Table of Contents

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CORRADINO

List of Figures

CORRADINO

List of Tables

1. Introduction

An I-75 Corridor Feasibility Study[1], completed in November 2000, articulated the need for additional freeway capacity in Oakland County to provide safe and efficient traffic movement. The I-75 Feasibility Study showed that in the horizon year of 2025, the present roadway will operate at a level-of-service (LOS) E or worse during the afternoon peak hour for almost the entire length of I-75 from 8 Mile Road to M-24 and from Baldwin Road to Sashabaw Road (Figure 1-1). North of Sashabaw Road, the computer models indicated that I-75 will operate under capacity in the 2025 afternoon peak hour, but further analysis revealed that the traffic in the 30th highest hour will exceed capacity in 2025. This latter peaking is associated more with recreational than commuter travel. Given this traffic growth experience, it is expected that all of I-75 will be over capacity in 2025.

The I-75 Feasibility Study indicated that it is difficult for transit to obviate the need to expand I-75 by one lane in each direction in most sections because the travel demand in the corridor is so much greater than this solution can address. But, it is equally clear that the technical tools for evaluating transit and HOV proposals were limited in their sophistication. For example, SEMCOG's travel demand system lacked a technique such as a modal split model to forecast the use of high-type transit and high-occupancy vehicle (HOV) facilities.

Today, SEMCOG is in the midst of developing an entirely new travel demand-forecasting model, using a software package called TransCAD. SEMCOG's new model will include a mode-choice model and should provide the tools needed for a comprehensive and detailed analysis of transit and HOV facilities in the region. But, because of the time needed to develop and validate such models, they are not available. So, MDOT's consultant, The Corradino Group (Corradino) implemented transit/HOV models to supplement SEMCOG's most up-to-date data and networks. It is important to note that this approach is used in a number of major urban areas without in-place models.

This project takes the I-75 Feasibility Study, examines its recommendations and re-evaluates them in more detail using more sophisticated modeling techniques. The analysis presented here re-examines the potential impact of transit and the use of high-occupancy vehicle (HOV) facilities/services on the need to widen I-75. And, while the I-75 Oakland County Planning/Environmental Study focuses intently on the section of I-75 from 8 Mile Road to M-59, the work described in this report reflects travel characteristics regionwide.

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[1] *I-75 Corridor Study in Oakland County*; prepared for the Michigan Department of Transportation, SEMCOG, the Road Commission for Oakland County and The Traffic Improvement Association of Oakland County; by The Corradino Group; November 2000.

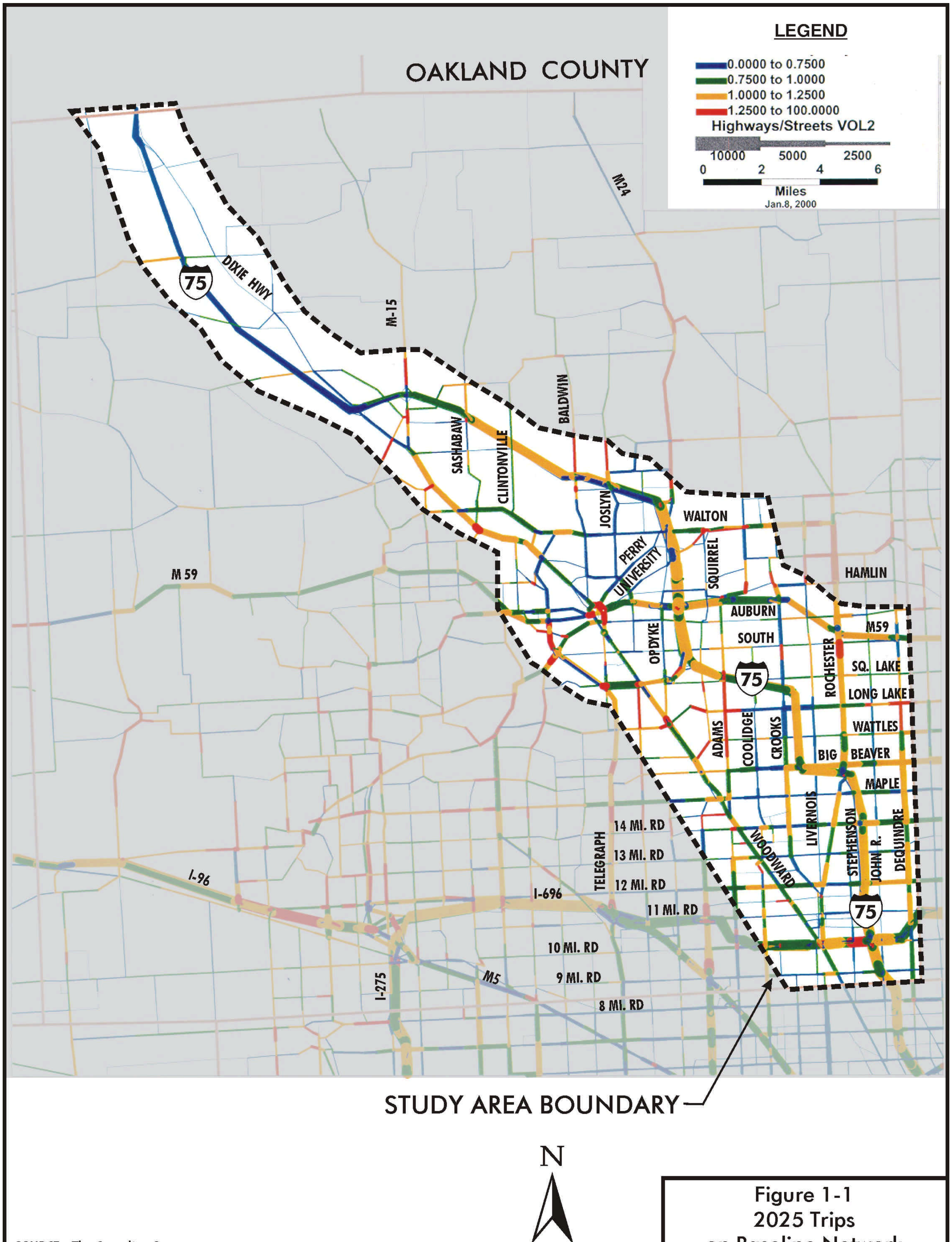

Figure 1-1
2025 Trips
on Baseline Network

SOURCE: The Corradino Group

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2. Summary

This technical memorandum is intentionally detailed in its technical content, because of the serious decision(s) it will require and because SEMCOG's new model-building efforts will likely use and/or ratify much of the background developed here. For those readers who are less interested in the technical detail, the key elements of this work and its findings are presented here.

2.1 Model Results

The primary purpose of the modeling effort is to assess whether either rapid transit in the Woodward Avenue corridor, or high-occupancy vehicle lanes (one in each direction) added to I-75 would obviate the need by 2025 to widen I-75 for a "general purpose" lane. The analysis, at the same time, indicates whether rapid transit in the Woodward Avenue corridor holds promise as part of an overall regional transportation strategy, regardless of whether it would provide significant traffic relief to I-75. The travel-forecasting model was applied to answer these questions.

2.2 Rapid Transit

The transit concept being evaluated is a high performance system running on Woodward Avenue from Pontiac in Oakland County to Jefferson Avenue in Downtown Detroit. It would include 28 stations and be characterized by:

- High speed (60 mph where distances and conditions permit);
- High quality vehicles with a quiet, smooth ride;
- Separation from other traffic to avoid congestion;
- Short headways, 3 minutes;
- Short dwell times, 15 seconds or less;
- Timed transfers with intersecting routes to avoid missed transfers;
- Communication between buses to also avoid missed transfers;
- Park-and-ride lots at stops north of, and including, the Michigan State Fairgrounds;
- Fare integration with intersecting transit service to permit a single fare for all segments of a trip; and,
- Pre-paid fares at platforms to reduce boarding times.

This concept was tested to assess whether it would relieve congestion along I-75 in the 2025 target year. Table 2-1 shows a summary of the results of this analysis.

Table 2-1
Rapid Transit and HOV Concepts
I-75 PM Peak Hour Characteristics (2025)

Measure	Alternatives	
	No Action	Rapid Transit
Regional Daily Transit Trips (Linked)[1]	117,682	154,667
Regional Transit Boardings (Unlinked)[2]	177,285	246,440
Woodward Rapid Transit Boardings	NA	43,035
DPM Boardings	10,967	9,930

Source: The Corradino Group of Michigan, Inc.
[1]Origin to destination.
[2]Stop to stop.

The addition of the Woodward Corridor rapid transit line would increase daily linked transit trips (origin to destination) from 117,682 in the No Action condition to 154,667; daily transit boardings (stop to stop) from 177,285 to 246,440; and, provided rapid transit service to more than 43,000 daily transit riders. This ridership level (43,000 daily boardings) is comparable to that forecast (50,000 daily boardings in 2020) in the most recent study of rapid transit in the Woodward Corridor by IBI Group.[2]

This ridership level (43,000 daily boardings) is high enough to conclude that rapid transit in the Woodward Corridor merits further study. This is particularly the case from Downtown Detroit to 8 Mile Road, and maybe, one station beyond, to 9 Mile Road. Further south, in the City of Detroit, the station at Michigan Avenue/Campus Martius is expected to have the highest daily volume of rider boardings/alightings in 2025 (12,219), with the Warren Avenue station forecast to have the second highest number of ons/offs (6,882) (Table 2-2). The highest daily two-way 2025 rapid transit line volume is expected to be about 22,000 riders and be sustained from Warren Avenue south to the People Mover station at Grand Circus Park. Again, this number suggests rapid transit from downtown Detroit to 8 Mile Road (maybe, to 9 Mile Road) is a candidate for more analysis. But, once past 10 Mile, the rapid transit line's daily two-way ridership in 2025 drops to less than 4,000 and then to 1,000 for some distance leading to the Pontiac terminal. This pattern does not offer relief of travel on I-75 regardless of the segment examined, because:

- Congestion levels on I-75 are so high that travelers in the corridor who would choose to use the new rapid transit system are quickly replaced by other auto travelers who might have previously chosen surface routes because of I-75 congestion.
- While the RT system and I-75 are in the same general travel corridor, they are still more than two miles apart in most locations. Moreover, "indirect" travel would be required to get to an RT station compared to driving on I-75.
- Most users of I-75 in Oakland County are not within walking distance of the RT system and the DDOT and SMART bus lines that feed the RT system. This is largely because of the dispersed residential development in Oakland County, and the fact that the majority of travelers on I-75 in Oakland County begins and ends its trips in Oakland County. Most Oakland County travelers with a Detroit destination would be presented with the choice of driving to an RT station and transferring, or driving the entire trip. Most travelers choose to drive the entire trip.

[2] *Woodward Corridor Transit Alternatives Study Final Report*; Detroit Transportation Corporation; by IBI Group; May 2000.

Table 2-2
Daily Rapid Transit Station Activity (2025)
Woodward Corridor

Location	Access	Daily Ons + Offs	Daily 2-way Load
Pontiac Transportation Center	Auto, walk, bus	1,046	
			1,046
Square Lake Road	Auto, walk, bus	768	
			1,028
Long Lake Road	Auto, walk, bus	66	
			1,036
Big Beaver	Auto, walk, bus	62	
			1,020
Maple Road	Auto, walk, bus	73	
			1,037
14 Mile	Auto, walk, bus	143	
			1,140
13 Mile	Auto, walk, bus	1,960	
			2,750
12 Mile	Auto, walk, bus	1,655	
			3,401
11 Mile	Auto, walk, bus	479	
			3,552
10 Mile	Auto, walk, bus	902	
			4,048
9 Mile	Auto, walk, bus	5,031	
			6,835
8 Mile	Auto, walk, bus	4,905	
			10,248
7 Mile	Walk, bus	4,000	
			11,732
McNichols	Walk, bus	3,408	
			13,212
Woodland Ave.	Walk, bus	1,622	
			14,152
Trowbridge	Walk, bus	2,968	
			16,204
Hazelwood	Walk, bus	4,183	
			18,165
Mount Vernon	Walk, bus	4,829	
			19,998
Grand Boulevard	Walk, bus	3,007	
			19,793
Antoinette	Walk, bus	4,941	
			20,024
Warren	Walk, bus	6,882	
			21,608
Alexandrine	Walk, bus	3,745	
			21,731
Mack	Walk, bus	326	
			21,759
Alfred	Walk, bus	5,324	
			21,869
I-75	Walk, bus	1,593	
			20,954
Grand Circus Park	DPM, walk	4,874	
			16,130
Campus Martius	Walk, bus	12,219	
			5,059
Jefferson Ave.	Walk, bus	5,059	

Source: The Corradino Group of Michigan, Inc.

In the end, the answer is "yes" to the two key questions this analysis asked: "Is another lane needed on I-75, at least where there are only three through lanes today?" and, "Is rapid transit viable in the Woodward Corridor?"

2.3 High-Occupancy Vehicle Lane

The effectiveness of a high-occupancy vehicle (HOV) lane alternative, as described earlier, was assessed by examining the PM peak hour throughput. One test assesses whether the HOV lane would carry more persons than the adjacent general purpose lane. Modeling shows this occurs along every part of the HOV facility (Table 2-3A) in the northbound (i.e., peak) direction in the PM peak hour. This suggests that the HOV lanes would be effective.

Table 2-3A
2025 PM Peak Hour Throughput (Vehicles and Persons)
HOV Lane (2-plus) vs. General Purpose Lane at Key Segments of I-75

Location	Total HOV Vehicles per Hour		Person Throughput per Lane				Passes Test in PM Peak Direction (NB)
			HOV		Adjacent General Purpose		
	NB	SB	NB	SB	NB	SB	
8 Mile to I-696	1,471	1,279	3,687	3,189	1,952	1,954	Yes
I-696 to 12 Mile	1,889	1,913	4,737	4,782	1,982	1,943	Yes
12 Mile to 14 Mile	1,870	1,713	4,684	4,277	2,058	1,934	Yes
Square Lake Road to M-59	1,586	1,072	3,949	2,684	2,512	2,233	Yes
Sashabaw to M-15	892	294	2,170	725	1,604	1,096	Yes
M-15 to U.S. 24	422	245	995	598	1,516	912	No
U.S. 24 to Genesee Co. Line	422	0	995	0	1,247	1,179	No

Source: The Corradino Group of Michigan, Inc.
Note: NB is the PM Peak Direction.

Another test is whether the HOV lanes would carry more than 700 vehicles per hour (a generally accepted measure of the viability of an HOV lane). Table 2-3A also shows that this occurs along every section of the HOV facility between 8 Mile and M-15 in the NB direction during the critical PM peak hour.

Another important comparison is of the <u>throughput of all lanes on I-75</u> with the addition of an HOV lane versus a general purpose lane. It is noted that the lanes were added to I-75 throughout Oakland County in separate test networks to construct an "apples versus apples" comparison. In this case (Table 2-3B), the total I-75 throughput is much greater with the addition of the HOV lane rather than a general purpose lane between I-696 and M-59. Outside that section, the difference in throughput is fewer than 200 persons per hour.

Table 2-3B
2025 PM Peak Hour Person Throughput
HOV Lane (2-plus) vs. General Purpose Lane at Key Segments of I-75

Location	Add General Purpose Lane		Add HOV Lane		HOV Increase	
	NB	SB	NB	SB	NB	SB
8 Mile to I-696	11,366	6,209	11,494	5,980	129	(229)
I-696 to 12 Mile	12,300	12,679	12,923	13,014	622	336
12 Mile to 14 Mile	10,327	9,729	10,856	10,079	529	350
Square Lake Road to M-59	11,204	9,858	11,486	9,812	283	(46)
Sashabaw to M-15	6,815	3,949	6,982	4,012	168	63
M-15 to U.S. 24	5,490	3,252	5,543	3,333	53	81
U.S. 24 to Genesee Co. Line	4,742	3,525	4,736	3,536	(6)	11

Source: The Corradino Group of Michigan, Inc.
Note: NB is the PM Peak Direction.

Another test from Texas Transportation Institute (TTI) indicates that travel time savings for the HOV lanes should exceed one minute per mile. Along I-75, this does not occur, as the HOV travel time savings for the entire section between Dixie Highway (U.S. 24) and I-696, is only about three minutes in the peak northbound direction over a distance of about 28 miles. But, further examination of this test reflects it may be impractical. For example, to achieve a one-minute travel time savings per mile when vehicles in the general purpose lane have an average speed of 30 mph requires the HOV lane vehicles to average 60 mph (Table 2-4). Further, at speeds in the general purpose lane over 32 mph, the HOV vehicles have to travel at average speeds of 70+ mph. And, at such speed differences, safety will be an issue when vehicles moving into and out of the HOV lane merge/diverge with vehicles moving so much slower. So, this one-minute-per-mile standard doesn't seem practical.

Table 2-4
Speed Differences to Achieve One Minute of Travel Time Savings

Speeds to Create a One-Minute Difference	
General Purpose Lane	HOV Lane
10 mph	12 mph
15 mph	20 mph
20 mph	30 mph
25 mph	43 mph
30 mph	60 mph
31 mph	64 mph
32 mph	69 mph
33 mph	73 mph
34 mph	78 mph
35 mph	84 mph
40 mph	84 mph
45 mph	120 mph
50 mph	300 mph

Source: The Corradino Group of Michigan, Inc.

Nevertheless, the travel time savings documented in the modeling here for the HOV lane in the section of I-75 from 8 Mile Road to M-15 can be translated into cost savings of $7.25 million over the 20-year life of the HOV lane. (This is the stream of annual cost savings in personal travel time over 20 years discounted to today's dollars at a four percent interest rate.) This is relatively small. Nevertheless, it makes the HOV concept worthy of some additional analysis, but at the "practical alternatives" stage of screening, which is usually undertaken prior to full EIS treatment.

One final test was made of the HOV concept to determine the effectiveness of limiting the use of the HOV lane to vehicles with three or more people. It is noteworthy that of 70 HOV projects existing in North America, four have "3-plus" HOV lanes (two in Los Angeles, one each in Seattle and Vancouver); three of these were previously "bus-only" lanes. And, of the 63 "2-plus" HOV projects, six were previously "3-plus" HOV facilities while one, in Seattle, was converted from a general purpose lane.

The results of the tests of the "3-plus" HOV concept indicate only the section of I-75 from 8 Mile to 14 Mile Roads passes the person <u>and</u> vehicle throughput tests (Table 2-5A). But, the entire throughput for I-75 is expected to be greater by using the additional lane for general purpose vehicles rather than HOVs (Table 2-5B). Lastly, the time savings for the northbound 28-mile length of HOV between Dixie Highway and I-696 is about four minutes, or one minute better than the "2-plus" HOV results.

Table 2-5A
2025 PM Peak Hour Throughput
(Vehicles and Persons)
HOV Lane (3-plus) vs. General Purpose Lane
at Key Segments of I-75

Location	Total HOV Vehicles per Hour		Person Throughput per Lane				Passes Test in PM Peak Direction (NB)
			HOV		Adjacent General Purpose		
	NB	SB	NB	SB	NB	SB	
8 Mile to I-696	756	664	2,570	2,258	2,199	2,108	Yes
I-696 to 12 Mile	959	860	3,261	2,924	2,194	2,220	Yes
12 Mile to 14 Mile	883	717	3,002	2,438	2,412	2,340	Yes
Square Lake Road to M-59	703	459	2,390	1,561	2,944	2,746	No
Sashabaw to M-15	334	92	1,136	313	1,854	1,213	No
M-15 to U.S. 24	129	73	439	248	1,669	1,012	No
U.S. 24 to Genesee Co. Line	129	0	439	0	1,429	1,173	No

Source: The Corradino Group of Michigan, Inc.
Note: NB is the PM Peak Direction.

Table 2-5B
2025 PM Peak Hour Person Throughput
HOV Lane (3-plus) vs. General Purpose Lane
at Key Segments of I-75

Location	Add General Purpose Lane		Add HOV Lane		HOV Increase	
	NB	SB	NB	SB	NB	SB
8 Mile to I-696	11,366	6,209	11,368	5,897	2	(312)
I-696 to 12 Mile	12,300	12,679	12,036	11,805	(264)	(874)
12 Mile to 14 Mile	10,327	9,729	10,237	9,457	(90)	(272)
Square Lake Road to M-59	11,204	9,858	11,222	9,797	18	(60)
Sashabaw to M-15	6,815	3,949	6,697	3,951	(118)	2
M-15 to U.S. 24	5,490	3,252	5,445	3,285	(46)	33
U.S. 24 to Genesee Co. Line	4,742	3,525	4,725	3,519	(17)	(6)

Source: The Corradino Group of Michigan, Inc.
Note: NB is the PM Peak Direction.
( ) Reduction

These data lead to the consultant to the conclusion that the "2-plus" HOV lane will be more effective. Further, it is likely the concept that will gain more public acceptance as tests indicate twice as many vehicles will use the lane.

Overall, these results are consistent (except with the travel time savings issue) with those in the Southeast Michigan High-Occupancy (HOV) Feasibility Study[3], wherein the I-75 segment between I-696 and M-59 was considered feasible and the section north from M-59 to U.S. 24 was judged marginally feasible. These results are also consistent with the I-75 Feasibility Study in which adding a general purpose lane or an HOV facility compared very closely so that a policy decision was required. At that level of analysis, a general purpose lane was chosen to accommodate additional I-75 traffic.

2.4 Findings and Next Steps

Based on this travel analysis, the consultant believes that the "2-plus" HOV lane is an alternate to be examined further at the "practical alternatives" level of detail to determine if it should be carried into the EIS. And, while preliminary indications are that the HOV (2-plus) section of I-75 could extend from 8 Mile Road to M-15, a more limited extent (i.e., between I-696 and M-59) may be chosen based on additional analysis of total (i.e., the sum of all lanes) I-75 person throughput. Nevertheless, because this option could have different effects than adding a general purpose lane in areas such as right-of-way acquisition, road and interchange design, air quality, and cost, it should be tested further. In any case, another lane is needed on I-75. And, while rapid transit in the Woodward Corridor is considered viable, continuing analysis of this concept is left to the advancement of SEMCOG's Speed Link concept as it does not alleviate the need to widen I-75.

These findings will now be reviewed by the I-75 Council. After that is complete, the results will be offered to the general public for its input.

[3] *Southeast Michigan High-Occupancy Vehicle (HOV) Feasibility Study*; Michigan Department of Transportation; by Parsons Brinckerhoff Michigan, Inc.; May 1999.

3. Modeling Background and Approach

3.1 Comparison of SEMCOG Models

For the 1999/2000 I-75 Feasibility Study, Corradino used a version of the SEMCOG model that was available at that time. The target year was 2025; the base year for the model was 1995. Corradino used PM (afternoon) peak hour assignments generated with the model setup provided by SEMCOG.

For the I-75 Oakland County Planning/Environmental Study, SEMCOG provided a set of 2000 and 2025 files. SEMCOG reported the peak hour model was not ready, so Corradino developed a PM peak hour setup. This setup followed the same pattern that SEMCOG used in their 1999 model and is used here to make the “new” 2025 PM peak hour assignments.

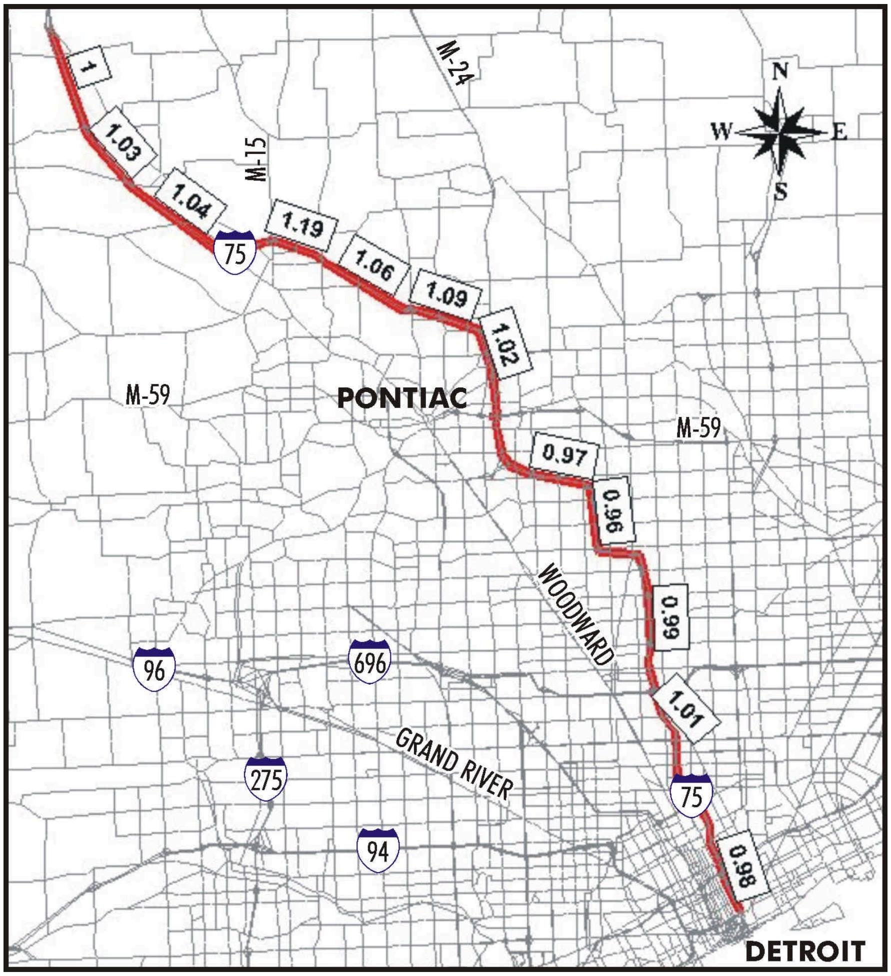
As just noted, SEMCOG has recently updated its base year data (2000), and future year (2025) data. To ensure that the “old” (I-75 Feasibility Study) and “new” (this I-75 study) SEMCOG models make similar highway forecasts, Corradino compared the 2025 PM peak assignments of each. Figure 3-1 illustrates the differences on I-75 in the region. The numbers are the ratio of the “new” I-75 volumes divided by the “old” volumes. In general, the ratios are higher than 1.0 north of Pontiac, where congestion is less, and less than 1.0 south of Pontiac, where congestion is greater. The largest differences are in the area of the Great Lakes Crossing Mall. This is expected when the socioeconomic data affecting such a new facility are updated. Otherwise, the ratios are very close to 1.00.

Table 3-1 presents a statistical analysis of the “old” and “new” assignments for facilities beyond I-75. The average highways link loadings are compared as well as the average percent different for all the links in a category. (The latter is expressed as the percent RMSE [root mean square error]). These statistics are provided for six sets of links:

- All links in the SEMCOG model
- All links that <u>are not centroid connectors</u> (i.e., all links that are actual roads)
- Non-centroid links in the Feasibility Study Area (Figure 3-2)
- All freeways
- I-75 north of Downtown Detroit
- All links within 2 miles of I-75 north of Downtown Detroit.

On average, measured by link loads, the new assignments are higher by about 4 percent than the old assignments. The average difference (i.e., RMSE) between assignments on a link-by-link basis, comparing the new to the old, is about 30 percent. But, for freeways, and especially for I-75 north of Downtown Detroit, the changes are small (difference about 7.5 percent). The consultant believes the results indicate the "new" SEMCOG model is producing statistically reliable results that are consistent with those developed in the I-75 Feasibility Study.

Figure 3-1
Ratio of "NEW" to "OLD" 2025 PM Peak Hour Assignments Along I-75



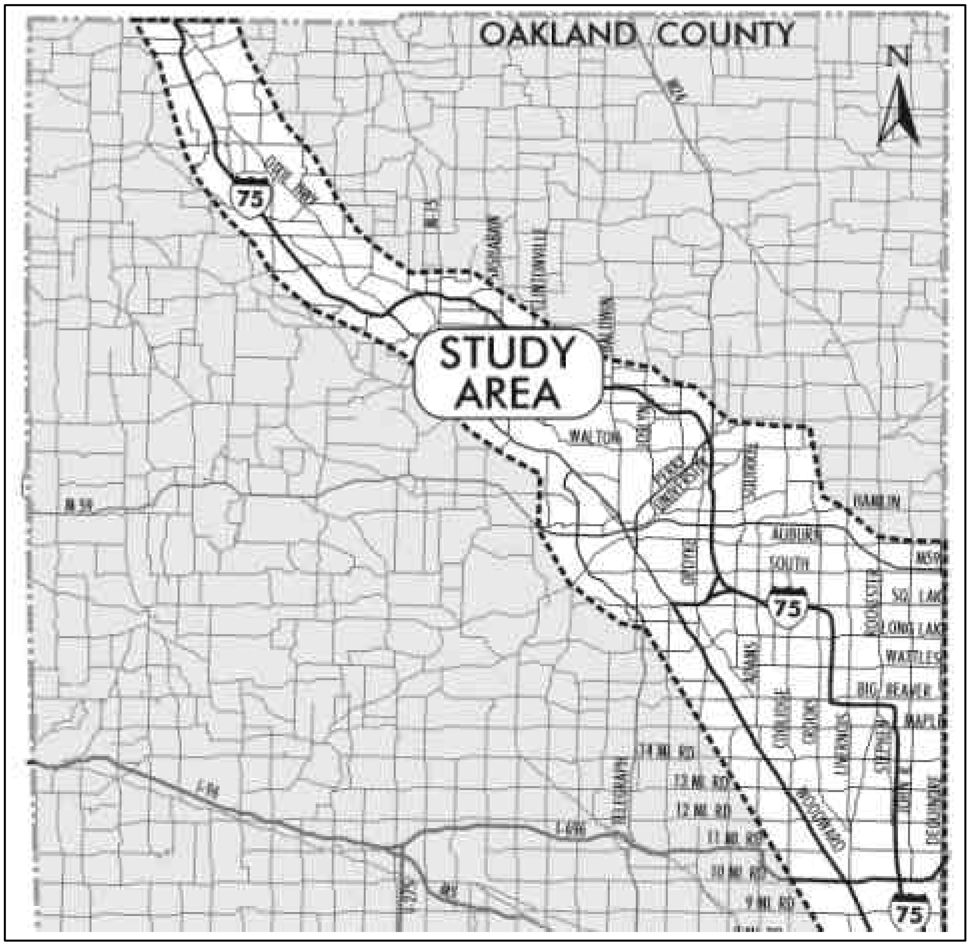
Source: The Corradino Group of Michigan, Inc.

Table 3-1
Comparison of "OLD" Model Used in I-75 Feasibility Study
and "NEW" (May 2002) SEMCOG Model for PM Peak Hour

Condition	Average Link Load		% Difference*	% RMSE
	"OLD"	"NEW"		
All Links	998	1,038	4.0	32.0
Non-centroid Links	1,096	1,139	3.9	30.8
Feasibility Study Area	1,622	1,843	13.6	33.1
All Freeway	4,417	4,803	8.7	8.9
I-75 North of Downtown Detroit	5,719	5,819	1.7	7.6
All links with 2 miles of I-75 North of Downtown Detroit	1,147	1,170	2.0	32.8

Source: The Corradino Group of Michigan, Inc.
*NEW-OLD ÷ OLD

Figure 3-2
I-75 Feasibility Study Area



Source: The Corradino Group of Michigan, Inc.

3.2 Overview of I-75 Project Model Development and Application

3.2.1 Model Description

Currently, SEMCOG's Regional Travel Forecasting Model does not include or use transit networks nor a mode choice model. Thus, while the model is a powerful tool for testing and analyzing highway alternatives, it is not useful for evaluating transit and HOV alternatives. Thus, Corradino implemented a transit modeling process, which includes peak and off-peak transit networks, a nested logit mode choice model, a transit assignment model, and a multi-path highway assignment model that includes an HOV assignment process. It is important to note that these features were inserted into SEMCOG's model, thereby replacing SEMCOG's practice of applying a set of "factors" to account for multiple-occupant vehicles and the presence of transit. The only variation with SEMCOG's modeling process was that SEMCOG carries six internal trip purposes from trip distribution to trip assignment, but the new process developed here aggregates these six purposes to three after trip distribution. This is the most frequent practice in modeling mode choice, as most practitioners have found that data are not available to carry more trip purposes through mode choice.

Transit service in the SEMCOG region was represented by peak and off-peak transit networks. Network development is described in more detail later in this report.

After trips have been allocated to transit modes and levels of highway vehicle occupancy (drive alone, two-occupant vehicles and three-or-more-occupant vehicles), SEMCOG's highway assignment process, modified to use three trip purposes and to display the results of a highway occupancy vehicle assignment, is used to make daily and PM (afternoon) peak hour traffic assignments. The traffic assignment process adds trips that have one or more trip ends outside the SEMCOG region, and truck trips. Additionally, a model step has been added to make a transit assignment.

3.2.2 Networks

The consultant started this analysis with the base networks provided from SEMCOG. For highways, SEMCOG supplied base year (2000) and 2025 networks. These were then adjusted slightly for use in the I-75 analysis. The adjustments did not change the network configuration, but were made so that the network could be used in the transit network program.

SEMCOG also provided a network representing the 2000 transit system. It was coded in a format to support a modeling program called HUDNET. Corradino developed an INET transit network from this file. INET was chosen over HUDNET because of a very important asset of INET – it considers highway congestion in the running time for buses operating in mixed traffic.

The INET transit networks contain route descriptions for the DDOT, SMART, AATA and Blue Water Systems. Corradino has developed a set of custom-written FORTRAN programs to create links to the transit vehicle/route network to enhance connectivity. These programs have been extensively tested in modeling efforts in Florida for such communities as Dade, Broward and Palm Beach Counties as well as Louisville, Kentucky and Indianapolis, Indiana. The programs are as follows:

- Transit walk centroid connectors - Connectors are drawn from Traffic Analysis Zone (TAZ) centroids to bus stops by the program WALKCON as a function of the area type. Walk connectors are at 2.5 mph, and are coded as 2-way maximum lengths of:

CBD (1)	0.20 mile
CBD-Fringe (2)	0.35 mile
Residential/Suburban (3)	0.40 mile
Outlying/Local CBD (4)	0.45 mile
Rural (5)	0.60 mile

- Auto access centroid connectors – the program AUTOCONI draws auto centroid connectors between TAZ centroid and designated auto access stations. Auto travel times and distances are extracted from the highway network (peak and off-peak).

- Walk connectors from bus routes to Rapid Transit (RT) stations - In most fixed-guideway analyses, bus routes must be modified to connect with fixed-guideway stations. The usual practice is to revise the bus routes so that they use a RT station as a bus stop, thereby allowing a transfer between the bus and RT line. The LRTCON program builds connectors to RT stations and nearby bus stops.

LRTCON builds "fast," two-way walk connectors at 10 mph, between bus stops and stations. The maximum connector distance is a function of the area type as follows:

- ?? CBD (1) 0.50 mile
- ?? CBD-Fringe (2) 0.50 mile
- ?? Residential/Suburban (3) 1.00 mile
- ?? Outlying/Local CBD (4) 1.00 mile
- ?? Rural (5) 1.25 mile

✍✍CBD walk network – The program TRCBD constructs 2-way walk connectors that use the highway network in a designated CBD grid area.

3.2.3 Transit Walk Area

The mode choice model built for this analysis requires information on the percentage of each TAZ that is within walking distance of transit. A GIS interface is set up to generate the required files. It is assumed that the portions of zones within 0.25 miles of a transit route operating on a non-freeway road have access. The portion of a TAZ within 0.5 miles of an RT station is assumed to have access. The transit walk area was built using ArcView. Mode choice for walk access is performed only for portions of TAZs that are in the walk access area.

The combination of the highway network, the INET transit route descriptions, and the highway and walk network connectors, described above, comprise the complete transit network.

3.3 Mode Choice Model

3.3.1 Framework

As also noted earlier, a nested logit mode choice model was inserted into the SEMOG model stream, replacing the application of "factors" to account for auto occupancy and the use of transit. The mode choice program was developed in FORTRAN, and was adapted from a transit corridor study in Indianapolis. The transit elasticities were taken from a set of household and transit on-board studies conducted by Corradino in Louisville, Kentucky. The elasticities are within the ranges that are used for large metropolitan areas in the U.S. As will be explained later, the model adjusted these elasticities so that it correctly estimates the existing transit ridership on the existing bus systems in the SEMCOG region.

The nested logit mode choice model allocates input trips for three trips purposes (home-based-work, home-based-other [or home-based-non-work], and non-home-based), to several travel modes. The modes are:

✍✍Walk-to-transit
✍✍Drive to transit
✍✍Drive alone auto (one-occupant or DA)
✍✍Shared ride auto with two occupants (SR2)
✍✍Shared ride auto with three occupants (SR3+)

Thus, the mode choice model determines transit ridership and auto occupancy.

The mode choice model allocates trips to each mode, in part, as a function of the ease of making the trip of each available mode. The model generates highway data for the following paths: 1) free-flow; 2) congested drive-alone; 3) congested 2-person HOV; and, 4) congested 3+person HOV. Eight sets of transit paths, times and fare matrices are built for the following conditions:

Peak Period	Midday Period
✍✍Walk access to bus.	✍✍Walk access to bus.
✍✍Walk access to RT.	✍✍Walk access to RT.
✍✍Auto access to bus.	✍✍Auto access to bus.
✍✍Auto access to RT.	✍✍Auto access to RT.

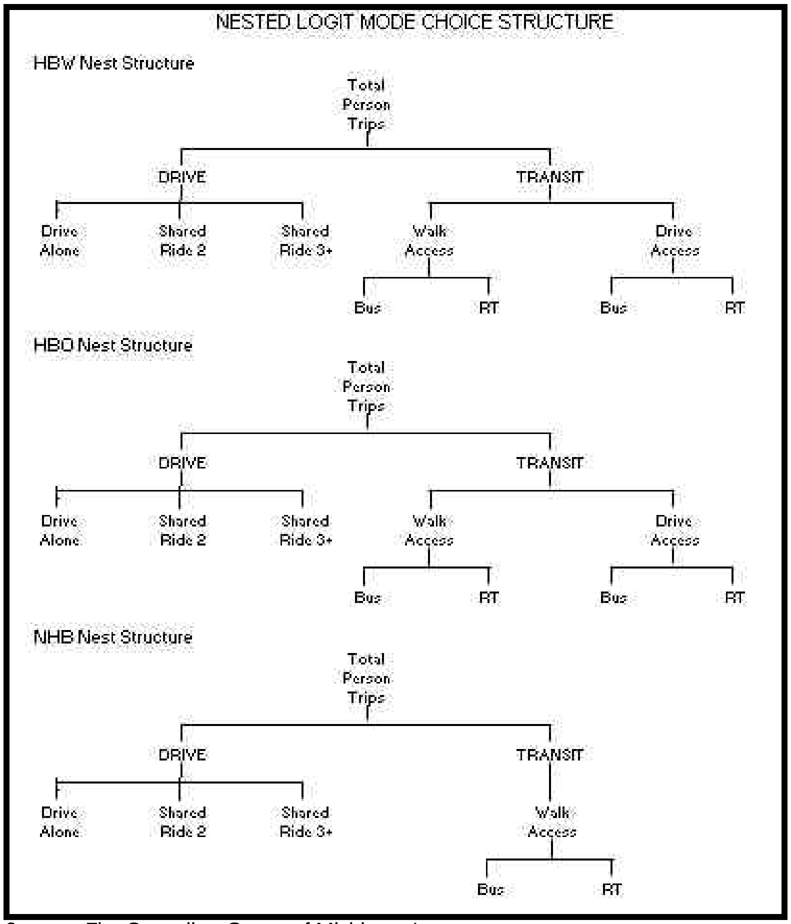
The model limits all transit paths to three transfers. To reflect reality, the path-builder program discourages long walk times and penalizes transfers.

In the end, the mode choice model developed for this I-75 project allocates trips to seven trip tables:

1. Auto drive alone
2. Auto 2-occupant shared ride
3. Auto 3 or more occupant shared ride
4. Walk to bus
5. Walk to RT
6. Drive to bus
7. Drive to RT

The model works as follows (Figure 3-3): First, it allocates person trips to either the transit or the auto (drive) mode. If the trip is an auto trip, the model uses a formulation to allocate it to the drive-alone, 2-person or 3+person auto mode. If the trip is a transit trip, the model allocates it to either the walk access or auto access mode. Then, whether auto or walk access, transit trips are allocated to bus or RT modes. It is important to note the split between competing modes occurs only if the alternative mode is available. For example, if the trip cannot be made by transit because no service is available, all transit trips are auto trips. Similarly, for a trip that is determined to be a transit trip, if the walk distance is too long, it is assumed an auto-access trip. Moreover, if the trip is assumed a walk-access transit trip, it is assumed a bus trip, if RT service is not available.

Figure 3-3
Mode Choice Model Structure



Source: The Corradino Group of Michigan, Inc.

The mode choice input variables are extensive. They include:

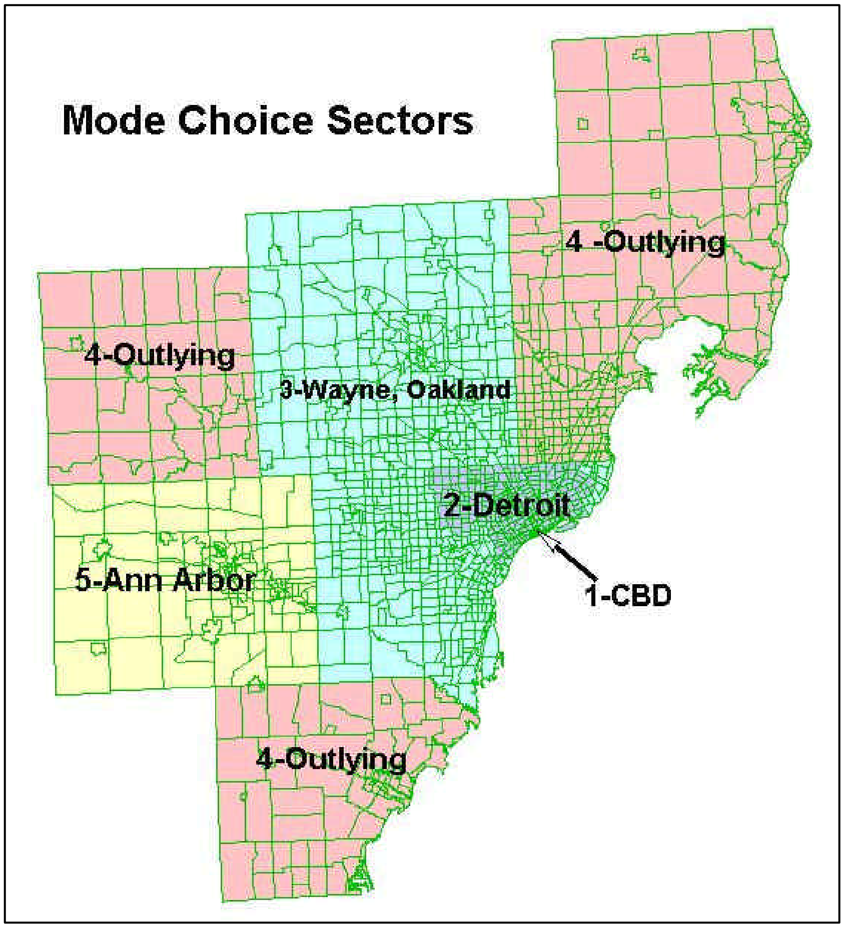
✍✍Components of the transit trip
- ?? Number of transfers
- ?? Walk time
- ?? Wait time (initial plus transfer)
- ?? Auto access time
- ?? In-bus time
- ?? In-RT time
- ?? Fare

✍✍Components of the auto travel trip
- ?? Travel time
- ?? Operating cost
- ?? Parking Cost

- Income of the home TAZ
- Whether the destination is the CBD

The model has been segmented by trip purpose and sector (Figure 3-4). The model uses different constants for trips originating in the CBD (1) and four sectors: City of Detroit (2), remainder of Wayne and Oakland Counties (3), Ann Arbor (5), and the remaining areas (Outlying – 4). This allows a finer degree of validation.

Figure 3-4
Mode Choice Sectors



Source: The Corradino Group of Michigan, Inc.

The mode choice model produces 19 person trip tables as follows:

- HBW drive-alone
- HBW 2-person auto
- HBW 3+person auto
- HBO drive-alone
- HBO 2-person auto
- HBO 3+person auto
- NHB drive-alone
- NHB 2-person auto
- NHB 3+person auto
- HBW walk to bus
- HBW walk to RT
- HBW drive to bus
- HBW drive to RT
- HBO walk to bus
- HBO walk to RT
- HBO drive to bus
- HBO drive to RT
- NHB walk to bus
- NHB walk to RT

Transit trip tables are added together and assigned to appropriate sets of transit paths. Eight transit assignments are made:

Peak Period	Midday Period
Walk to bus	Walk to bus
Drive to bus	Peak drive to bus
Walk to RT	Peak walk to RT
Drive to RT	Peak drive to RT

3.3.2 Model Calibration

Mode choice model calibration is the process of adjusting parameters so that the model is able to replicate existing transit ridership and auto occupancies with reasonable accuracy. Generally, the "elasticities" in the model (i.e., the slope of the logit curves) are determined from disaggregate data. Such data are not available for the SEMCOG region, and thus, elasticities were borrowed from another city. The constant terms in the model can be determined from aggregate, or systemwide data. All of the required aggregate data were available for SEMCOG, or estimated from SEMCOG data.

3.3.2.1 Data Sources

Ideally, model calibration is performed using actual travel behavior data gathered from a home-interview origin-destination survey and an onboard transit survey. An on-board O-D survey was recently conducted for the SEMCOG region, but it was not available in a processed form for full calibration. Nevertheless, much of the required aggregate data used here were taken from this SEMCOG survey.

Recent data collected for SEMCOG from the region's transit operators provided information on transit boardings by route. The onboard survey data indicate that daily linked transit trips for the current SEMCOG bus service is about 127,000 (Table 3-2). This information was summarized by sector (shown in Figure 3-4) and by trip purpose for use in the model calibration process, discussed next.

Table 3-2
SEMCOG On-Board Transit Survey Results (2002)

System	Daily Boardings	Percent Transfer	Linked Trips	Drive to Bus Trips
DDOT	158,215	40%	94,929	3,697
SMART	31,749	37%	20,002	779
Ann Arbor	15,229	23%	11,726	0
Blue Water	1,421	40%	853	0
Total	206,614	38%	127,510	4,476

Source: SEMCOG and The Corradino Group of Michigan, Inc.

A comprehensive set of travel surveys (onboard and home-interview) was completed for Louisville, Kentucky, in 1994. This set of surveys was to calibrate the nested logit models used here. The SEMCOG model was patterned after this model in Louisville as well as in Indianapolis. Noteworthy is the fact that the Federal Transit Administration (FTA) has approved preliminary engineering of the Louisville proposal; and, in Indianapolis, transit improvements are being considered in a supplemental study to a Draft Environmental Impact Statement.

Auto occupancies were taken from SEMCOG's models. As noted earlier, SEMCOG used six trip purposes, while the nested logit model required data for three. Thus, weighted average rates were calculated from the six purposes. The auto occupancy rates, which are calibration targets, are as follows:

- HBW – 1.071 persons per vehicle
- HBO – 1.538 persons per vehicle
- NHB – 1.386 persons per vehicle

3.3.2.2 Calibration Results

The modal split model was calibrated by adjusting the computer-based equations so that transit ridership and auto occupancies estimated by the model matched observed values, i.e., the "targets." Table 3-3 presents a summary of transit system ridership by corridor. The column entitled "target" is the estimated linked trips for trips originating (production end) in each corridor. The column entitled "value" is the number of trips reported by the model. For the overall study area, the error is less than one percent, and for each corridor the model estimates are within about one percent of the observed ridership.

Table 3-3
Model Calibration by Sector

Sector	Calibration by Sector Transit Trips		% error
	Target	Value	
CBD	2,884	2,884	0.009%
Detroit	99,180	100,314	1.143%
Wayne Oakland	10,733	10,702	-0.289%
Outlying	5,394	5,346	-0.896%
Ann Arbor	9,318	9,319	0.006%
	127,510	128,565	0.828%

Source: The Corradino Group of Michigan, Inc.

Similarly, the allocation of trips by mode, purpose and corridor was compared to observed data. Table 3-4 shows that for every mode, purpose and corridor, the nested logit model replicates the observed number of trips.

3.3.2.3 Model Comparisons

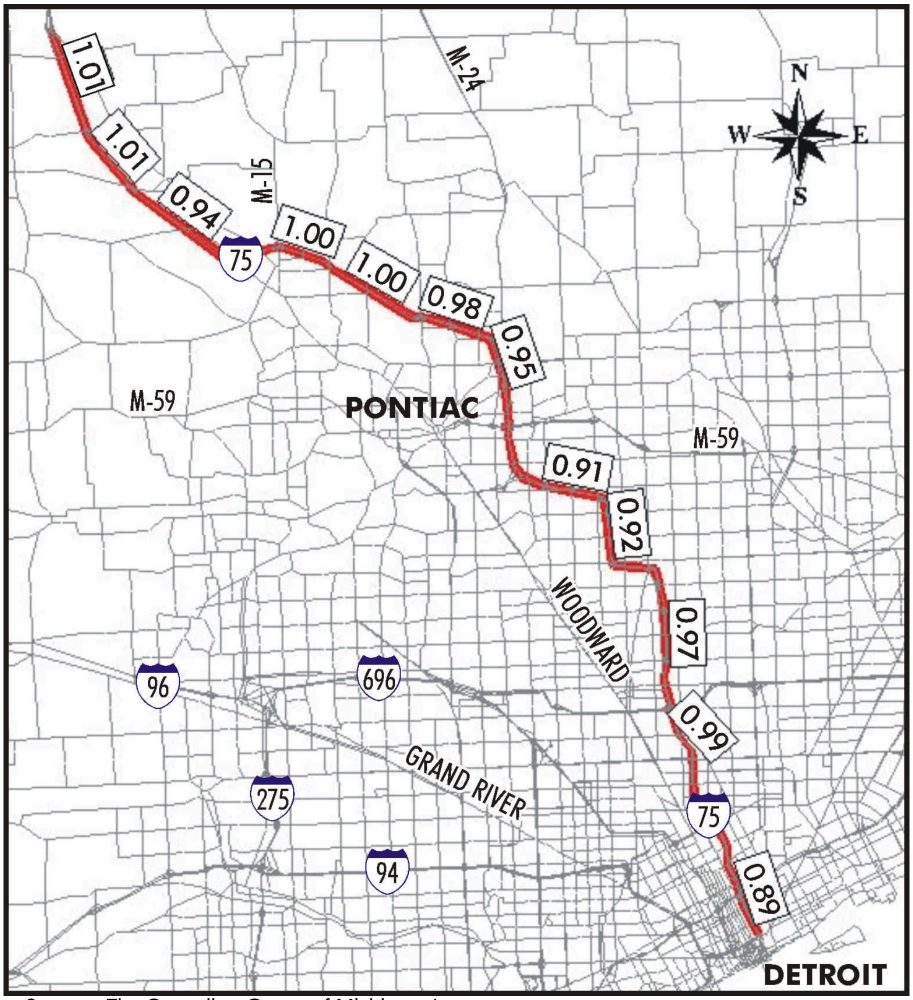
This newly developed model was also compared to the SEMCOG model used in the I-75 Feasibility Study (Figure 3-5 and Table 3-5). The results indicate the newest model is within five percent of the Feasibility Study volumes on I-75 north of M-59, which is closer than the "new" SEMCOG model is to the old SEMCOG model (Figure 3-1). Between M-59 and I-696 the differences range from one percent to nine percent lower than the Feasibility Study model. So, using this newest model in this section of I-75 makes it more difficult to justify another lane. But, analyses indicate the 2025 volumes from this newest model along the I-75 section from 8 Mile Road to M-59 in each direction will experience the worst levels of congestion (mostly Level of Service F) in the peak hours without adding any capacity.

Table 3-4
Model Calibration by Mode, Purpose and Sector

Sector		Purpose	Mode							TOTAL
			DA	SR2	SR3 +	Walk Bus	Walk RT	Drive Bus	Drive RT	
CBD										
	HBW	Model	1,497	127	69	202	142	-	-	2,037
		Target	1,496	126	69	345	-	-	-	2,037
	HBO	Model	1,950	1,437	1,313	293	248	-	-	5,241
		Target	1,950	1,437	1,314	540	-	-	-	5,241
	NHB	Model	33,865	16,609	13,472	927	1,072	-	-	65,945
		Target	33,865	16,609	13,472	1,998	-	-	-	65,945
Detroit										
	HBW	Model	275,409	23,255	12,794	36,833	6,573	3,050	-	357,914
		Target	276,404	23,350	12,842	42,978	-	2,340	-	357,914
	HBO	Model	596,263	439,251	401,870	36,177	2,865	1,287	-	1,477,713
		Target	596,261	439,252	401,869	39,044	-	1,287	-	1,477,713
	NHB	Model	360,560	176,841	143,439	12,360	1,169	-	-	694,369
		Target	360,559	176,841	143,438	13,531	-	-	-	694,369
Wayne Oakland										
	HBW	Model	1,172,024	99,010	54,457	2,385	333	433	-	1,328,642
		Target	1,171,996	99,007	54,454	2,773	-	412	-	1,328,642
	HBO	Model	1,606,215	1,183,264	1,082,559	4,032	109	137	-	3,876,316
		Target	1,606,217	1,183,263	1,082,560	4,140	-	137	-	3,876,316
	NHB	Model	1,403,301	688,269	558,260	3,205	68	-	-	2,653,103
		Target	1,403,302	688,268	558,262	3,271	-	-	-	2,653,103
Outlying										
	HBW	Model	633,096	53,483	29,414	1,753	51	46	-	717,843
		Target	633,097	53,482	29,415	1,800	-	48	-	717,843
	HBO	Model	892,972	657,835	601,854	2,036	10	81	-	2,154,788
		Target	892,955	657,820	601,835	2,108	-	69	-	2,154,788
	NHB	Model	642,969	315,351	255,787	1,367	2	-	-	1,215,476
		Target	642,969	315,353	255,786	1,369	-	-	-	1,215,476
Ann Arbor										
	HBW	Model	163,357	13,799	7,590	3,948	-	266	-	188,960
		Target	163,357	13,800	7,590	3,948	-	265	-	188,960
	HBO	Model	205,428	151,335	138,455	3,104	-	356	-	498,678
		Target	205,428	151,334	138,455	3,105	-	356	-	498,678
	NHB	Model	210,430	103,209	83,714	1,645	-	-	-	398,998
		Target	210,431	103,209	83,714	1,645	-	-	-	398,998

Source: The Corradino Group of Michigan, Inc.

Figure 3-5
Ratio of "EIS" Model to "OLD" SEMCOG 2025 PM Peak Hour Assignments Along I-75



Source: The Corradino Group of Michigan, Inc.

Table 3-5
Comparison of "OLD" Model Used in I-75 Feasibility Study
and "EIS" SEMCOG Model for PM Peak Hour

Condition	Average Link Load		% Difference*	% RMSE
	"OLD"	"EIS"		
All Links	998	951	-4.7	31.6
Non-centroid Links	1,096	1,041	-5.0	30.4
Feasibility Study Area	1,622	1,507	-7.1	34.9
All Freeway	4,417	4,266	-3.4	8.5
I-75 North of Downtown Detroit	5,719	5,465	-4.4	9.4
All links with 2 miles of I-75 North of Downtown Detroit	1,147	1,064	-7.3	34.3

Source: The Corradino Group of Michigan, Inc.
*(EIS-OLD) ÷ OLD

4. Rapid Transit and HOV Concepts

This section describes the concepts for rapid transit and a high-occupancy vehicle facility in the Woodward and I-75 corridors, respectively.

4.1 Rapid Transit (RT) Features

The transit concept being evaluated is a very high performance system running on Woodward Avenue from Pontiac in Oakland County to Jefferson Avenue in downtown Detroit. It is characterized by:

- High speed (60 mph where distances and conditions permit),
- High quality vehicles with a quiet, smooth ride,
- Separation from other traffic to avoid congestion,
- Short headways, 3 minutes,
- Short dwell times, 15 seconds or less,
- Timed transfers with intersecting routes,
- Communication between buses to avoid missed transfers,
- Park-and-ride lots at stops north of, and including, the Michigan State Fairgrounds,
- Fare integration with intersecting transit service to permit a single fare for all segments of a trip, and,
- Pre-paid fares at platforms to reduce boarding times.

4.2 The Rapid Transit Route

Woodward Avenue was selected because it has been defined by professional analysis over two generations as the priority corridor for high-type transit. There is a rail line running parallel to Woodward from north of Pontiac to Baltimore Street (New Center) in Detroit. But, it is separated from the more densely populated areas in the south portion of the Woodward corridor by a distance that would have a tendency to reduce ridership. So, in light of these corridor characteristics, the proposed rapid transit route begins at Pontiac's Transportation Center on West Woodward Avenue and travels south in its own guideway/pathway on Woodward with stops at the locations listed in Table 4-1 and shown in Figure 4-1.