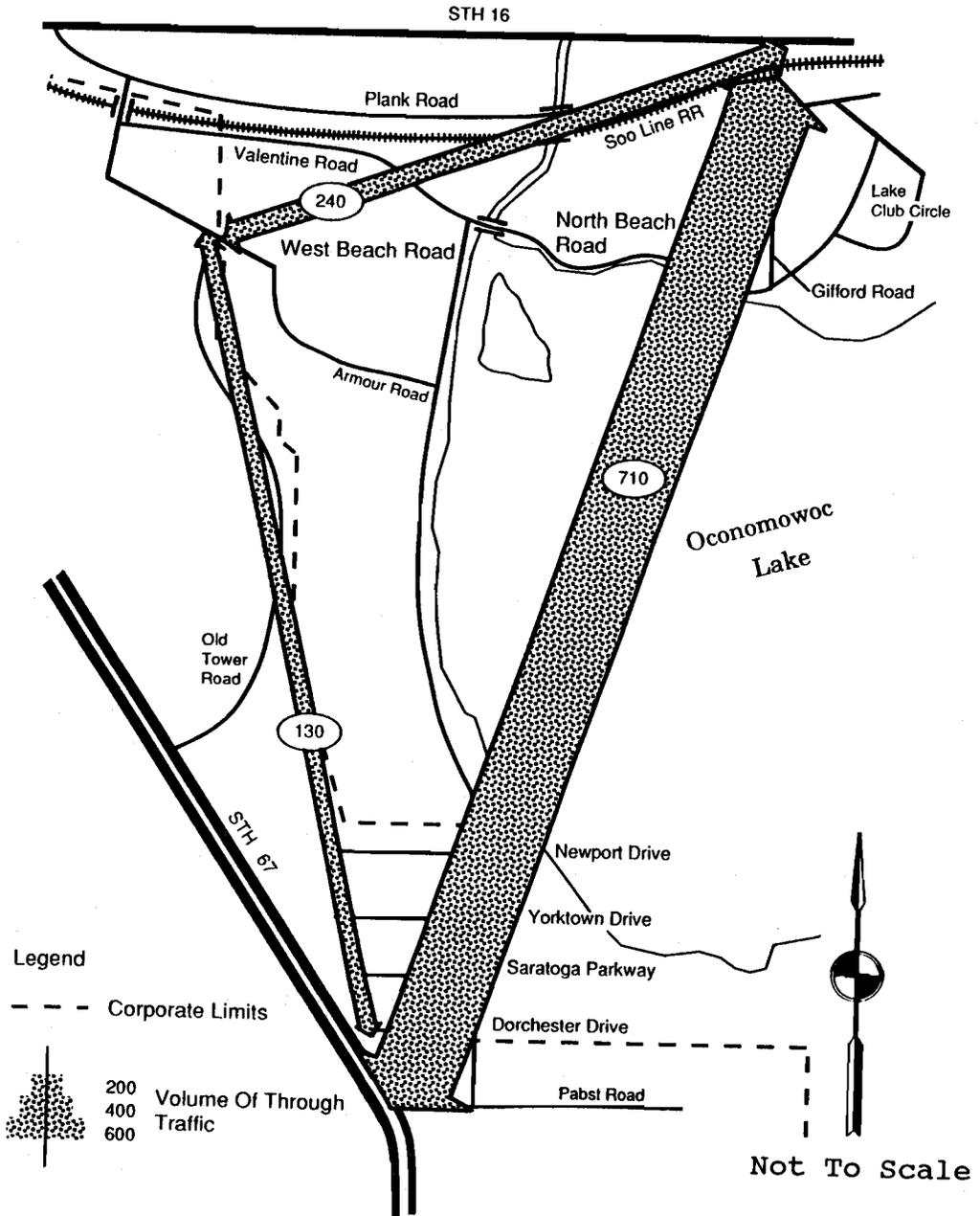
TRAVEL PATTERNS OF THE 24-HOUR ESTIMATED
VEHICLE TRIPS TRAVELING THROUGH
THE VILLAGE OF OCONOMOWOC LAKE: 1989

Outbound at:	W. Beach Road	Gifford Road	Armour Road	Valentine Road	Total Inbound
Inbound at:					
W. Beach Road....	--	355	65	20	440
Gifford Road.....	355	--	120	25	500
Armour Road.....	65	120	--	5	190
Valentine Road...	20	25	5	--	50
Total Outbound	440	500	190	50	--

Source: SEWRPC.

Figure 3

MAJOR THROUGH TRAFFIC MOVEMENTS IN THE
VILLAGE OF OCONOMOWOC LAKE: OCTOBER 1989



Source: SEWRPC.

Table 3

TRAFFIC VOLUMES ALONG SELECTED SEGMENTS OF N. BEACH ROAD AND GIFFORD ROAD
 WITHIN THE VILLAGE OF OCONOMOWOC LAKE ON AN AVERAGE WEEKDAY FOR SELECTED YEARS

Streets	Year										
	1970	1971	1972	1973	1976	1979	1982	1985	1988	1989	1990
W. Beach Road Between Armour Road and Valentine Road.....	1,580	--	--	--	--	--	--	--	2,350	1,240	--
Between Newport Drive and Armour Road.....	--	1,450	1,580	1,880	2,510	1,940	1,970	2,180	--	1,330	1,500
N. Beach Road Between W. Beach Road and Gifford Road.....	--	--	--	--	--	--	--	--	1,790	2,000	--
Valentine Road Between W. Beach Road and Bridge Street.....	--	--	--	--	--	--	--	--	--	220	--
Gifford Road Between N. Beach Road and Hewitt's Point Road...	890	820	890	--	1,510	--	--	--	1,920	1,550	1,800

Source: Wisconsin Department of Transportation, Village of Oconomowoc Lake, and SEWRPC.

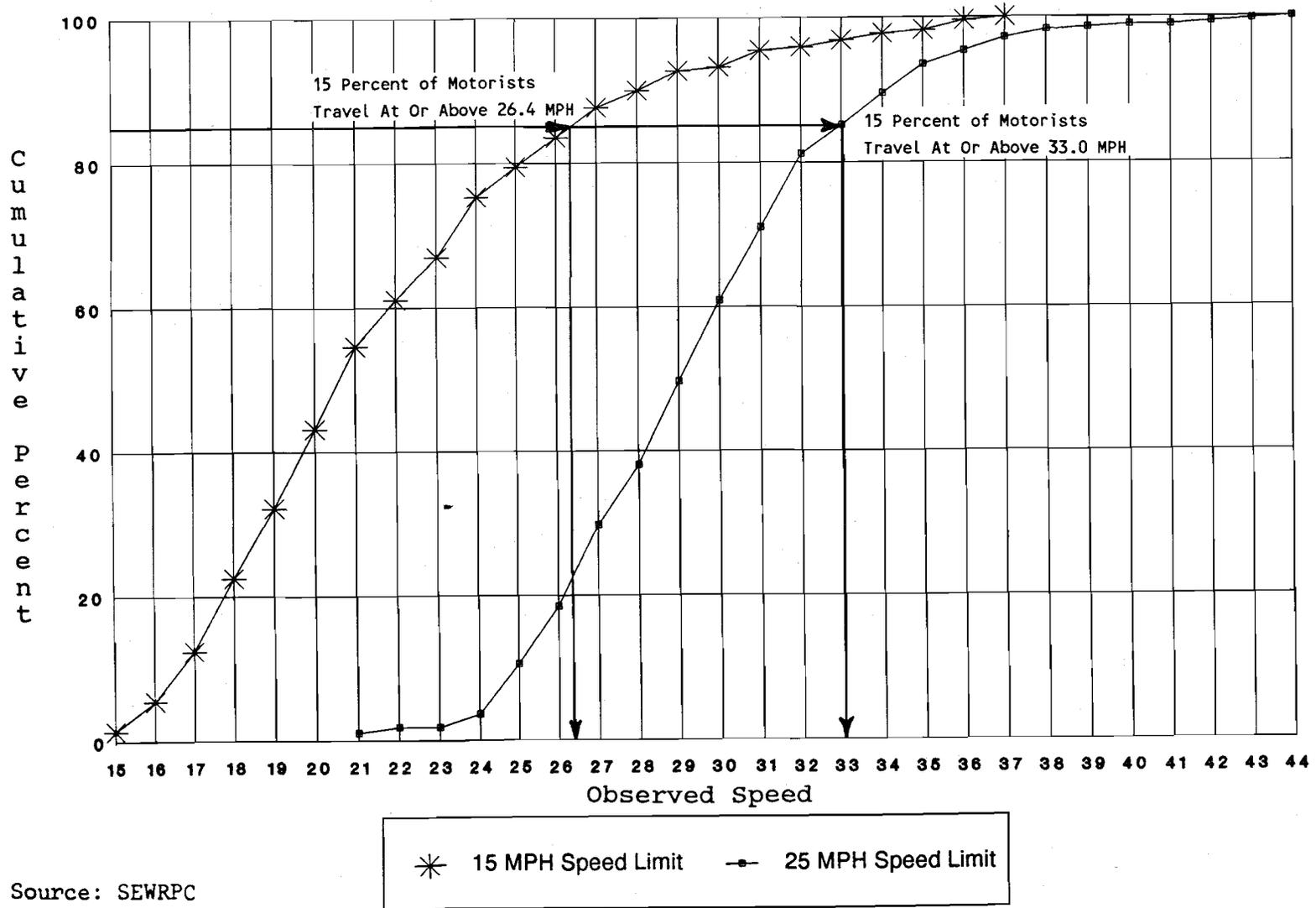
traffic counts at these locations in May 1990, while higher than the average weekday traffic volumes recorded in October 1989, are still slightly less than the traffic volumes recorded in the Village in 1988 prior to bridge reconstruction and the institution of the 15 mile per hour speed limit.

Operating Speeds

Two spot speed studies were conducted by the Commission staff on W. Beach Road in November 1989 and May 1990. The November 1989 study was conducted during the off-peak hours from 9:30 a.m. to 3:00 p.m.; and the May 1990 study from 11:45 a.m. to 4:30 p.m. During November 1989 the average travel speed was 29.8 miles per hour--30.3 miles per hour for northbound vehicles and 29.2 miles per hour for southbound vehicles. The 85th percentile speed--the speed at or below which 85 percent of traffic is traveling--was measured to be 33.0 miles per hour--33.4 miles per hour and 32.5 miles per hour for W. Beach Road traffic traveling northbound and southbound, respectively. The cumulative speed distribution of W. Beach Road traffic is shown graphically in Figure 4. The "10 mile per hour pace"--that is, the 10-mile per hour range of speed including the largest number of vehicles--was determined to be 25 to 34 miles per hour, with 86 percent of the vehicle traffic. By direction of traffic, the 10 mile per hour pace was 26 to 35 miles per hour and included 87 percent of the traffic traveling north on W. Beach Road; and 25 to 34 miles per hour and included 86 percent of the traffic traveling south on W. Beach Road.

The May 1990 spot speed study was conducted to determine motorist compliance with the posted 15 mile per hour speed limit. The average travel speed for northbound vehicles was 22.2 miles per hour--24.0 miles per hour and 20.5 miles per hour for northbound and southbound traffic, respectively. The 85th percentile speed was 26.4 miles per hour--28.2 miles per hour for northbound traffic; and for southbound traffic, 23.6 miles per hour. The cumulative speed distribution of traffic is shown graphically in Figure 4. The "10 mile per hour pace" range of speed was determined to be 17 to 26 miles per hour, with 78 percent of the traffic traveling within this range of speed--19 to 28 miles per hour with 76 percent of the traffic for northbound traffic and 16 to 25 miles per hour with 90 percent of the southbound traffic.

FIGURE 4
 CUMULATIVE SPEED DISTRIBUTION CURVES
 OF VEHICLE SPEED ON W. BEACH ROAD:1989-1990



Accidents

A three-year history of vehicular accident data was collected for the study segment of W. Beach Road and N. Beach Road. The location of each accident is shown in Figure 5. A total of five accidents occurred during the three-year period, with three accidents occurring in 1987; two accidents occurring in 1988; and no accidents occurring in the time period of January 1 to December 13, 1989. Of the total five accidents, four, or 80 percent, involved property damage only; one, or 20 percent, resulted in personal injuries. There were no fatal accidents or accidents involving pedestrians or bicyclists.

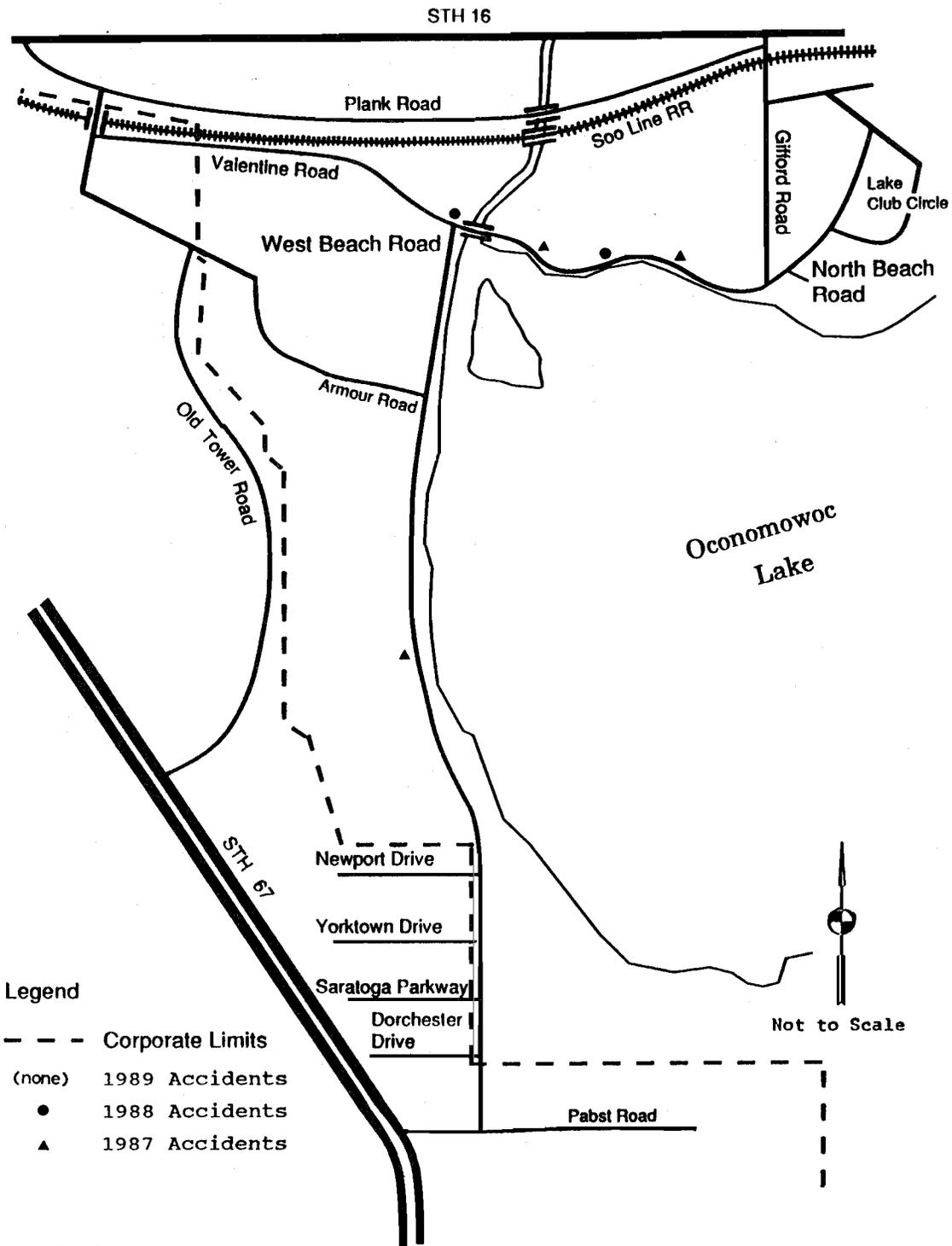
Travel Time Between STH 67 at Pabst Road and STH 16 at Gifford Road

The existing route which is most direct with respect to both time and distance between STH 67 at Pabst Road and STH 16 at Gifford Road is along N. and W. Beach Roads and Gifford Road, as shown in Figure 6. Motorists may be expected to use the route which results in the minimum travel time. The travel time over N. and W. Beach Roads and Gifford Road, based on a 25 mile per hour speed limit, is estimated to be approximately four minutes and 50 seconds, or about one minute faster than the estimated travel time over an existing alternate route including Old Tower Road.¹ The long planned re-routing of STH 67, as shown in Figure 7, is programmed by the Wisconsin Department of Transportation for construction in 1991 and may be expected to provide an alternative route requiring less travel time than the route using W. and N. Beach Roads. This route has an estimated travel time of approximately four minutes and 30 seconds, or about 40 seconds less than the route using Gifford Road from the new STH 16 interchange, and N. and W. Beach Roads. As a result, the implementation of the re-routing of STH 67 at an assumed speed limit of 35 miles per

¹Ideally, the travel time for the study segment and the alternative routes would be measured directly. However, construction on USH 16 rendered direct measurement impossible for existing conditions. Similarly, the travel time of the proposed STH 67 bypass could not be directly measured. An estimate of travel time could also be based on average travel speed or the 85th percentile speed when these data are available. However, these data are not available for the proposed STH 67 bypass and, thus, because the posted speed limits are known, the posted speeds were used to calculate the travel time on N. and W. Beach Roads and the alternate routes through the City of Oconomowoc.

Figure 5

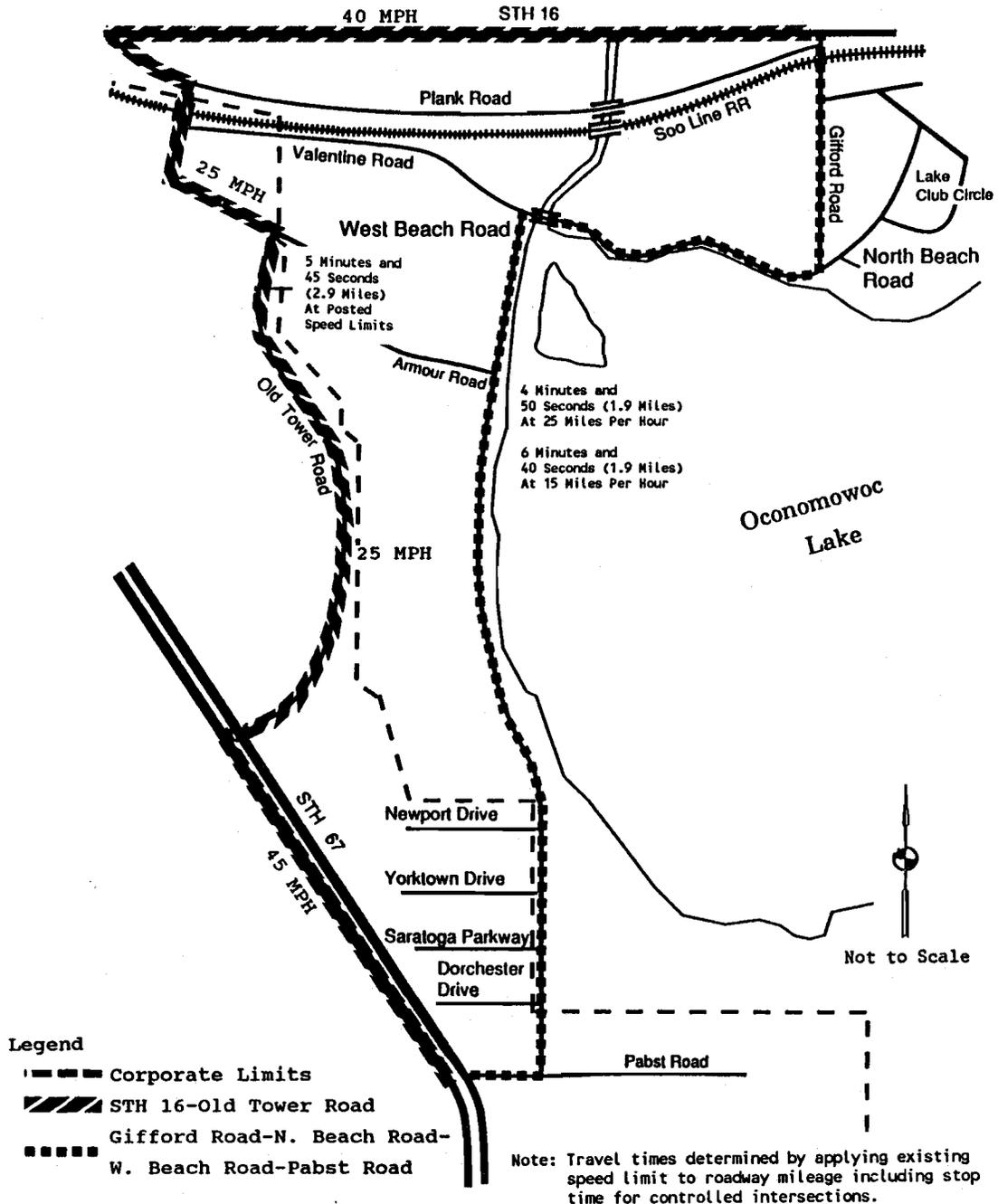
TRAFFIC ACCIDENT LOCATIONS ON SELECTED
STREETS IN THE VILLAGE OF OCONOMOWOC LAKE



Source: SEWRPC.

Figure 6

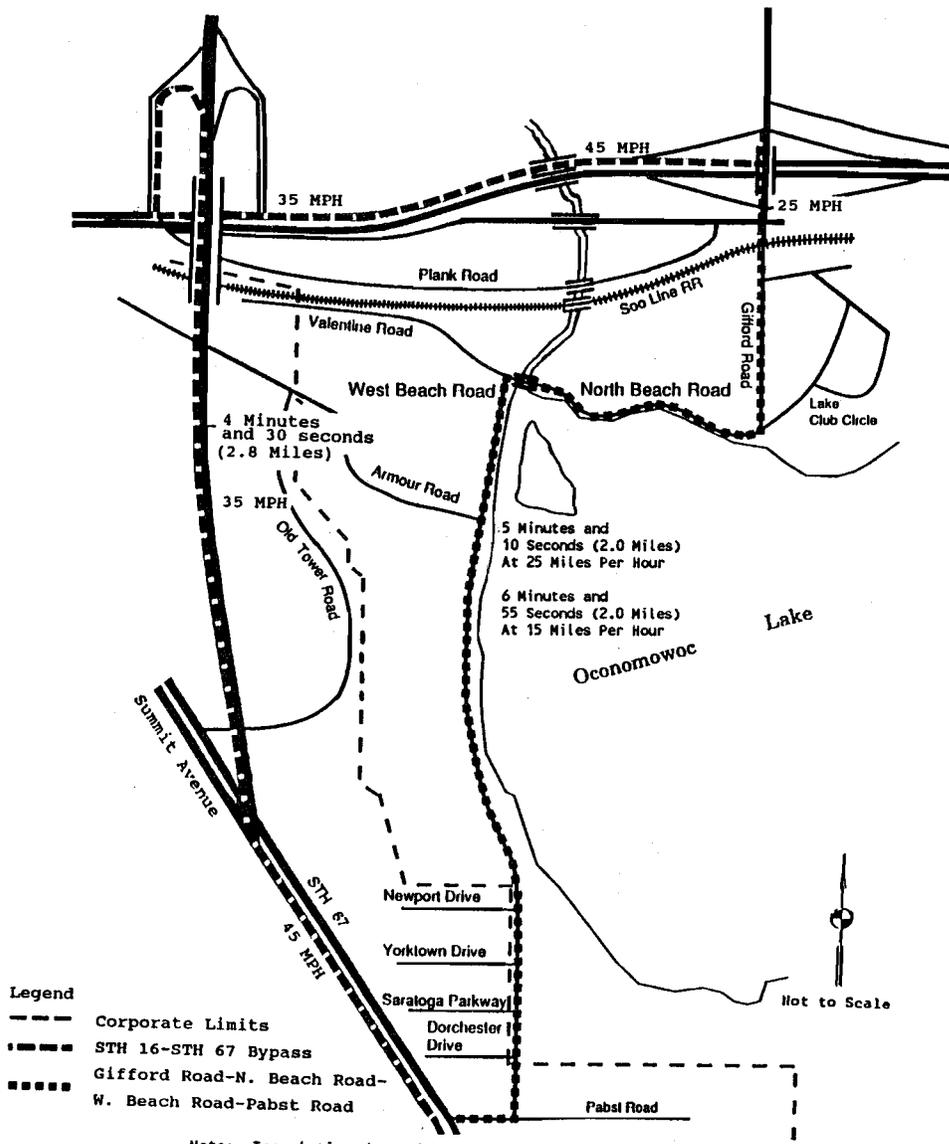
COMPARATIVE TRAVEL TIMES FOR SELECTED
EXISTING ROUTES BETWEEN STH 16 AND STH 67
IN THE VILLAGE OF OCONOMOWOC LAKE



Source: SEWRPC.

Figure 7

COMPARATIVE TRAVEL TIMES FOR SELECTED
EXISTING AND PROGRAMMED ROUTES BETWEEN STH 16 AND STH 67
IN THE VILLAGE OF OCONOMOWOC LAKE



hour may be expected to significantly reduce through traffic on N. and W. Beach Roads.

ANALYSIS AND PROBLEM IDENTIFICATION

This section of the memorandum report analyzes the physical and operational data collected and compares it with accepted traffic engineering standards to identify existing traffic problems.

Pedestrian and Bicyclist Safety

As noted in the roadway physical characteristics inventory, the existing roadway cross-section has a 20-foot pavement width and no shoulders. A desirable land access street would have a cross-section of 22 feet of pavement with five-foot-wide shoulders; and a minimum land access street would have a cross-section of 18 feet of pavement with three-foot-wide shoulders. The existing cross-section may be considered substandard as a land access street. The substandard roadway cross-section, particularly the lack of shoulders, exacerbates the lack of sidewalks as pedestrians and bicyclists share the pavement with motor vehicles. Thus, the existing roadway serves two incompatible types of traffic: vehicular and pedestrian/bicyclist. The accident potential between vehicles and pedestrians and bicyclists is significant, particularly given narrow pavement width and lack of shoulders.

It should also be noted that approximately 300 feet north of Newport Drive there is an abrupt change in both the horizontal and vertical alignments of W. Beach Road. Approximately 400 feet north of Newport Drive there is a beach area with boat slips on the east side of W. Beach Road and a private road on the west side of W. Beach Road. The sight distance of pedestrians crossing from the private roadway to the beach area is restricted to and from the south by the change in the W. Beach Road alignment, increasing the difficulty pedestrians and motorists experience in identifying potential hazards.

Another location where a concentration of pedestrian crossing activity may be expected is on W. Beach Road about 75 feet south of Armour Road. There is a beach area with boat slips located on the east side of W. Beach Road and a

private drive to a planned unit development located on the west side of the roadway. Sight distance is restricted to and from the south by foliage on the east side of the roadway, increasing the difficulty pedestrians and motorists experience in identifying potential hazards.

Foliage adjacent to the roadway restricts sight distance at other locations along the study segment as well. Sight distance restrictions have the potential to create pedestrian/vehicular conflicts for those pedestrians walking on the edge of the roadway as well as those pedestrians crossing the roadway. Those locations where foliage adjacent to the roadway reduces the sight distance below that necessary to enable a motorist to sight an object in the travel path and stop before striking it are shown in Figure 8.²

Traffic

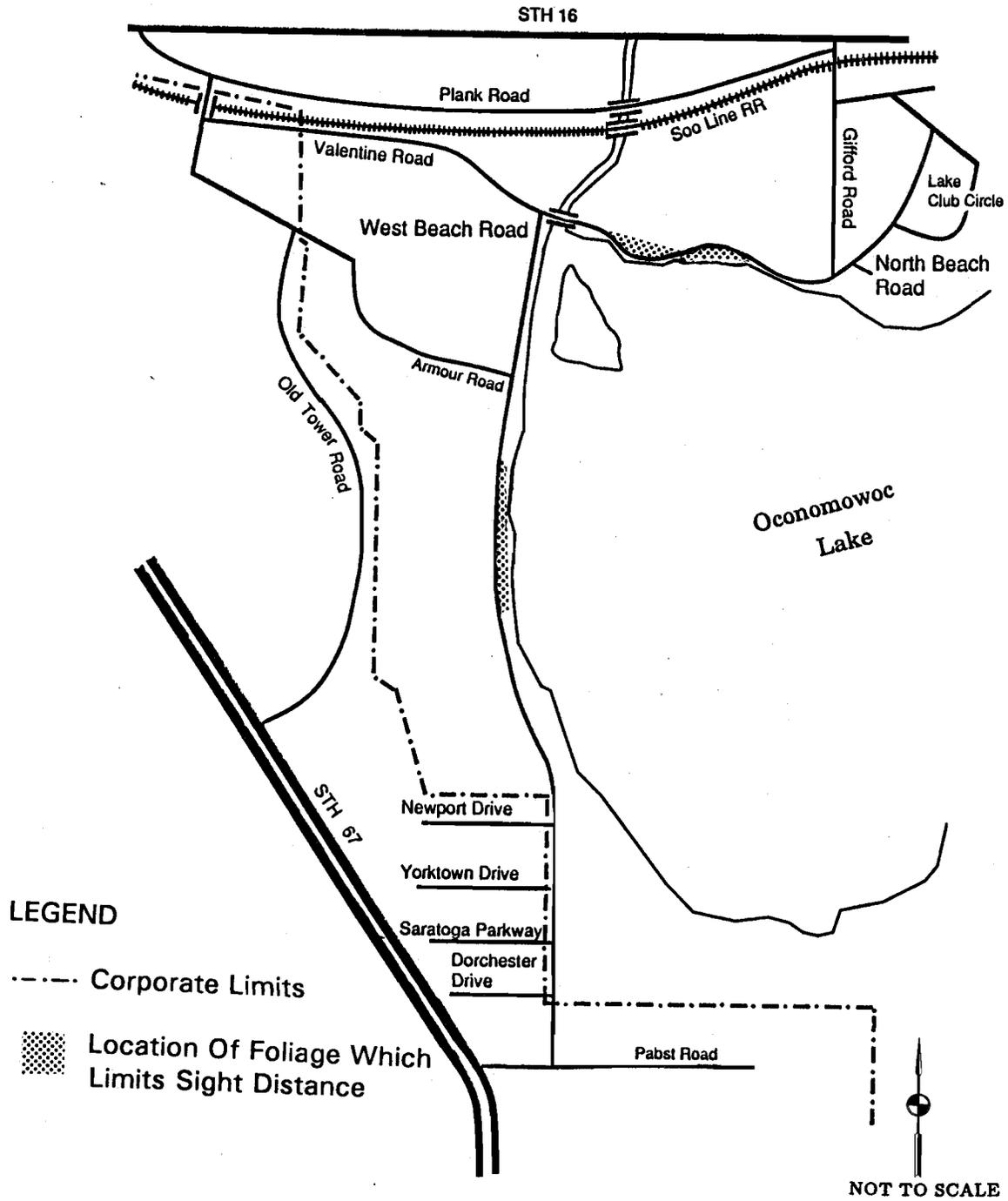
The historic traffic data indicate that traffic volumes on the study segment of W. Beach Road and N. Beach Road exceed the threshold of 1,500 vehicles per average weekday, typically considered the maximum desirable volume for land access streets. The maximum acceptable traffic volume on land access streets is 2,500 vehicles per day. It may be noted that based on current traffic volumes the Wisconsin Department of Transportation classifies N. Beach Road as a major collector and W. Beach Road as a minor arterial. As previously noted, the Commission's year 2000 adopted regional transportation system plan classifies these facilities as local land access or collector facilities in recognition of the manner in which they should function, rather than the manner in which they currently function.

The license plate survey conducted in October 1989 established that, of the total 1,550 vehicles observed at Gifford Road on the survey day, 1,000 vehicles, or about 64 percent, were through traffic. Similarly, of the total 1,330 vehicles observed at W. Beach Road, 880 vehicles, or about 66 percent,

²The minimum distance for a motorist to sight an object in his path and to be able to stop his vehicle prior to striking that object is dependent upon the speed of the vehicle. At 25 miles per hour the minimum sight distance is 150 feet; at 35 miles per hour the minimum sight distance increases to 250 feet.

Figure 8

AREAS OF LIMITED SIGHT DISTANCE



Source: SEWRPC.

represent through traffic. Of the total 840 vehicles at Armour Road, 380, or about 45 percent, represent through traffic; and, of the total vehicles observed at Valentine Road, 100 vehicles, or about 50 percent, represent through trips. It may be noted that these estimated through traffic volumes are approximately equal to the increase in traffic observed following the re-opening of the N. Beach Road structure.

Thus it may be concluded that substantial through traffic does exist on the study segment of N. Beach Road and W. Beach Road. Furthermore, it would appear that the 15 mile per hour speed limit has had only a limited impact on traffic volume on Gifford Road and W. and N. Beach Roads. Average weekday traffic volumes in May 1990 following the re-opening of the N. Beach Road bridge are approaching historic high levels in 1988.

Accidents

The three-year accident history was analyzed and the only pattern identified was that three of the five accidents, or 60 percent, occurred at night. None of the accidents involved either pedestrians or bicyclists. As previously shown in Figure 5, each of the accidents occurred at a different location. Thus, it may be concluded that there is not a particular location along the study segment which requires additional analysis for safety improvements due to existing accidents.

Operating Speeds

Spot speed data were collected at two different points in time. The first time such data were collected, the posted speed limit was 25 miles per hour; the second time, the seasonally lower speed limit of 15 miles per hour was in effect. When the 25 mile per hour speed limit was in effect, the average speed was 29.8 miles per hour and 85 percent of all motorists traveled at or below 33 miles per hour. About 86 percent of all motorists were found to travel within the 10 mile per hour pace. The top 15 percent of all motorists traveling at the highest speeds were traveling at 33 to 43 miles per hour.

When the 15 mile per hour speed limit was in effect, the average speed was 22.2 miles per hour, and 85 percent of all motorists traveled at or below 26.4

miles per hour. About 78 percent of all motorists traveled within the 10 mile per hour pace. The top 15 percent of all motorists traveling at the highest speeds were traveling at 26 to 37 miles per hour.

Motorist compliance with the 25 mile per hour speed limit is compared to motorist compliance with the 15 mile per hour speed limit in Table 4. Compliance was only slightly worse under the 15 mile per hour speed limit with respect to the degree to which vehicles travel over the speed limit and the variation in vehicle speeds. Under both speed limits, nearly 80 percent of vehicle traffic traveled between about one and ten miles per hour over the speed limit; and the top 15 percent of vehicle traffic traveling at the highest speeds were traveling at 10 to 20 miles per hour over the speed limit.

These findings of substantially the same motorist compliance with the 15 and 25 mile per hour speed limits are atypical. Before and after studies of speed limit reductions under similar circumstances--when the average speed and 85th percentile speed already substantially exceed the original speed limit--have indicated that motorist compliance substantially is reduced if speed limits are lowered. Typically, the percentage of vehicles traveling over the speed limit substantially increases; however, on W. Beach Road this percentage only increased from approximately 85 to 95 percent. Also, typically the degree to which vehicles travel over the speed limit and the variation in vehicle speeds substantially increases; however, on W. Beach Road the maximum percentage of vehicles traveling within a 10 mile per hour range was only reduced from 86 to 78 percent; and the 10 mile per hour range remained at a range of about one to ten miles per hour over the speed limit. Lastly, on W. Beach Road the top 15 percent of speeding vehicles were determined to be traveling at a range of 10 to 20 miles per hour over the speed limit both before and after the speed limit reduction.

Inappropriate Traffic Control

An intersection identified as having inappropriate traffic control is the intersection of N. and W. Beach Roads with Valentine Road. At this intersection, two facilities of the same order--N. and W. Beach Roads--intersect with

Table 4

COMPARISON OF MOTORIST COMPLIANCE WITH
THE 15 AND 25 MILE PER HOUR SPEED LIMIT

Speeds	25 Miles per Hour	15 Miles per Hour
Average Speed.....	+4.8 miles per hour over the speed limit	+7.2 miles per hour over the speed limit
85th Percentile Speed...	+8 miles per hour over the speed limit	+11 miles per hour over the speed limit
10 Mile Per Hour Pace...	86 percent of traffic (25-34 miles per hour)	78 percent of traffic (17-26 miles per hour)
Speed Range of the Top 15 Percent of Traffic Traveling at Highest Speeds.....	34-44 miles per hour	26-37 miles per hour

Source: SEWRPC.

a lower order facility--Valentine Road. As the lower order facility, the Valentine Road approach is appropriately stop sign controlled. However, it may be noted that, of the two facilities of the same order, only the W. Beach Road approach is stop sign controlled. At this intersection there is a physical feature--the presence of the Oconomowoc River--which imposes sight restricting geometric conditions on the east- and northbound approaches, namely a substantial change in the vertical alignment caused by the structure over the river which is substantially higher than the intersection itself. Significant amounts of plant material in the southeast quadrant of the intersection and/or the structure railing appear to further restrict sight distance for eastbound and northbound, as well as westbound, motorists. Thus it may be concluded that a sight distance problem exists on all approaches. Consideration of a three-way stop sign at this intersection may be necessary to alleviate this problem.

Signs at two non-intersection locations were identified as inappropriate as well. The first is the warning sign on the north side of N. Beach Road with the message "Dangerous Intersection", and the second--also located on the north side of N. Beach Road--is the warning sign with the pictograph for "Turn." The message "Dangerous Intersection" is a non-standard message and, while the message may seem clear, the circumstances creating the danger are not clear; and, as a result, motorist interpretation of and response to the message has the potential to vary. The warning sign with the pictograph "TURN" is a standard sign which is intended to convey the same two-part message to all motorists: 1) there is an impending abrupt change in horizontal alignment; and 2) the change in alignment is more safely negotiated at speeds below that posted on the facility itself. While turning left from N. Beach Road to W. Beach Road is an abrupt change in direction and is more safely executed at slower speeds, it is not required by a change in alignment. Motorists have the options of proceeding straight through the intersection or turning right. Thus it may be concluded that these signs are inappropriate.

Conclusions

Analysis of the data indicates that four traffic problems exist on the study segment. The first problem is substantial traffic traveling through the Village of Oconomowoc Lake on the study segment. The second problem is a

vehicular speeding problem on W. Beach Road when the 25 mile per hour limit is in force, and a similar problem which is only modestly greater--when the seasonal 15 mile per hour speed limit is in force. The third problem is a pedestrian/ bicyclist safety problem. The fourth problem identified is inappropriate traffic control.

ALTERNATIVE AND RECOMMENDED TRAFFIC MANAGEMENT AND IMPROVEMENT ACTIONS

This section of the memorandum report presents traffic management and improvement actions which address the identified traffic problems.

The major traffic problem identified on the study segment is excessive through traffic. The principal action recommended to alleviate this problem is the long planned construction of a new route for STH 67 between STH 67 at Old Tower Road and STH 16 approximately one mile west of CTH P, as shown on Map 2. This new roadway segment may be expected to divert through traffic from N. and W. Beach Roads as it would provide a route of less travel time between STH 67 at Pabst Road and STH 16 at CTH P. The construction of this new roadway has been recommended by the Regional Planning Commission since 1974 as documented in SEWRPC Planning Report No. 18, A Jurisdictional Highway System Plan for Waukesha County.

The Wisconsin Department of Transportation has programmed the completion of the construction of this new roadway for 1992, as described in Table 5. The estimated construction cost of the new roadway is \$5 million. Travel time on this alternate route between STH 67 at Pabst Road and STH 16 at Gifford Road is estimated to be approximately 40 seconds less than the travel time on the route consisting of Gifford Road, and N. and W. Beach Roads, between STH 16 at Gifford Road and STH 67 at Pabst Road. It is estimated that the construction of STH 67 on new alignment may be expected to reduce traffic on N. and W. Beach Road from the estimated historic traffic volume of 1,800 to 2,350 vehicles per average weekday in 1988 to 500 to 750 vehicles per average weekday. It may be noted that the remaining traffic volume is well below the threshold of 1,500 vehicles per average weekday which is typically considered the maximum desirable volume of traffic for local land access streets. Thus,

Table 5

CURRENTLY ANTICIPATED TIMETABLE OF THE
PROGRAMMED PROJECT FOR CONSTRUCTION OF STH 67
ON NEW ALIGNMENT BETWEEN SUMMIT AVENUE AND STH 16

Steps in Project Construction	Date ^a
First Public Informational Meeting...	September 19, 1990
Second Public Informational Meeting..	February 6, 1990
Third Public Informational Meeting...	June 1990
Public Hearing.....	June 1990
Construction Plans Finalized.....	February 1991
Construction Contract Let.....	July 1991
Construction Begins.....	November 1991
Construction Finish.....	Early fall 1992

^aUnless day identified, all times subject to change.

Source: Village of Oconomowoc Lake, the Wisconsin Department of Transportation, and SEWRPC.

the construction of the new routing for STH 67 may be expected to abate the through traffic problem on W. and N. Beach Roads. In addition, by removing through traffic and substantially reducing traffic volume, the identified pedestrian/bicyclist safety problem and the vehicle speeding problem may also be reduced. It should be noted that the Village will not experience such relief from these traffic problems until after roadway construction is completed in the fall of 1992. It is recommended that the Village Board adopt a resolution endorsing the implementation of the State project in a timely manner and forward copies to the Secretary of the Wisconsin Department of Transportation and to state legislators. The Commission staff would further recommend that the Village consider discontinuing the 15 mile per hour seasonal speed limit upon implementation of the new STH 67 route, as the new route may be expected to reduce traffic volumes and speeding on N. and W. Beach Road.

It should be noted that, although substantial through traffic diversion may be expected as a result of the construction of STH 67 on new alignment between Summit Avenue and Wisconsin Avenue, such diversion will not occur until after completion of construction in 1992. Accordingly, the Commission staff considered potential interim actions, including the speed limit reduction implemented by the Village in 1989. The Commission staff would not have recommended to the Village the implementation of the seasonal speed limit reduction because of concerns with respect to a potential increase in both speeding and variation in vehicle speeds and their potential implications for vehicle and pedestrian safety. Also, the potential for the speed reduction to divert substantial through traffic would have been estimated by Commission staff to be minimal. Data gathered by Commission staff subsequent to the implementation of the speed reduction indicates that potentially little through traffic has indeed been diverted.

With respect to vehicle speed, analysis of vehicle speeds before and after the reduced speed limit indicates that not only did an unanticipated decrease in the 85th percentile speed occur which essentially mirrored the decrease in the speed limit, but there was only a marginal decrease in the percentage of vehicles traveling within the 10 mile pace range of speeds. This may be attributed

to the speed limit enforcement program implemented by the Village. The Commission staff would continue to expect a potential increase in the 85th percentile speeds and a greater variation of speeds on N. and W. Beach Roads under the 15 mile per hour seasonal speed limit. Therefore, should the Village determine to retain the 15 mile per hour seasonal speed limit prior to the construction of the new STH 67 route, the Commission staff would recommend that the Village continue to operate a substantial and aggressive speed enforcement program to reduce the potential for increased speeding. Furthermore, the Commission staff would recommend that the Village periodically monitor vehicle traffic speed during the implementation of the seasonal speed limit to establish that an increase in the 85th percentile speed and an increase in the variation in vehicle speeds have not occurred with their potential consequences for reduced vehicular and pedestrian safety.

Because the seasonal speed limit does not appear to have reduced through traffic on N. and W. Beach Roads, and because the potential does exist for increased vehicle speeding and variation in speeds with its consequences for traffic safety, the Commission staff identified and evaluated a wide range of alternative measures to the seasonal speed limit which may be expected to address both problems on N. and W. Beach Roads, that is, the amount of through traffic and vehicle speeding. These alternative traffic management actions which the Village could implement in the interim included two alternative installation of regulatory signing to prohibit selected turning movements at selected intersections and the construction of a cul-de-sac at one of three alternative locations. Each of these five traffic management actions may be expected to preclude use of the existing through traffic route and, as well, reduce the directness of local travel. It may be expected that these alternative actions would function like the closure for reconstruction of the W. Beach Road structure over the Oconomowoc River in 1989, which virtually eliminated through traffic from N. and W. Beach Roads, reducing historic traffic counts from between 1,900 and 2,300 vehicles per average weekday to 500 vehicles per average weekday. An evaluation of each of these alternative interim traffic management actions is presented in Table 6.

Table 6

EVALUATION OF TRAFFIC MANAGEMENT ACTIONS TO ABATE THROUGH TRAFFIC PROBLEM
ON N. AND W. BEACH ROADS AND GIFFORD ROAD IN THE VILLAGE OF OCONOMOWOC ON AN
INTERIM BASIS UNTIL IMPLEMENTATION OF THE STH 67 BYPASS IN THE CITY OF OCONOMOWOC

Existing Routes and Alternative Actions	Route Description	Travel Time (minutes)	Estimated						Through Traffic Diversion ^a (number of vehicles)	Estimated Cost
			Northbound			Southbound				
			Added Travel Time (minutes)	Total Travel Time (minutes)	Alternate Route Travel Time (minutes)	Added Travel Time (minutes)	Total Travel Time (minutes)	Alternate Route Travel Time (minutes)		
Existing Routes Existing route through the Village of Oconomowoc Lake	Gifford Road; N. Beach Road; W. Beach Road; and Pabst Road	4.83	--	--	--	--	--	--	--	\$ --
Existing alternate route	USH 16; Plank Road; Bridge Street; Armour Street; Old Tower Road; STH 67	5.75	--	--	--	--	--	--	--	--
Alternative Actions Prohibit left turns on eastbound approach of N. Beach Road at Gifford Road; and westbound approach of N. Beach Road at W. Beach Road ^{b, c}	Gifford Road; Lake Club Circle; N. Beach Road; W. Beach Road; and Pabst Road	--	1.0	5.85	5.85	--	--	--	900-1,850	400
	USH 16; Plank Road; Bridge Street; Armour Street; Old Tower Road; STH 67	--	--	--	--	0.9	5.75	5.75	--	--
Prohibit left turns on westbound approach of N. Beach Road at W. Beach Road; and right turns on northbound approach of W. Beach Road at N. Beach Road	USH 16; Plank Road; Valentine Road; Armour Street; Old Tower Road; STH 67	--	1.5	6.35	5.75	1.5	6.35	5.75	1,850	400
Construct cul-de-sac on Gifford Road approximately 550 feet south of Hewitt's Point Road	Gifford Road; Lake Club Circle; N. Beach Road; W. Beach Road; and Pabst Road	--	1.0	5.85	5.85	0.8	5.70	5.75	0-1,850	10,500
Construct cul-de-sac on W. Beach Road between Armour Road and Earling Court	USH 16; Plank Road; Bridge Street; Armour Street; Old Tower Road; STH 67	--	3.75	8.60	5.75	3.75	8.60	5.75	1,850	10,500
Construct cul-de-sac on W. Beach Road between S. Beach Road and Saratoga Parkway	USH 16; Plank Road; Valentine Road; Armour Street; Old Tower Road; STH 67	--	1.1	5.95	5.75	1.1	5.95	5.75	1,850	10,500

-continued-

Table 6 (continued)

Existing Routes and Alternative Actions	Route Description	Advantages	Disadvantages
Existing Routes Existing route through the Village of Oconomowoc Lake	Gifford Road; N. Beach Road; W. Beach Road; and Pabst Road	--	--
Existing alternate route	USH 16; Plank Road; Valentine Road; Armour Street; Old Tower Road; STH 67	--	--
Alternative Actions Prohibit left turns on eastbound approach of N. Beach Road at Gifford Road; and westbound approach of N. Beach Road at W. Beach Road	Gifford Road; Lake Club Circle; N. Beach Road; W. Beach Road; and Pabst Road USH 16; Plank Road; Valentine Road; Armour Street; Old Tower Road; STH 67	Through traffic may be expected to be diverted from N. and W. Beach Roads and Gifford Road Emergency vehicles may disregard turn prohibitions and, thus, there will not be an impact on emergency vehicle response time	Southbound village traffic originating north of Oconomowoc Lake will likely require an additional 2.0 minutes of travel time to reach STH 67 at Pabst Road. Northbound village traffic originating west and south of Oconomowoc Lake will require an additional 1.0 minute of travel time to reach USH 16 at Gifford Road An estimated 400 additional trips per average weekday made by residents would divert to Hewitt's Point Road and Lake Club Circle Northbound through traffic may not divert, given equal travel times on each route Significant law enforcement activity likely to be required to ensure motorist compliance
Prohibit left turns on westbound approach of N. Beach Road at W. Beach Road; and right turns on northbound approach of W. Beach Road at N. Beach Road	USH 16; Plank Road; Valentine Road; Armour Street; Old Tower Road; STH 67	Through traffic may be expected to be diverted from N. and W. Beach Roads and Gifford Road	Southbound village traffic originating north of Oconomowoc Lake will likely require an additional 2.0 minutes of travel time to reach STH 67 at Pabst Road. Northbound village traffic originating west and south of Oconomowoc Lake will require an additional 1.5 minutes of travel time to reach USH 16 at Gifford Road. An estimated 375 trips per average weekday by village residents would divert to land access streets in the City of Oconomowoc. Significant law enforcement activity likely to be required to ensure motorist compliance
Construct cul-de-sac on Gifford Road approximately 550 feet south of Hewitt's Point Road	Gifford Road; Lake Club Circle; N. Beach Road; W. Beach Road; and Pabst Road	Through traffic may be expected to be diverted from N. and W. Beach Roads and Gifford Road	North- and southbound village traffic will require an additional 1.1 minutes of travel time. An estimated 400 trips per average weekday made by village residents would divert to Hewitt's Point Road and Lake Club Circle

-continued-

Table 6 (continued)

Existing Routes and Alternative Actions	Route Description	Advantages	Disadvantages
<p>Alternative Actions (continued) Construct cul-de-sac on Gifford Road (continued)</p>		<p>Temporary traffic barricades may be installed at an estimated cost of \$1,200 and the impact of the closure measured for a trial period. Upon completion of the trial period, a decision could be made with regard to the desirability of a permanent closure</p>	<p>Maximum estimated increase in emergency response time is 1.0 minute</p>
<p>Construct cul-de-sac on W. Beach Road between Armour Road and Earling Court</p>	<p>USH 16; Plank Road; Valentine Road; Armour Street; Old Tower Road; STH 67</p>	<p>Through traffic may be expected to be diverted from N. and W. Beach Roads and Gifford Road</p> <p>Temporary traffic barricades may be installed at an estimated cost of \$1,200 and the impact of the closure measured for a trial period. Upon completion of the trial period, a decision could be made with regard to the desirability of a permanent closure</p>	<p>Earling Court residents will require an additional 3.8 minutes to reach USH 16 at Gifford Road. Residents north of the will require an additional 1.7 minutes at Pabst Road. An estimated 400 trips per average weekday made by residents would divert to land access streets in the City of Oconomowoc</p> <p>Maximum estimated increase in emergency vehicle response time is 1.7 minutes</p>
<p>Construct cul-de-sac on W. Beach Road between S. Beach Road and Saratoga Parkway</p>	<p>USH 16; Plank Road; Valentine Road; Armour Street; Old Tower Road; STH 67</p>	<p>Through traffic may be expected to be diverted from N. and W. Beach Roads and Gifford Road</p> <p>Temporary traffic barricades may be installed at an estimated cost of \$1,200 and the impact of the closure measured for a trial period. Upon completion of the trial period, a decision could be made with regard to the desirability of a permanent closure</p>	<p>North- and southbound local traffic will require an additional 1.1 minutes of travel time. An estimated 500 trips per average weekday made by village residents would divert to land access streets in the City of Oconomowoc</p>

^aThe estimate of diversion is based upon the amount of village traffic determined by the license plate survey and the resultant estimated through traffic based on the historic traffic count.

^bAn option of this traffic management alternative was the prohibition of left turns only during the hours of peak traffic flow. An advantage of this option is that it would not alter residents' travel patterns throughout the day, but rather only during those periods of peak traffic flow. However, it should be noted that the through traffic problem is not limited to the peak periods. Therefore, this option was not recommended.

^cThe construction of a barrier curb traffic diverters at the subject intersections considered to physically prohibit the same left turns, as the regulatory signing. The advantage of this alternative is to reduce the need for law enforcement activity to prevent selected left turns. The disadvantage of this alternative, in addition to the inconvenience to Village residents caused by more circuitous travel, is that left turns by emergency vehicles are physically prevented as well. The traffic diverters are estimated to divert approximately 1,850 through vehicles per average weekday to Old Tower Road, increasing the average weekday traffic on this facility from approximately 4,220 vehicles to 6,070; and would divert additional local traffic of approximately 200 vehicles per average weekday to the segment of N. Beach Road between Gifford Road and the north leg of Lake Club Circle. The estimated cost to construct the traffic diverters is \$6,000. Therefore, implementation of traffic diverters was rejected.

Source: SEWRPC.

Based on the evaluation of the five alternative traffic management actions presented in Table 6, it is recommended that the Village consider as an interim measure implementation of the regulatory signing alternative to prohibit left turns on the eastbound approach of N. Beach Road at Gifford Road; and the westbound approach of N. Beach Road at W. Beach Road to divert through traffic until STH 67 is constructed on new alignment. The staff recommends consideration of this action because, of the alternative actions considered, it is the least disruptive to local traffic, minimizing circuitous travel for residents; and may be readily implemented at a nominal capital cost. However, it is likely that implementation of this alternative will as well necessitate an increase in law enforcement activity. Further, it may be expected that the diverted through traffic will use local streets in the City of Oconomowoc until STH 67 is constructed on new alignment.

Of the three cul-de-sac alternatives examined, the best alternative was the construction of a cul-de-sac on W. Beach Road between S. Beach Road and Saratoga Parkway. This action would more surely divert through traffic than a cul-de-sac on Gifford Road, and with less disruption to local traffic than a cul-de-sac on W. Beach Road just south of Armour Road. It could also be implemented through the use of temporary barricades. Use of temporary barricades rather than immediate cul-de-sac construction facilitates implementation; would reduce the capital costs; and would permit implementation on a trial basis. However, it may be expected that not only will through traffic be diverted to local streets in the City of Oconomowoc, but Village of Oconomowoc Lake traffic as well, including emergency vehicles.

Village officials and residents have expressed concern over pedestrian and bicyclist safety. An additional traffic management action considered to alleviate pedestrian safety problems was to designate a pedestrian crosswalk through the installation of pavement markings and advisory signing which would cross W. Beach Road at a point approximately 400 feet north of Newport Road. The advantages of this action would be an increase in driver awareness of pedestrian crossing locations and the identification of a specific location where pedestrians should cross the roadway. It is recommended that pavement

markings and advisory signing be installed at the location identified. The estimated cost of implementing this recommendation is about \$300.

In addition there are a number of locations where foliage adjacent to the roadway restricts motorist sight distance, thus creating a potential for vehicular/pedestrian conflicts, as shown on Figure 8. The short-range action considered to alleviate the sight distance restrictions was the removal of some encroaching brush at the locations shown on Figure 8 to provide a minimum of 250 feet of unrestricted sight distance. The advantage of this action is to provide adequate sight distance for both motorists and pedestrians to reduce pedestrian/vehicular conflicts. The estimated cost is approximately \$1,500.

Another short-range action considered to alleviate the concern regarding pedestrian and bicyclist safety was the construction of a footpath. The advantage of this action would be a substantial improvement in pedestrian safety which would accompany the full separation of vehicular traffic from pedestrians and bicyclists. The disadvantages of this alternative action include the cost of implementation and the necessity of removing trees, shrubs, and other obstacles adjacent to the roadway to accommodate the construction of a five-foot-wide, three-inch-thick bituminous concrete footpath at the right-of-way line. Further, it is anticipated that the need for a footpath would be substantially reduced after through traffic is diverted from N. and W. Beach Roads by the realignment of STH 67, or implementation of the interim measures recommended herein. It is recommended that a pedestrian path be provided along the west side of W. Beach Road from Newport Drive to Valentine Road; and on the north side of N. Beach Road from Valentine Road to Gifford Road, which includes modifying the existing bridge over the Oconomowoc River to accommodate pedestrians; and on the west side of Gifford Road north to Hewitt's Point Road only if the construction of the new segment of STH 67 is delayed and if no other interim measures are implemented to divert through traffic. It is estimated that implementation of this short-range action would cost approximately \$50,000.

To alleviate an inappropriate traffic control problem at the intersection of N. and W. Beach Roads and Valentine Road, the installation of a stop sign on

the N. Beach Road approach was considered. At this intersection, sight distance is restricted by a railing on the structure over the Oconomowoc River and plant material in the southeast quadrant. This action would improve traffic safety at this intersection. Thus, it is recommended that a stop sign and an advance warning sign with the message "Stop Sign Ahead" be installed on the westbound approach to this intersection, at an estimated cost of \$150. It may be noted that the N. Beach Road structure over the Oconomowoc River limits the available sight distance of vehicles approaching from the east on N. Beach Road to approximately 140 feet, which is less than the 150 feet of unobstructed sight distance required for the 25 mile per hour posted speed. However, a sight distance of approximately 250 feet could be provided on this approach by locating the stop sign and stop line approximately 29 feet, or about one car length, east of the intersection. Vehicles stopped at this location would thus be visible to motorists approaching from the east, even at speeds up to 35 miles per hour.

The installation of the stop sign and the "Stop Sign Ahead" sign on the westbound approach of N. Beach Road at its intersections with W. Beach Road and Valentine Road would permit the removal of two warning signs on the north side of N. Beach Road. One of these sign employs a non-standard message which may lead to different interpretations of and reactions to the message by different motorists, thereby increasing accident potential. The other sign warns of an abrupt alignment change which does not exist. It may be noted that the recommended stop sign installation will assign the right-of-way in the intersection, thereby improving the safety of the intersection and permitting removal of the warning sign with the message "Dangerous Intersection." Further, because all motorists on the westbound approach will be required to stop, those turning left to proceed south on W. Beach Road may be expected to do so at a safe speed as they accelerate from a stopped condition. Therefore, it is recommended that these two warning signs be removed, at an estimated cost of \$150.

Additional Measures Considered But Rejected

The following additional traffic management actions, including those suggested by citizens, were considered but rejected to alleviate the volume of through traffic and excessive vehicle speeds on W. and N. Beach Roads: 1) designating N. Beach Road a one-way street; 2) installing speed control bumps or speed control humps on W. and N. Beach Roads; 3) installing "No Thru Traffic" signs on W. Beach Road immediately south of Dorchester Drive and on Gifford Road immediately south of its intersection with STH 16; 4) the placement of stop signs at midblock locations; 5) pavement chokers; 6) speed-actuated warning signs; and 7) marked pedestrian cross walks at several alternative locations on W. Beach Road.

Designating N. Beach Road a one-way street for traffic traveling to the west was rejected because: 1) there is no nearby parallel facility for travel in the opposite direction; 2) it would not prevent motorists from completing through trips from the north; 3) studies have shown that vehicle speeds tend to be higher on one-way streets; 4) a one-way street would result in more circuitous travel for residents; and 5) generally increases trip length and is more confusing to the occasional visitor. For these reasons this traffic management action was rejected.

The installation of speed control bumps on W. and N. Beach Roads was considered but rejected. Speed control bumps are raised sections in the pavement surface extending transversely across the traveled way approximately four inches high off the pavement surface and normally less than two feet in length. Speed control bumps differ from speed control humps in that bumps are higher and shorter, catching only the wheels on one end of a vehicle. Their effects on the ride of the vehicle are, therefore, more pronounced than the effects of speed control humps. Speed control bumps are: 1) not recommended for use in the Manual of Uniform Traffic Control Devices; 2) reported to interfere with winter snow plowing operations; 3) a hazard to bicyclists and motorcyclists; 4) can buck firemen riding on the back of fire trucks off the truck; 5) can potentially distract motorists from observing pedestrians/ bicyclists; and 6) there are no ditches to discourage motorists from leaving the roadway to avoid the speed bumps. In addition, driver discomfort with respect

to traveling over speed bumps actually decreases at high speeds. Finally, vehicles crossing a speed bump generate noise that may be a problem for residents in the immediate vicinity.

In contrast to speed control bumps, speed control humps are raised pavement surface undulations extending transversely across the traveled way which can provide effective speed control on a continuous basis without the presence of law enforcement personnel. A standard speed hump is constructed to a height of three inches and 12 feet in width. A series of speed humps approximately 300 feet apart typically results in speeds of 22 to 23 miles per hour over the hump, with motorists accelerating to slightly higher speeds between humps have been demonstrated to achieve and maintain an average speed of about 25 miles per hour.³ The installation of speed humps must be accompanied by the installation of appropriate advisory signing and pavement markings in advance of each hump. The disadvantages of installing speed humps on the study segment include: 1) the installation of speed humps does not address the principal problem identified on the study segment of through traffic; 2) the potential loss of control by motorists deliberately traveling over the humps at excessive speeds; 3) a lack of curbs may encourage motorists to leave the pavement to avoid the speed hump, exposing pedestrians and bicyclists to additional accident hazards; and 4) an increase in emergency response time, as the preferred crossing speed for fire trucks and ambulances is 15 miles per hour. Finally, the cost of installing enough speed humps to effectively achieve and maintain an average travel speed of 25 miles per hour is estimated to be approximately \$12,500. Therefore, this traffic management action was rejected.

³It may be noted that the maximum height to which speed humps are recommended to be constructed is four inches. The speed over such a hump ranges between 15 and 19 miles per hour. With attendant acceleration between speed humps, the average speed would be expected to exceed 15 miles per hour. Thus, speed humps would not be considered a practical alternative to achieving and maintaining an average 15 mile per hour travel speed.

The installation of signs stating "No Thru Traffic" was rejected because of the extreme difficulty of enforcing this measure; and because such signing has been demonstrated ineffective when implemented elsewhere.

The placing of stop signs midblock and used as a form of speed control was rejected because: 1) the basic purpose of stop signs is to assign right-of-way at intersections and is not recommended for use as a speed control device in the Manual of Uniform Traffic Control Devices; 2) the installation of unwarranted "stop" signs can result in an increase in traffic accidents as motorists who do see and obey the sign become mixed with motorists who do not obey or do not see the stop sign; and 3) studies indicate that motorists tend to increase their speed between stop signs to make up the time lost as a result of the stop.

The construction of pavement chokers to divert traffic and control travel speeds was rejected. A choker is a narrowing of the street to a single travel lane either at an intersection or midblock. While studies have shown that chokers can reduce the volume of through traffic, in order to be effective the number of lanes must be reduced or friction added to a considerable length of street. Because chokers would require extensive and costly modification of the roadway cross-section for a considerable portion of its length, and because the reduction in the number and width of travel lanes increases the potential of driver error and accidents, this traffic management action was rejected.

The installation of speed-actuated flashing warning signs was considered but rejected. This traffic management action links speed detection instrumentation to a flashing beacon or sign indicating to the motorist that he/she is exceeding the posted speed limit. Because this traffic management action is costly and has not been shown to have any effect on motorists' behavior, it was rejected.

A traffic management alternative considered but rejected was the painting of cross walk markings at locations within the segment of W. Beach Road between a point 75 feet south of Armour Road north to the intersection of W. Beach Road with N. Beach Road. Pedestrian cross walk marking is a method of encouraging

pedestrians to use a particular crossing and should be marked only where necessary for the guidance and control of pedestrians. Because previous studies have shown that unjustified marked cross walks suffer higher pedestrian accident rates, present an illusion of safety to pedestrians, and increases motorist noncompliance, this traffic management alternative was rejected.

SUMMARY

On July 27, 1989, officials of the Village of Oconomowoc Lake requested that the Southeastern Wisconsin Regional Planning Commission conduct a traffic engineering study of W. Beach Road from Newport Drive to N. Beach Road and N. Beach Road from W. Beach Road to Gifford Road in the Village of Oconomowoc Lake. This study was to identify existing problems with excessive volumes of through traffic and high vehicle speeds. This report presents the findings and recommendations of that study.

Both W. and N. Beach Roads are constructed to rural cross sections with no shoulders. The pavement width of N. and W. Beach Roads is 20 feet wide. Both facilities are functionally classified as local land access streets in the Commission's year 2000 transportation system plan, which classifies facilities as they should function. However, historic traffic counts indicate that the study segment operates as a collector facility; that is, it is carrying traffic between arterial facilities in excess of 1,500 vehicles per average weekday in addition to providing access to abutting properties. It may be noted that the Wisconsin Department of Transportation, which classifies facilities the way that they currently function primarily on the basis of traffic volumes, classifies W. Beach Road as a minor arterial and N. Beach Road as a major collector.

In September and October, the Commission conducted traffic counts at the same locations on selected Village streets. The traffic counts conducted in September were taken prior to the re-opening of the N. Beach Road structure over the Oconomowoc River to traffic, and as a result, traffic volumes were reduced from historic levels to approximately 300 and 500 vehicles per average weekday on N. and W. Beach Roads, respectively. The traffic counts conducted by the Commission in October at the same locations indicated that traffic volumes

were returning to pre-construction levels, increasing to approximately 1,300 and 1,250 vehicles per average weekday on N. Beach Road and W. Beach Road, respectively. The substantial difference between the September 1989 and October 1989 traffic count data on the study segment further indicates that W. Beach Road and N. Beach Road currently carry through traffic. Additional traffic counts were conducted in May 1990 to determine any effect the posted 15 mile per hour speed limit may have had on the volume of traffic on the study segments. Based on the most recent traffic count data collected, the 15 mile per hour speed limit has had little impact on reducing the volume of traffic on the study segments.

To determine the extent the study segment was being used by through traffic, a license plate survey was conducted by the Commission staff on October 24, 1989. Vehicle license plates were recorded by direction when a vehicle passed a survey station. The data collected indicated that at Gifford Road 64.5 percent of vehicles observed represent through traffic. Similarly, at W. Beach Road, 66.2 percent of vehicles observed represent through traffic; and at Armour Road and Valentine Road, 45.2 percent and 50.0 percent of the vehicles observed represent through traffic, respectively. Thus, it was concluded that through traffic is a significant problem on the study segment.

A spot speed study conducted by the Commission staff on W. Beach Road in November 1989 found that the 85th percentile speed, or that speed considered safe and reasonable by motorists, and the speed at or below which 85 percent of all motorists travel, was 33 miles per hour. Thus, because the 85th percentile speed exceeds the posted speed limit by eight miles per hour, it was concluded that there is a modest speeding problem. An additional spot speed study was conducted in May 1990 to determine motorist compliance with the posted seasonal 15 mile per hour speed limit. It was determined that 85 percent of all traffic traveled at or below 26 miles per hour, or 11 miles per hour over the posted speed limit. The 10 mile per hour pace range is a measure of the volume of traffic traveling at substantially the same speed. The proportion of traffic within the 10 mile per hour pace range of speed when the speed limit was posted at 15 miles per hour was approximately 78 percent compared to 86 percent of the traffic traveling within the 10 mile per hour pace range of

speeds when the 25 mile per hour speed limit was in effect. It may be concluded that compliance with the posted 15 mile per hour speed limit is only marginally worse than compliance with the 25 mile per hour speed limit. This finding of substantially similar motorist compliance with both the 15 and 25 mile per hour speed limits is atypical, and may likely be attributed to an aggressive program of speed enforcement conducted by the Village. Without the speed enforcement program, it may be expected that the 85th percentile speed and the variance in speeds will increase when the seasonal speed limit of 15 miles per hour is in effect.

Dual use of a facility by pedestrians and vehicles, while not desirable in any case, can be acceptable when vehicular flows are low and if pedestrians can step off the facility onto a shoulder or other part of a clear zone adjacent to the roadway in the presence of a vehicle. However, as traffic volumes increase, pedestrians are forced more and more to seek refuge off the pavement itself or expose themselves to significant hazards. Given the historic traffic volumes on the study segment, the narrow pavement width, and lack of shoulders; and the lack of any clear zone along significant portions of the study segment, particularly N. Beach Road, it was concluded that there is a pedestrian safety problem along the study segment. A second pedestrian safety problem was identified at a point on W. Beach Road approximately 400 feet north of Newport Drive where a change in both the horizontal and vertical alignments creates a sight distance problem. Additional sight distance problems exist where foliage encroaches on the edge of the roadway at a number of locations.

The final problem identified was inappropriate traffic control, including the lack of a stop sign on the westbound approach to the intersection of N. and W. Beach Roads with Valentine Road, and the use of inappropriate signs on the north side of N. Beach Road in its place.

The Commission staff recommended that, to abate the through traffic speeding and pedestrian safety problems, the Village pursue the implementation of the long recommended new routing for STH 67 between existing STH 67 at Old Tower Road and STH 16. The Wisconsin Department of Transportation has programmed the completion of the construction of this roadway for 1992. This new STH 67 route

may be expected to provide a more attractive route for travel than N. and W. Beach Roads, substantially reducing traffic volume and addressing not only the through traffic problem, but also the pedestrian and bicycle safety problems and vehicle speeding problem.

The Village has implemented a 15 mile per hour seasonal speed limit on N. and W. Beach Roads as an interim measure in an attempt to address the three problems of through traffic, vehicle speeding, and pedestrian-bicyclist safety. The Commission analysis of this interim measure indicates that the measure may not be expected to resolve the through traffic problem. Although the seasonal lowered speed limit has not resulted in increased speeding or a wider variation in speeds, the Commission staff recommends that the Village continue its speed enforcement program and periodically monitor traffic speed to ensure that such speeding problems with their consequences for vehicular-pedestrian safety do not occur.

The Commission staff identified and evaluated alternative traffic management actions which the Village could consider for implementation in the interim until the re-routing of STH 67 would be constructed. Based upon this evaluation, the Commission staff recommended that the Village consider as an interim measure implementation of regulatory signing to prohibit left turns on the eastbound approach of N. Beach Road at Gifford Road, and the westbound approach of N. Beach Road at W. Beach Road.

The Commission staff also recommended the designation of a pedestrian crosswalk through pavement markings and signing on W. Beach Road approximately 400 feet north of Newport Road.

The Commission staff also recommended that the intersection of N. and W. Beach Roads and Valentine Road be modified with respect to its traffic control through the installation of a three-way stop sign rather than the existing two-way stop sign.