

TRAFFIC ENGINEERING STUDY OF N. 68TH STREET IN THE VILLAGE OF BROWN DEER

MILWAUKEE COUNTY WISCONSIN

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**MEMORANDUM REPORT
NUMBER 121**

**TRAFFIC ENGINEERING STUDY OF N. 68TH STREET
IN THE VILLAGE OF BROWN DEER
MILWAUKEE COUNTY, WISCONSIN**

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SEWRPC Staff Memorandum Report No. 121

TRAFFIC ENGINEERING STUDY OF N. 68TH STREET IN THE
VILLGAE OF BROWN DEER, MILWAUKEE COUNTY, WISCONSIN

INTRODUCTION

On September 25, 1992, the Village of Brown Deer requested the Commission staff to conduct a traffic engineering study of N. 68th Street. The study was requested to address resident concerns about through traffic and vehicular speeds on N. 68th Street between W. Dean Road and W. Brown Deer Road (STH 100). This report describes the current traffic conditions; identifies and evaluates alternative traffic engineering actions which may serve to abate these problems; and recommends traffic engineering measures for implementation.

STUDY SEGMENT OF N. 68TH STREET BETWEEN W. DEAN ROAD AND
W. BROWN DEER ROAD (STH 100)

Central to the identification of the existing traffic problems is the collection of data with respect to existing roadway physical and operational characteristics, including the average weekday traffic volumes, travel times, intersection delays and spot speed studies.

Functional Classification

Street and highway systems may be classified in several ways. Two of the more important classification systems are functional and 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 street are sometimes referred to together as local, or non-arterial, 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 generally also provide access to abutting properties. Land access streets are those streets which primarily provides access to abutting property.

It may be noted that the N. 68th Street study segment is currently classified as a local street by the Wisconsin Department of Transportation. While the Regional Planning Commission classifies facilities only as arterial or non-arterial, the location of N. 68th Street in relation to the other streets in the area bounded by the study segment; W. Brown Deer Road (STH 100); N. 60th Street; and W. Bradley Road, as shown on Map 1, indicates that this facility may function in part as a collector facility. Arterial facilities in the vicinity of the N. 68th Street study segment are provided at one mile spacing and include W. Brown Deer Road; N. 60th Street; W. Bradley Road; and N. 76th Street.

The jurisdictional classification of a facility identifies the governmental agency responsible for the facility. N. 68th Street between W. Dean Road and a point 700 feet south of W. Brown Deer Road is under the jurisdiction of the Village of Brown Deer and, thus, the Village of Brown Deer is responsible for its construction, operation, and maintenance. The western half of the 700 foot long segment of N. 68th just south of W. Brown Deer Road is in the City of Milwaukee, while the eastern half is in the Village of Brown Deer. These two municipalities have jurisdiction of the half of the roadway which lies within their respective boundaries.

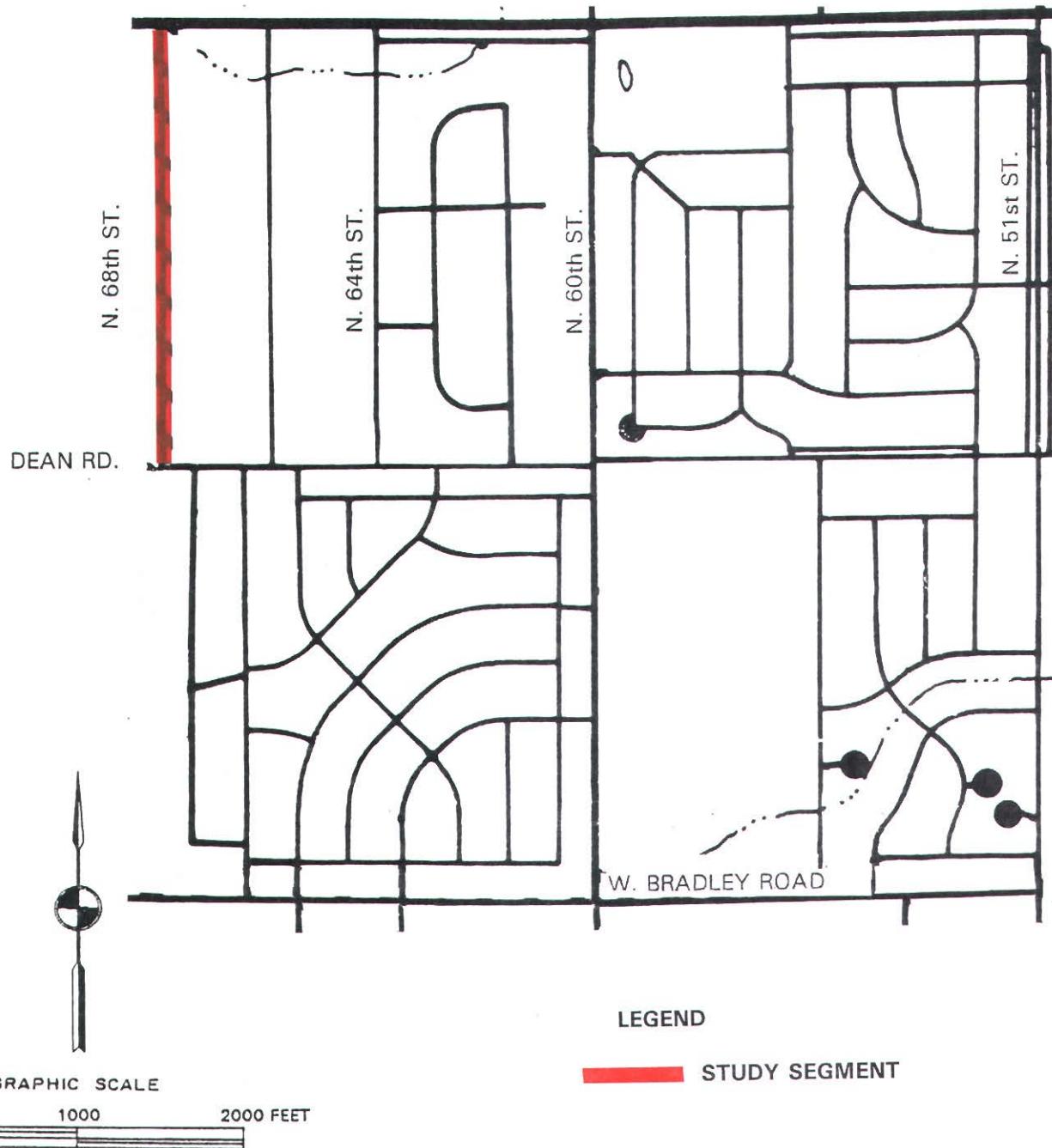
ROADWAY PHYSICAL AND OPERATIONAL CHARACTERISTICS

The N. 68th Street segment is constructed to a rural cross-section with a pavement width of about 18 feet and gravel or grass shoulders ranging from about one to three feet between W. Dean Road and a point approximately 350 feet south of W. Brown Deer Road (STH 100). There are no sidewalks along this stretch of N. 68th Street. Between W. Brown Deer Road and a point approximately 350 feet

Map 1

LOCATION OF THE N. 68TH STREET STUDY SEGMENT
IN THE VILLAGE OF BROWN DEER

BROWN DEER -- STH 100



south, the study segment is constructed to a divided urban cross section with twin 28 feet wide roadways separated by a 19 foot wide median. A sidewalk is constructed on the west side of this stretch of roadway.

The vertical alignment of the study segment is comprised of two basic roadway gradients connected by a vertical curve, with its crest located about 900 feet south of W. Brown Deer Road. South of the crest of the vertical curve the roadway gradient is about one percent, and, north of the crest of the vertical curve the roadway gradient is about seven percent. These two gradients are connected by a short vertical curve of about 120 feet in length.

The intersection of the study segment of W. Brown Deer Road is a three-legged "tee" intersection with the N. 68th Street approach controlled by a stop sign and the W. Brown Deer Road approaches are uncontrolled. The intersection of the study segment and W. Dean Road is a two-legged right angle intersection and neither approach is controlled. There are no intersecting streets between W. Brown Deer Road and W. Dean Road.

The posted speed limit on the study segment is 20 miles per hour. Speed limit signing at N. 68th Street was reviewed and found to conform to standards set forth in the Manual on Uniform Traffic Control Devices and promulgated by the Federal Highway Administration.

No parking is permitted in the portion of the study segment with the rural cross-section. Parking is permitted on the portion of the study segment with the urban cross-section.

Traffic Volumes

The Commission staff conducted 24-hour machine traffic counts on N. 68th Street during the fourth week of August, 1993. The average workday traffic counts was observed to be approximately 1,070 vehicles. This substantially exceed the volume of about 300 to 350 vehicle trips per average weekday which may be expected, based upon the number of residences which abut the study segment and the average trip generation rates for residential land uses determined by historic Commission origin and destination studies. The 1,070 vehicles per

average weekday observed however, is well below not only the 1,500 vehicles per average weekday volume threshold generally considered to be the maximum desirable traffic on a land access facility, but the 2,500 vehicle per average weekday threshold generally considered to be the maximum desirable traffic on a collector facility as well.

License Plate Survey

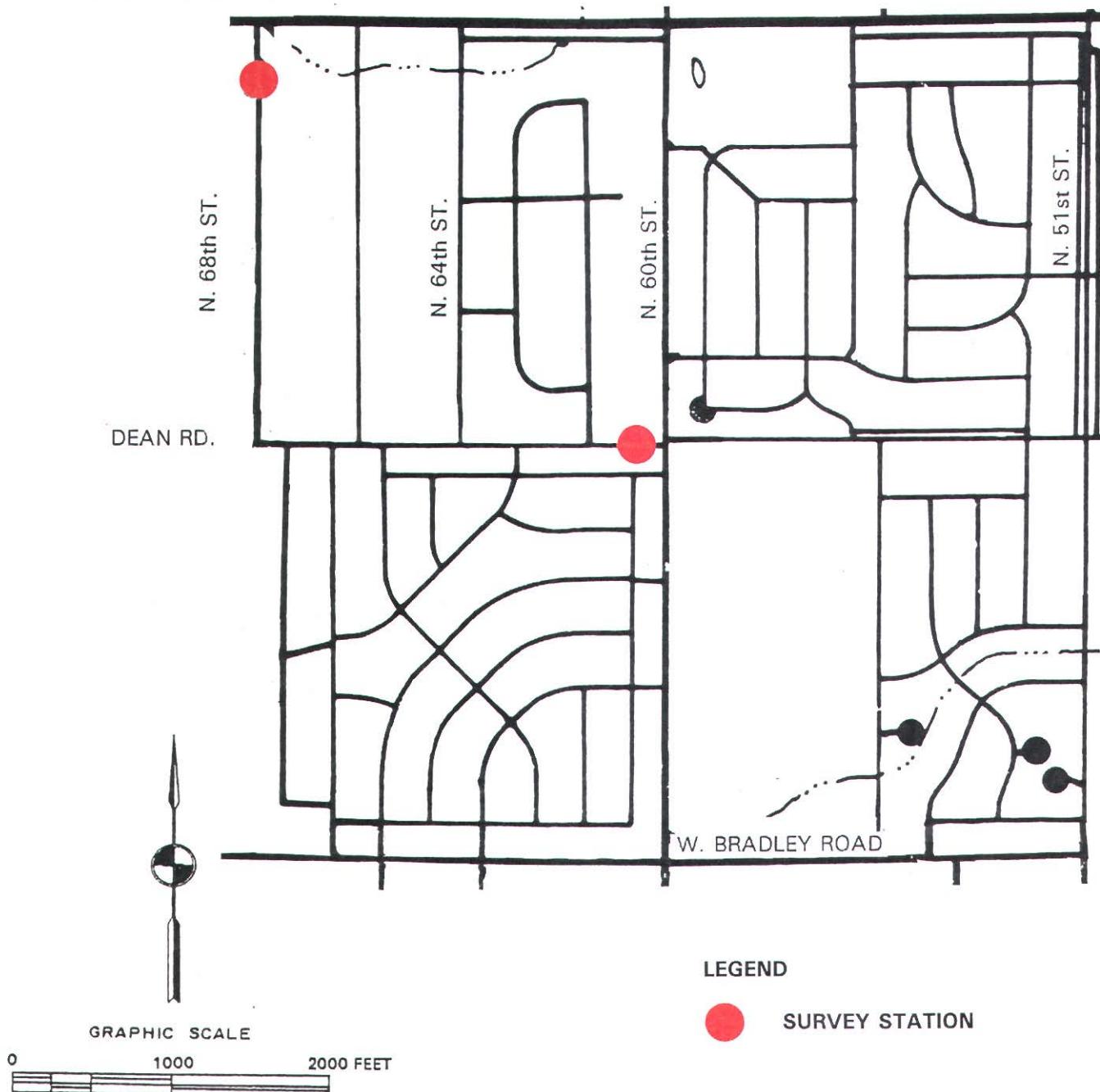
On Wednesday, August 25, 1993, the Commission staff conducted a license plate survey utilizing the two stations shown on Map 2. The survey was conducted to determine the proportion of the total average weekday traffic on the study segment that had neither an origin nor a destination at properties abutting the study segment of N. 68th Street. Data was collected between 7:00 a.m. and 3:30 p.m. and consisted of recording the license plate of each vehicle by direction at each survey station. It may be noted that, based on the average weekday traffic count data collected on the study segment, about 45 percent of the total average weekday traffic volume maybe expected between 7:00 a.m. and 3:30 p.m.

The license plates observed on vehicles entering the study segment at one station were compared to the license plates observed exiting the study segment at the other station. Results from this survey shows that about 28 percent, of the vehicles observed traveling north on N. 68th Street were previously observed traveling west on W. Dean Road; and about 17 percent, of the vehicles observed traveling south on N. 68th Street were also observed traveling east on W. Dean Road. This traffic may be considered arterial-type traffic which has neither trip end at properties abutting N. 68th Street nor in the neighborhoods between N. 60th Street, N. 68th Street, W. Bradley Road, and W. Brown Deer Road (STH 100). This traffic includes non-residents and service vehicles using the study segment rather than the adjacent arterial streets. When combined, the number of vehicles observed traveling through both stations represented about 25 percent of the vehicles observed. Because travel patterns observed during the a.m. portion of the day are generally duplicated in the reverse direction later in the day it is reasonable to assume that approximately 25 percent of the total average weekday traffic, or about 270 vehicles, on the study segment is arterial-type traffic.

Map 2

LICENSE PLATE SURVEY STATION LOCATIONS
IN THE VILLAGE OF BROWN DEER: AUGUST 25, 1993

BROWN DEER -- STH 100



The 350 vehicle trips attributed to residential development abutting the N. 68th Street study segment and the 270 vehicle trips attributed to arterial traffic combine to represent about 620 vehicle trips, or about 58 percent of the total average weekday traffic volume on the study segment. The remaining 450 vehicle trips, or 42 percent, are comprised of trips which may be expected to have either their origin or destination abutting the study segment but rather have either their origin or destination in the neighborhoods bounded by N. 68th Street; W. Brown Deer Road; N. 60th Street; and W. Bradley Road. For such traffic, N. 68th Street functions as a collector facility serving as a bridge between the land access streets in these neighborhoods and the adjacent arterial system.

Roadway Stopping Sight Distance

The safe stopping sight distance is the distance required for a motorist to perceive an object in the roadway and to safely brake to a stop prior to colliding with the object. Determination of restricted stopping sight distance is based on an eye height of 3.5 feet and an object height of 0.5 feet. Stopping sight distance is dependent upon and increases with vehicle speed. Safe stopping sight distance ranges from about 275 to 325 feet for an assumed speed condition of 36 to 40 miles per hour.¹ The stopping sight distance on the study segment was analyzed. Results from this analysis show that the roadway stopping sight distance at the crest of the vertical curve just south of W. Brown Deer Road is marginally adequate at the posted speed limit of 20 miles per hour; and, substandard for higher speeds.

Operating Speeds

The Commission staff conducted a spot speed study on N. 68th Street, on August 23, 1993, during off-peak traffic hours between 9:00 a.m. to 4:30 p.m. Based on data from that study, the 85th percentile speed--the speed at or below which 85 percent of the traffic was traveling--was observed to be 34.4 miles per hour, or 14.4 miles per hour above the posted speed limit in the northbound direction. The "10 mile per hour pace", that is, the 10-mile per hour range of

¹Based on operating speed data presented later in this report, 85 percent of all motorists on the study segment were observed to be traveling at about 35.6 miles per hour.

speeds containing the largest number of vehicles, was found to be 26 to 35 miles per hour, with 79 percent of the vehicles traveling within this range of speed.

In the southbound direction, the 85th percentile speed was observed to be 37.4 miles per hour, or 17.4 miles per hour above the posted speed limit. The 10 mile per hour pace was found to be 28 to 37 miles per hour, with 61 percent of the vehicles traveling within this range of speed.

The 85th percentile speed of the northbound and southbound traffic streams combined was found to be 35.6 miles per hour, or 15.6 miles above the posted speed limit. The 10 mile per hour pace was found to be 26 to 35 miles per hour, with 71 percent of the vehicles traveling within this range of speed.

TRAVEL TIME AND INTERSECTION DELAY

Because approximately 25 percent of the average weekday traffic on the N. 68th Street study segment was identified as arterial type traffic, the Commission staff conducted intersection delay and travel time studies to determine if excessive delay may be occurring on N. 60th Street, from W. Dean Road to W. Brown Deer Road (STH 100), and on W. Brown Deer Road from N. 60th Street to N. 68th Street which may cause motorists to divert from these arterials.

Intersection Delay Study

The Commission staff conducted p.m. peak hour intersection delay studies for the northbound left turning traffic on N. 60th Street and on N. 68th Streets at their respective intersections with W. Brown Deer Road. The northbound traffic on N. 60th Street turning left on W. Brown Deer Road, which is a signalized intersection, experiences approximately 57 seconds of delay per vehicle. In comparison, the northbound traffic on N. 68th Street turning left on W. Brown Deer Road, which is an unsignalized intersection, experiences approximately 52 seconds of delay per vehicle. Because these delays are virtually the same, there is no apparent reason for motorists to divert from the arterial to the non-arterial street system, that is, to travel on W. Dean Road and N. 68th Street rather than N. 60th Street and W. Brown Deer Road based upon delays at the intersections.

Travel Time Study

Travel time data were collected on two routes between the W. Dean Road and N. 60th Street intersection and the N. 70th Street and W. Brown Deer Road intersection. One route was comprised on N. 60th Street and W. Brown Deer Road and the other was comprised of W. Dean Road and N. 68th Street. These routes are virtually the same length, approximately 1.2 miles. Travel time data was collected for both the off peak and p.m. peak hour travel periods. Travel time data are set forth in Table 1.

As noted in Table 1, the travel time on the N. 60th Street and W. Dean Road route is based on travel at the posted speed limit. However, the travel speed during the non-peak period was observed nearly 15 miles per hour above the posted speed limit on N. 68th Street between W. Dean Road and W. Brown Deer Road. Traveling at 35 miles per hour along this segment rather than the posted 20 miles per hour would permit motorists to save an estimated 38 seconds. Saving 38 seconds or 0.64 minutes would make travel over this route faster by about 23 seconds in the off peak and about 38 seconds during the p.m. peak hour. Further, whereas motorists are constrained to travel at the same speed as the general traffic stream on N. 60th Street and W. Brown Deer Road because of the heavy average weekday traffic volumes; motorists on N. 68th Street and W. Dean Road may be able to increase the travel speeds nearly at will as average weekday traffic volumes are very low. Finally, motorists may avoid the traffic signals by traveling on W. Dean Road and N. 68th Street rather than W. Brown Deer Road and N. 60th Street. Even though the travel time data collected suggests that these three traffic signals do not substantially increase time, motorists perception may be otherwise.

PROBLEM IDENTIFICATION

The first problem identified on the N. 68th Street Study Segment is related to the substantial change in the vertical alignment which occurs approximately 900 feet south of W. Brown Deer Road. This change is accomplished by a short vertical curve, about 120 feet in length. Analyses indicate that the crest of the vertical curve restricts the sight distance to about 120 feet in both directions. Available roadway stopping sight distances were compared to stopping

Table 1

OBSERVED OFF PEAK AND PEAK HOUR TRAVEL TIMES
ON SELECTED ROUTES IN THE VILLAGE OF BROWN DEER: 1993

	AVERAGE TRAVEL TIME		DISTANCE (miles)
	OFF PEAK (minutes)	PEAK (minutes)	
N. 60th Street and W. Brown Deer Road: from N. 60th Street at W. Dean Road to N. 70th Street at W. Brown Deer Road.	3.06	3.39	1.12
W. Dean Road; N. 68th Street; and W. Brown Deer Road ^a from N. 60th Street at W. Dean Road to N. 70th Street at W. Brown Deer Road.	3.31	3.39	1.12

^a Travel time measurements on this route were made at posted speed limit: on N. 68th Street the posted speed limit is 20 miles per hour, on W. Dean Road is 25 miles per hour, on N. 60th Street is 35 miles per hour and on W. Brown Deer Road is 40 miles per hour.

Source: SEWRPC

sight distance requirements set forth in "A Policy on Geometric Design of Highways and Streets," published by the American Association of State Highway and Transportation Officials based on the observed 85th percentile speed of about 35.6 miles per hour on the study segment. The available stopping sight distance of approximately 120 feet while marginally adequate at the posted speed limit of 20 miles per hour, is less than the required range of 275 to 325 feet for an assumed speed ranging from 36 to 40 miles per hour representative of the 85th percentile speed. Thus, it may be concluded that the vertical curve located approximately 900 feet south of W. Brown Deer Road results in stopping sight distances that are substandard based on the observed 85th percentile speed.

It may be noted that northbound N. 68th Street has an area approximately 300 feet long with substandard stopping sight distance, beginning about 1,220 feet south of W. Brown Deer Road. Southbound N. 68th Street also has an area approximately 300 feet in length with substandard stopping sight distance, beginning about 620 feet south of W. Brown Deer Road. This represents about 12 percent of the approximately 2,580 foot stretch of N. 68th Street.

The second problem identified on the study segment is related to observed vehicular speeds. During the non-peak hours of traffic, the 85th percentile speed on N. 68th Street was determined to be 35.6 miles per hour, or 15.6 miles per hour above the posted speed limit, for the northbound and southbound traffic streams combined, and 71 percent of all vehicles were found to be traveling within the 10 mile per hour pace speed range. It may be concluded that the posted speed limit of 20 miles per hour is generally disregarded, and that a vehicular speeding problem exists.

The third problem identified on the study segment is related to the amount of through or arterial-type traffic observed. The results of the license plate survey indicates that of the total average weekday traffic volume on the study segment, approximately 25 percent, is comprised of "arterial-type" traffic, that is traffic not associated with either abutting development nor adjacent subdivisions. Such traffic should not be utilizing the study segment of N. 68th Street, but rather the adjacent arterials of N. 60th Street and W. Brown Deer Road.

The fourth problem identified on the study segment is related to the physical roadway characteristics of N. 68th Street. These characteristics were compared to the land access and collector street design guidelines set forth in Table 2, and it may be concluded that the study segment only minimally meets the physical design standards for land access streets. However, based on the location of N. 68th Street and its relationship to the adjacent street system, it would appear that N. 68th Street is intended to function as a collector. Further, approximately 67 percent of the average weekday traffic observed on N. 68th Street does not have either trip end at properties abutting the study segment, and may therefore be categorized as either collector or arterial-type traffic.

It may be noted, however, the observed average weekday traffic count on N. 68th Street was about 1,070 vehicles per average weekday, well below the threshold of volume typically considered acceptable and the threshold of volume typically considered desirable on collector streets of about 4,000 and 2,500 vehicles per average weekday, respectively. Further, these traffic counts are well below the threshold of traffic volume typically considered the "maximum acceptable" and the "maximum desirable" for a land access street of about 2,500 and about 1,500 vehicles per average weekday respectively.

The intersection delay study conducted by the Commission staff, during the evening peak traffic hour, shows that northbound traffic on N. 60th and on N. 68th Streets experiences very similar delays at their respective intersections with W. Brown Deer Road when turning left. Thus, it may be concluded that the delays experienced by motorists at the intersection of N. 60th Street and W. Brown Deer Road do not appear to be a significant factor in the diversion of arterial-type traffic to the study segment. Results from the travel time study conducted by the Commission staff indicate that the travel time between the intersections of N. 60th Street and W. Dean Road and N. 70th Street and W. Brown Deer Road via N. 68th Street and W. Dean Road may be 35 to 40 seconds less than the travel time via N. 60th Street and W. Brown Deer Road. This difference may contribute to the presence of arterial-type traffic on the study segment.

Conclusions

Based upon the analyses conducted by the Commission staff it may be concluded

Table 2

LAND ACCESS AND COLLECTOR STREET DESIGN

Design Element	Recommended Standards ^a			
	Land Access Street		Collector Street	
	Urban	Rural	Urban	Rural
Centerline Curve Radius Minimum	100'	100'	300'	300'
Pavement Width Minimum Maximum	18' 36'	22' --	36' 48'	24' --
Type of Curb	None or Roll-Type	NA	Vertical Face	NA
Shoulder	NA	8'	NA	10'
Sidewalk Width	NA	NA	4 to 6'	NA

^aSee SEWRPC Planning Guide No. 1, Land Development Guide, November, 1963.

Source: SEWRPC

that concerns expressed by Village officials and residents with respect to N. 68th are valid. A sight distance problem related to the vertical curve near the north end of the study segment was identified. Substantial disregard for the posted speed limit was observed. A problem of through or arterial-type traffic using a facility not intended to serve such traffic was observed. Finally, the roadway itself is only minimally constructed to land access street standards, but, based upon its relationship to adjacent streets and the type of traffic served functions as a collector facility.

ALTERNATIVE AND RECOMMENDED TRAFFIC MANAGEMENT ACTIONS

The Commission staff considered a number of traffic management actions and other improvement actions to alleviate the existing traffic problems identified on the N. 68th Street study segment. Traffic management actions are relatively low cost short-range improvements which may be expected to alleviate existing traffic problems and which may be undertaken in the near future.

The Commission staff identified and evaluated nine short-range, alternative measures which may be expected to alleviate the traffic problems identified on the study segment of N. 68th Street. Four of the nine alternative measures considered are passive in nature; that is, are measures which rely on motorist compliance with regulatory signing to achieve the desired action. The other five alternative traffic management measures considered are physical in nature and would impose the desired action on the motorists.

A range of traffic management and other actions were considered to abate the vehicular speeding problem and/or to divert the arterial-type traffic from the N. 68th Street study segment. Four of the actions are passive in nature relying on voluntary motorist compliance to modify travel patterns or behavior. The remaining actions are more physical in nature generally involving construction of some feature that would impose a change in travel patterns on motorists.

The first alternative action considered specifically to alleviate the problem of motorists exceeding the posted speed limit is increased law enforcement on a random basis. Motorists operate at speeds which they consider reasonable and

safe under existing roadway conditions. Factors which influence the choice of speed include horizontal and vertical alignment, pavement and width condition, building setback, and driveway spacing. Based upon analysis of the spot speed studies conducted by the Commission staff, motorists are violating the posted 20 miles per hour speed limit.

It should be noted that it is often the fastest vehicles in the traffic stream rather than those traveling at the median or at the 85th percentile that disturbs residents and raises concerns about pedestrian and bicyclist safety. Additional law enforcement has the potential to cause these motorists to reduce their travel speed. The advantages of this alternative include: 1) increased motorist compliance with the posted speed limit which may be expected, particularly when a law enforcement officer is present; 2) travel speeds are reduced, the roadway stopping sight distance required at the crest of the vertical curve also decreases and would in fact correspond to that available if travel speeds are reduced to 20 miles per hour; and, 3) as travel speeds on the study segment are reduced, travel time increases and that arterial traffic currently using the study segment may be diverted back to the arterial system. The disadvantages of this alternative include: 1) potentially diminished compliance with the speed limit when a police officer is not present; 2) it does not address the roadway sight distance problem for motorists driving above the posted speed limit; and, 3) the costs attendant to providing an additional four to five man hours per week of speed enforcement activity. In addition, the provision of added enforcement activity on a random basis, particularly between the hours of 6:00 a.m. and 6:00 p.m. Since enforcement activity would increase compliance with the posted speed limit and thereby reduce the sight distance required for safe vehicular operations as a result of the vertical curve at the north end of the study segment, this alternative action is recommended for implementation at an estimated cost of \$5,200-6,500 annually.

A passive traffic management action considered to divert arterial-type traffic from the study segment was the installation and/or relocation of "No Thru Trucks" regulatory signing. "No Thru Trucks" regulatory signs are posted on W. Dean Road approximately 2,375 feet west of N. 60th Street. The advantage of this regulatory signing is to discourage through trucking on W. Dean Road and the N.

68th Street study segment. The disadvantage of this signing is its location. Trucks are already on W. Dean Road west of N. 60th before the signs are within the line of sight. Thus, to enhance the effectiveness of these signs, it is recommended that they be located 2,275 feet east to a point about 100 feet west of N. 60th Street at an estimated cost of \$300. It is further recommended that the Village work with the City of Milwaukee to affect the installation of such sign adjacent to the southbound lane of N. 68th Street just south of W. Brown Deer Road.

An alternative action considered to abate the problem of restricted roadway stopping sight distance was a spot geometric improvement to lower the crest of the existing vertical curve, located about 900 feet south of W. Brown Deer Road. Analyses of the vertical curve indicate that the available stopping sight distance of 120 feet is substantially less than the 275 to 300 feet desired for the observed 85th percentile travel speed.

Provision of the required stopping sight distance of 325 feet to accommodate the observed 85th percentile speed of 35.6 miles per hour would require reconstructing N. 68th Street to lengthen the vertical curve to at least 600 feet, thereby lowering the crest approximately five feet. The disadvantages of this alternative include: 1) current roadway design standards and the potential new vertical alignment may result in changes in the existing ground level as far as 20 to 40 feet beyond the existing east and west right of way lines, respectively; and, 2) the improved alignment may increase travel speeds because the stopping sight distance may be considered adequate at the posted speed limit of 20 miles per hour. It is recommended that this alternative action only be implemented should the increased law enforcement activity fail to substantially reduce travel speeds on the study segment.

An alternative considered, but rejected, to alleviate the speeding problem on the study segment was to install speed control bumps or speed humps on N. 68th Street. Speed control bumps are raised sections in the pavement surface extending transversely across the traveled way approximately four inches above the pavement surface and normally less than one foot in length. Speed control bumps catch only the wheels on one end of a vehicle a time. The effect on the

ride of the vehicle is, therefore, more pronounced than the effects of speed control humps. The disadvantages of speed control bumps are as follows: 1) are not recommended for use by the Manual on Uniform Traffic Control Devices; 2) are reported to interfere with winter snow plowing operations; 3) constitute a safety hazard to bicyclists and motorcyclists; 4) can potentially distract motorists from observing pedestrians/bicyclists; 5) are not recommended where the gradient of the roadway exceeds five percent; and, 6) are not recommended on roadways without a barrier curb as motorists are able to avoid traversing speed control bumps by driving off the pavement. In addition, driver discomfort actually decreases as the speed of the vehicle crossing the bump increases, and as the speed that motorists are traveling increases over the posted speed limit, the sight distance required for safe operations increases at the crest of the vertical curve. Finally, vehicles crossing a speed control bump generate noise that may be a problem for residents in the immediate vicinity. Therefore, because of the substantial disadvantages to this alternative this traffic management action is not recommended for implementation.

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 to achieve and maintain an average speed of about 25 miles per hour. The study segment has a seven percent gradient which is about 700 feet in length and begins about 350 feet south of W. Brown Deer Road. Because speed humps should not be installed on gradients which exceed five percent, nearly 1,050 feet of the study segment is eliminated from consideration for the installation of speed humps. At 300 foot spacings, five speed humps would be installed on the southern 1,600 feet of the study segment. The installation would be accompanied by the installation of appropriate signing and pavement marking in advance of each hump. The disadvantages of speed humps on the study segment include: 1) while vehicular speeds would be expected to decrease, they would not be reduced to posted speed limit; 2) vehicles may be expected to accelerate to 27 to 28 miles per hour

between the speed humps; 3) as the speed that motorists are traveling increases over the posted speed limit, the roadway sight distance becomes greatly affected due to the vertical alignment; 4) the potential loss of control by motorists deliberately traveling over the humps at excessive speeds; 5) an increase in emergency response time, as the preferred crossing speed for fire trucks and ambulances is about 15 miles per hour; 6) installation is not recommended if the roadway gradient exceeds 5 percent; 7) installation is not recommended on roadways without barrier curbs as motorists are able to avoid traversing speed control bumps by driving off the pavement; and, 8) maintenance of the signing and marking in advance of each of the speed control humps is required. Since the speed humps would only be installed on the southern 60 percent of the study segment and because of the lack of barrier curb, this traffic management action is not recommended for implementation.

An alternative passive traffic management action considered, but rejected, to alleviate the vehicular speeding problem on the study segment was the installation of regulatory "STOP SIGNS" at the intersection of W. Dean Road and N. 68th Street to control speeds. The purpose of regulatory signing is to inform motorists of traffic laws or regulations and indicate the applicability of legal requirements that would not otherwise be apparent. The primary purpose of a stop sign is to assign the right-of-way at an intersection. Because N. 68th Street terminates at W. Dean Road and because W. Dean Road terminates at N. 68th Street, the N. 68th Street traffic stream does not cross the W. Dean Road traffic stream. Thus, there is no need to assign right-of-way at this intersection. The disadvantages of this action include: 1) The use of stop signs for speed control is inappropriate and ineffective; 2) motorists typically increase travel speeds between stop signs to make up for time lost at stop signs; 3) inappropriate or unwarranted traffic control devices are disregarded and foster disregard for and disrespect of all traffic control devices; 4) as vehicular travel speeds increase the potential traffic safety problem related to restricted roadway stopping sight distance; 5) it may be expected that travel speeds would be unchanged as the stop signs would be installed at one end of the study segment; and, 6) absent a substantial increase in travel time over the study segment, it is unlikely that arterial traffic would be discouraged from using the study segment. Therefore, because the use of "STOP SIGNS" is not appropriate for speed control, this

alternative action is not recommended for implementation.

Another alternative passive traffic management action considered, but rejected, to divert the arterial-type traffic from the study segment was the installation of regulatory signing to prohibit left turn movements at the intersection of N. 68th Street and W. Brown Deer Road for the northbound traffic on N. 68th Street, on weekdays during the hours of 7:00 a.m. to 7:00 p.m. The disadvantage of this alternative is that: 1) it does not address the vehicular speed problem; 2) northbound traffic on N. 68th Street going west on W. Brown Deer Road may turn left into the Sequoia Shopping Center located on the southwest quadrant of W. Brown Deer Road and N. 68th Street, thereby avoiding the turn prohibition; and 3) it does not address the roadway sight distance problem. Thus, because this alternative does not abate the sight distance or vehicular speeding problems it is not recommended for implementation.

Another alternative passive traffic management action considered, but rejected, which may be expected to divert the arterial-type traffic from the study segment was the installation of regulatory signing to prohibit left turn movements at the intersection of N. 60th Street and W. Dean Road for the northbound traffic on N. 60th Street, on weekdays during the hours of 7:00 a.m. to 7:00 p.m. The disadvantage of this alternative is that: 1) it does not address the vehicular speed problem; and 2) it does not address the roadway sight distance problem. Further, only about 20 percent of the northbound N. 60th Street traffic that was observed turning left on W. Dean Road continues west and turns right onto N. 68th Street. A left-turn prohibition at this intersection would have a significant negative impact on 60 percentage of the traffic turning west onto W. Dean Road, from N. 60th Street. Therefore, because this alternative does not abate the sight distance or vehicular speeding problems and because of the substantial negative impact on left turning on vehicles, it is not recommended for implementation.

Another alternative passive traffic management action considered, but rejected, to divert arterial- and collector-type traffic from the study segment was the conversion of N. 68th Street, between W. Brown Deer Road and W. Dean Road, to a one-way facility in the southbound direction. The disadvantage of this

alternative include: 1) it does not address the vehicular speed problem; 2) speeds on N. 68th Street may tend to increase; 3) as travel speeds increase the restricted roadway safe stopping sight distance problem is exacerbated; 4) an adjacent parallel facility for travel in the opposite direction will be required. The northbound arterial- and collector-type traffic would be shifted to the parallel route, likely N. 66th Street, a land access street. Such traffic does not properly belong on N. 66th Street. Finally, conversion to one-way operation will result in travel indirection and cause inconvenience for residents abutting N. 66th Street and N. 68th Street. Thus, because this alternative action does not abate the sight distance or vehicular speeding problems, it is not recommended for implementation.

Another alternative action considered, but rejected, which may be expected to divert the arterial-and collector-type traffic from the study segment was to construct a cul de sac on N. 68th Street. The disadvantages of this alternative include: 1) there is insufficient available right of way to accommodate the required minimum right-of-way radius of 60 feet and a minimum outside curb radius of 40 feet needed for the cul de sac; 2) the length of the study segment and resultant cul de sac would exceed the desirable and maximum lengths of 600 and 750 feet, respectively; 3) construction would result in travel indirection and inconvenience for residents of N. 68th Street; 4) it may shift the arterial- and collector-type traffic to N. 66th Street; and, 5) it may not reduce the observed 85th percentile speed on the study segment. Thus, because of the travel indirection and inconvenience for N. 68th Street residents and the potential to shift the arterial and collector traffic to N. 66th Street, this alternative is not recommended for implementation.

Summary and Conclusions

A total of nine alternative actions were considered to abate the problems identified on the study segment. Two of the actions are recommended for implementation: 1) an increase in law enforcement activity; and 2) the relocation and installation of "No Thru Trucks" regulatory signing on W. Dean Road and N. 68th Street respectively. Finally, it is recommended that consideration be given to the implementation of a spot geometric improvement to lower the crest of the hill located about 900 feet south of W. Brown Deer Road

if the increased law enforcement activity does not reduce travel speeds on the study segment.

SUMMARY

On September 25, 1992, the Village of Brown Deer requested that the Commission staff conduct a traffic engineering study of N. 68th Street between W. Brown Deer Road (STH 100) and W. Dean Road. This study was to address resident concerns of through traffic and attendant vehicular speed problems on the study segment. This memorandum report presents the findings and recommendations of the requested study.

The study segment N. 68th Street may be functionally classified as collector facility based upon its layout and relationship to the adjacent street system. This facility is constructed to a rural cross-section, with a pavement width of 18 feet and shoulders ranging from one to three feet in width, thus, marginally satisfying the cross-section standards for a land access facility, but not those of a collector facility. The crest of a vertical curve approximately 900 feet south of W. Brown Deer Road (STH 100) restricts roadway stopping sight distance to about 120 feet in the vicinity of the curve.

The Commission staff conducted 24-hour machine traffic counts on N. 68th Street in August, 1993. Average weekday traffic volume is about 1,070 vehicles. The current average weekday traffic count of 1,070 vehicles is less than the volume of traffic--1,500 vehicles per average weekday--typically considered to be the maximum desirable volume of traffic on a local land access street. In addition, is less than the volume of traffic--2,500 per average weekday--typically considered to be the maximum acceptable volume on a local land access street.

In order to determine the extent to which the study segment is being used by arterial and/or collector-type traffic, a license plate survey was conducted in August, 1993. The license plate survey established that about 25 percent of the vehicles observed on N. 68th Street were also observed on W. Dean Road and, thus, could be considered arterial-type traffic or traffic which had neither trip end at a property abutting the study segment nor in the neighborhoods between N. 60th

Street, N. 68th Street, W. Bradley Road, and W. Brown Deer Road. Travel generated by residences abutting the study may be expected to comprise about 33 percent of the average weekday traffic volumes observed and, thus, it may be concluded that collector type traffic or traffic originating in or destined to adjacent neighborhoods represents about 42 percent of the average weekday traffic. Thus, the license plate survey indicated that, the study segment functions as an arterial/collector facility, and that only a small percentage of the traffic volume uses the study segment as a land access facility.

Spot speed studies were conducted on N. 68th Street. Analyses of the data indicated that during non-peak hours, 85 percent of the motorists travel at or below 35.6 miles per hour, or about 15.6 miles above the posted speed limit.

Four traffic related problems were identified on the study segment. The first problem identified was a traffic safety problem due to the restricted roadway stopping sight distance caused by the crest of a short vertical curve located about 900 feet south of W. Brown Deer Road. The second problem identified was substantial motorist disregard for the posted study segment speed limit. The third problem identified was the amount of arterial- and collector-type traffic observed using the study segment. The fourth problem identified was that the N. 68th Street study segment is minimally constructed to minimum land access facility standards but functions as a collector facility.

A number of traffic management actions were considered in attempt to alleviate traffic problems identified in the study segment. Of the nine alternative actions identified and evaluated, two are recommended for implementation: 1) an increase in law enforcement on a random basis to abate the problem of motorists exceeding the posted speed limit; 2) the relocation of existing and installation of new "No Thru Trucks" regulatory signing on W. Dean Road and N. 68th Street respectively. It is also recommended that Village officials consider implementation of a spot geometric improvement to lower the crest of the hill located about 900 feet south of W. Brown Deer Road if the recommended increase in law enforcement activity does not substantially decrease travel speeds on the study segment.