Section H
# TRAVEL DEMAND MODEL

The urban area travel demand modeling process for Kalamazoo was a cooperative effort between the Kalamazoo Area Transportation Study (KATS), being the Metropolitan Planning Organization (MPO), and the Michigan Department of Transportation, Statewide and Urban Travel Analysis Section (MDOT). MDOT provided the lead role in the process and assumed responsibility for modeling activities with both entities reaching consensus on selective process decisions. The local transportation planning agency is the MPO, comprised of representatives of local governmental units and is the umbrella organization responsible for carrying out transportation planning in cooperation with MDOT and the Federal Highway Administration. This is typically accomplished by full coordination of the local agencies with the MPO.

Travel demand modeling and capacity deficiency identification and analysis were undertaken as part of the continuing phase of the transportation planning process required by the Transportation Equity Act for the 21st Century (TEA-21). The travel demand modeling of the transportation system is utilized for aiding in the policy determinations that result in both long range plans and short range studies (corridor studies and sub-area studies). Emphasis in this current effort was on the development of the 2025 Transportation Plan. The results of the modeling effort provide an important decision making tool for plan development. The modeling process is a systems-level effort. Although individual links of a highway network can be analyzed, the results are intended for determination of system-wide impacts. At the systems level, impacts are assessed on a broader scale than the project level.

For the purpose of conducting transportation planning in an urban area, the Metropolitan Planning Organization (MPO) defines the study area which includes all of Kalamazoo County. The time frame for the Transportation Plan is 1998 to 2025.

The travel demand modeling for Kalamazoo has been completed through the use of TransCAD software utilized by MDOT. The model is a computer simulation of current and future traffic conditions and is a system-level transportation planning model. The deficiencies identified are generalized 24-hour (daily) deficiencies, based on generalized 24-hour capacities and traffic assignment volumes.

The urban travel demand forecasting process used has six phases:

1. Data Collection, in which socio-economic and facility inventory data are collected.

2. Trip Generation, which calculates the number of trips produced in or attracted to a traffic analysis zone (TAZ).

3. Trip Distribution, which takes the trips produced in a TAZ and distributes them to all other TAZs, based on attractiveness of the zone.

4. Traffic Assignment, determines what routes are utilized for trips.

5. Model Calibration/validation, which involves verifying that the volumes (trips) simulated in traffic assignment replicate observed traffic counts.

6. System Analysis, tests alternatives and analyzes changes in order to improve the transportation system.

There are two basic systems of data organization in the travel demand forecasting process. The first system of data is organized based on the street system. Most roads with a national functional class (NFC) of rural minor collector and higher are included in the network. The unit of analysis is called a “link.” Usually, a link is a segment of roadway which is terminated at each end by an intersection. In a traffic assignment network, intersections are called “nodes.” Therefore, a link has a node at each end.

The second data organization mechanism is the traffic analysis zones. Zones are determined based upon several criteria, including similarity of land use, compatibility with jurisdictional boundaries, the presence of physical boundaries, compatibility with the street system, and compatibility with the zone system used within the Statewide Model. Streets are generally utilized as zone boundary edges. All socio-economic and trip generation information for both the base year and future year are summarized by zone.

The two data systems, the street system (network) and the zone system (socio-economic data), are interrelated through the use of “centroids.” Each zone is portrayed on the network by a point (centroid) which represents the weighted center of activity for that zone. A centroid is connected by a set of links to the adjacent street system. That is, the network is provided with a special set of links for each zone which connects the zone to the street system. Since every zone is connected to the street system by these “centroid connectors,” it is possible for trips from each zone to reach every other zone by way of a number of paths through the street system.

## NETWORK

A computerized “network” (traffic assignment network) is built to represent the existing street system. It includes most streets within the study area classified as a “rural minor collector” or higher by the national functional classification system. Other roads are added to provide continuity and/or allow interchange between these facilities.

The Kalamazoo 1998 calibrated/validated network includes 748 miles of roadway (excluding centroid connectors) with the following classifications:

- 98 miles of freeways (trunklines)
- 18 miles of ramps (trunklines)
- 80 miles of other trunklines
- 132 miles of local major arterials
- 259 miles of minor arterials
- 161 miles of collectors

There are 329 one-way links equaling 148 miles; 1,161 two-way links equaling 600 miles. Transportation system information required for each link includes, at a minimum, distance, speed, link type, national functional classification, traffic counts (where available), and 24-hour volumes for a specified level of service (frequently described as its capacity). If the information is not the same for the entire length of a link, the predominant value is used. The KATS staff reviewed and approved the network and link attributes. The calibrated/validated network for the KATS urban area is shown in Figures H-1 and H-2.

Network link types follow MDOT's standard format:

| | |
|---|---|
| 1 - freeways | 5 - minor arterials |
| 2 - ramps | 6 - collectors |
| 3 - other state trunkline | 7 - centroid connectors |
| 4 - major arterials | |

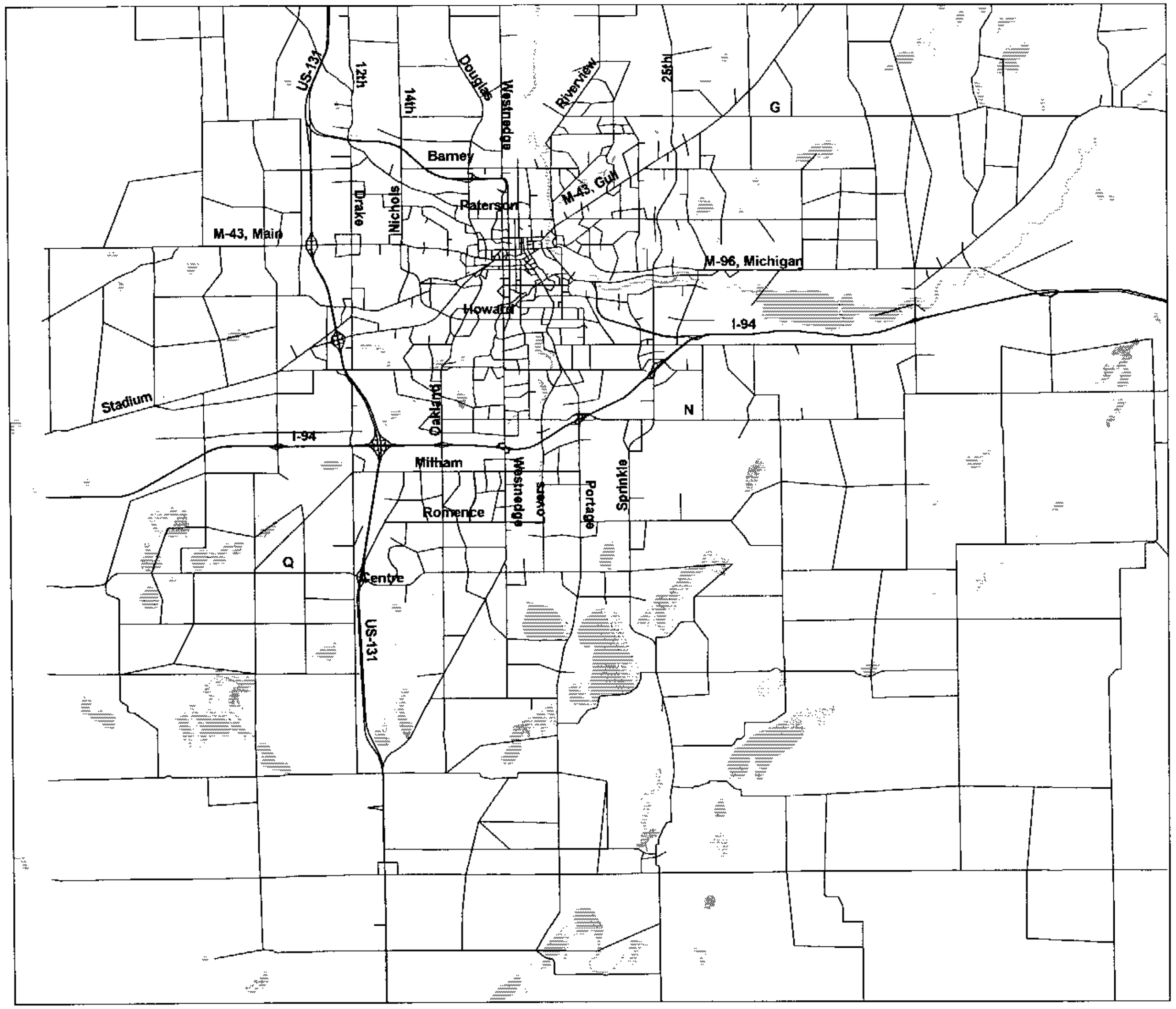


**Figure H - 1**
**Road System Network**
**Entire County**

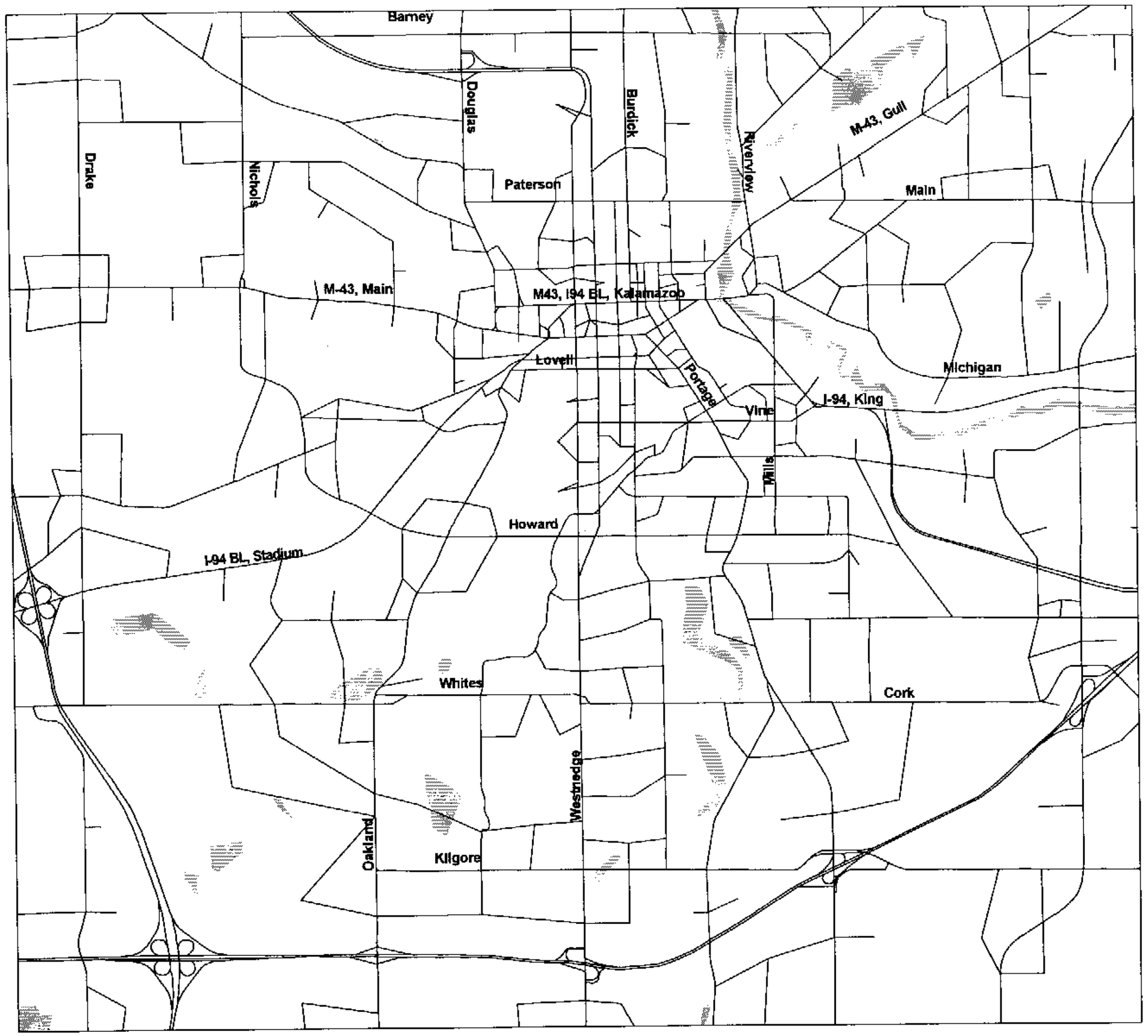


**Figure H - 2**
**Road System Network**
**Expanded Scale**

The street network is used in the traffic assignment process. The traffic assignment process takes the trip interactions between zones from trip distribution and loads them onto the network. The travel paths for each zone-to-zone interchange are based on the minimum travel time between zones. They are calculated by a computer program which examines all possible paths from each origin zone to all destination zones. The shortest path is determined by the distance of each link and the speed at which it operates. The program then calculates travel times (link distance x speed) for all of the possible paths and records the links which comprise the link distance divided by the link speed. Time penalties were added for right and left intersection turn movements. At three specific intersections, time penalties for specific movements were modified. The added times (penalties) are shown on Table H-1 and Table H-2.

Table H-1
Time Penalty Table

| MOVEMENT | PENALTY (MIN.) |
|---|---|
| Right Turn | 0.15 |
| Straight Through | none |
| Left Turn | 0.33 |
| U-Turn | prohibited |

Table H-2
Specific Intersection Time Penalty Table

| From | To | Movement | Penalty (min.) |
|---|---|---|---|
| Howard | Stadium | left | 0.5 |
| Gull Rd | Gull Rd(M-43) | straight (crossing M-43) | 0.75 |
| Gull Rd (M-43) | Gull Rd | straight (crossing M-43) | 0.75 |

Speeds used to calculate minimum travel times are based on each link's roadway type, area type, and link type. Speeds represent a relative impedance to travel and not posted speed limits. Various speeds for each roadway type and area type were tried in an attempt to get reasonable travel paths. The final speed matrix is shown in Table H-3.

The shortest travel time paths were reviewed by KATS staff to ensure that they represent actual travel patterns around, through, and within the Kalamazoo urban area. Roadway types used to determine speed:

- 1 - Freeway (full access controlled)
- 3 - Three travel lanes or two lanes plus center turn lane
- 5 - Four travel lanes plus center turn lane
- 7 - Six travel lanes plus center turn lane
- 9 - Two-way undivided
- 10 - Ramp with free flow
- 11 - Ramp with signal or stop

Table H-3
Final Speed Table
Miles Per Hour

| Facility Type* | Roadway Type | CBD | Urban | Suburban | Fringe | Rural |
|---|---|---|---|---|---|---|
| Freeway | 1 | 50 | 55 | 60 | 65 | 65 |
| Ramp | 10 | 25 | 25 | 25 | 25 | 25 |
| Ramp | 11 | 20 | 20 | 20 | 20 | 20 |
| Trunkline (non-freeway) | | | | | | |
| *divided or one-way* | | 29 | 34 | 41 | 49 | 53 |
| *undivided or two-way* | 3,5,7,9 | 26 | 31 | 38 | 46 | 50 |
| Major arterial | | | | | | |
| *divided or one-way* | | 28 | 33 | 40 | 48 | 52 |
| *undivided or two-way* | 3,5,7,9 | 25 | 30 | 37 | 45 | 49 |
| Minor arterial | | | | | | |
| *divided or one-way* | | 26 | 31 | 38 | 43 | 50 |
| *undivided or two-way* | 3,5,7,9 | 23 | 28 | 35 | 40 | 45 |
| Collector | all | 20 | 25 | 30 | 35 | 42 |
| Centroid | all | 15 | 20 | 25 | 30 | 35 |

* Each lane, including center turn lane, over two for undivided or two-way and over four for divided and one-way streets will get one mph increase. Example a five lane road would be three mph faster than a two lane road.

## SOCIO-ECONOMIC DATA

The socio-economic data was provided by the KATS staff. KATS provided both 1998 base year and projected 2025 population, dwelling units, vehicles and employment summaries by Traffic Analysis Zone (TAZ). There are 372 TAZs and 30 external stations (entry and exit from the system). More detailed information on the socio-economic data is provided in Section G.

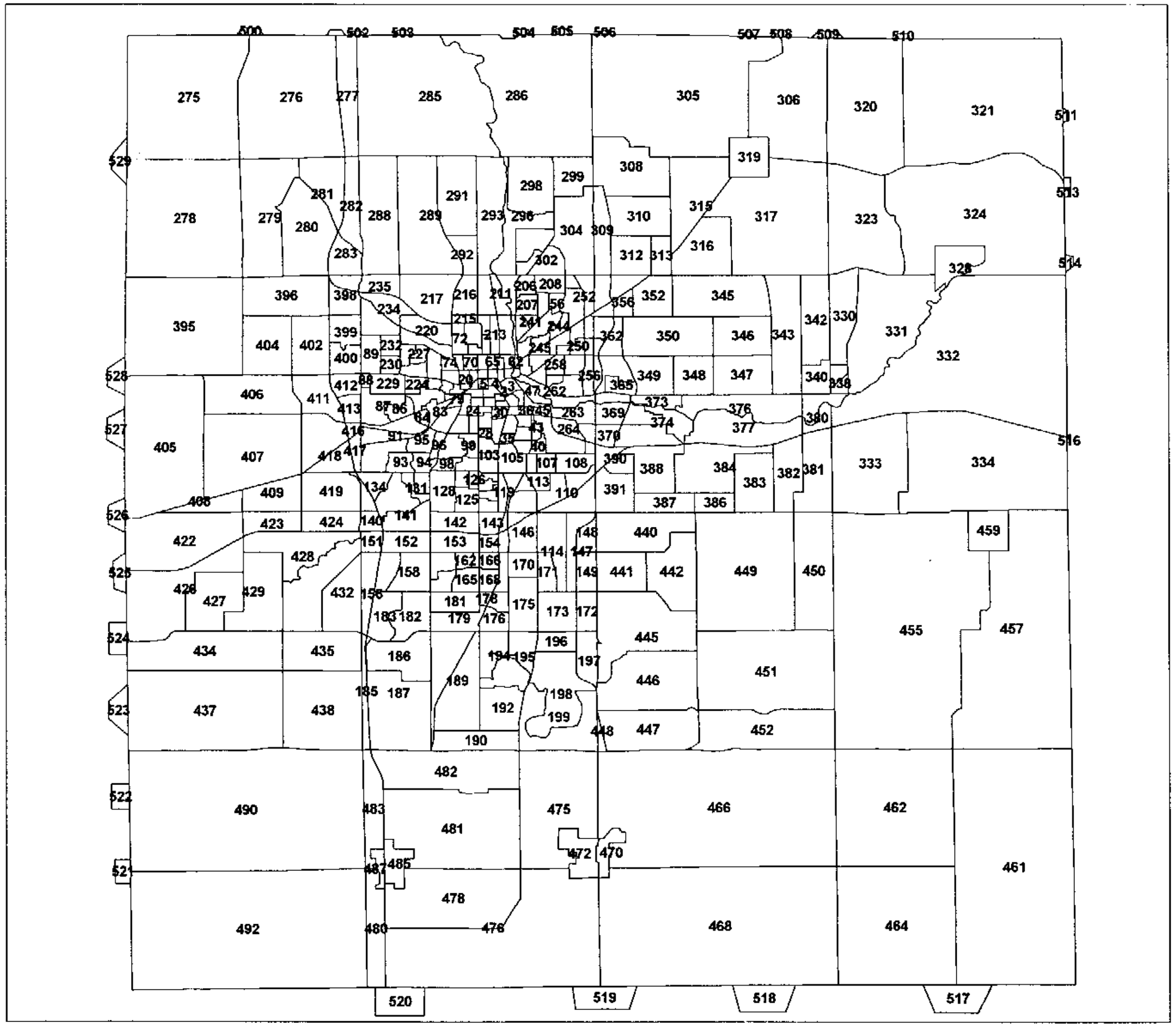


**Figure H - 3**
**Traffic Analysis Zones**
**Entire Couonty**

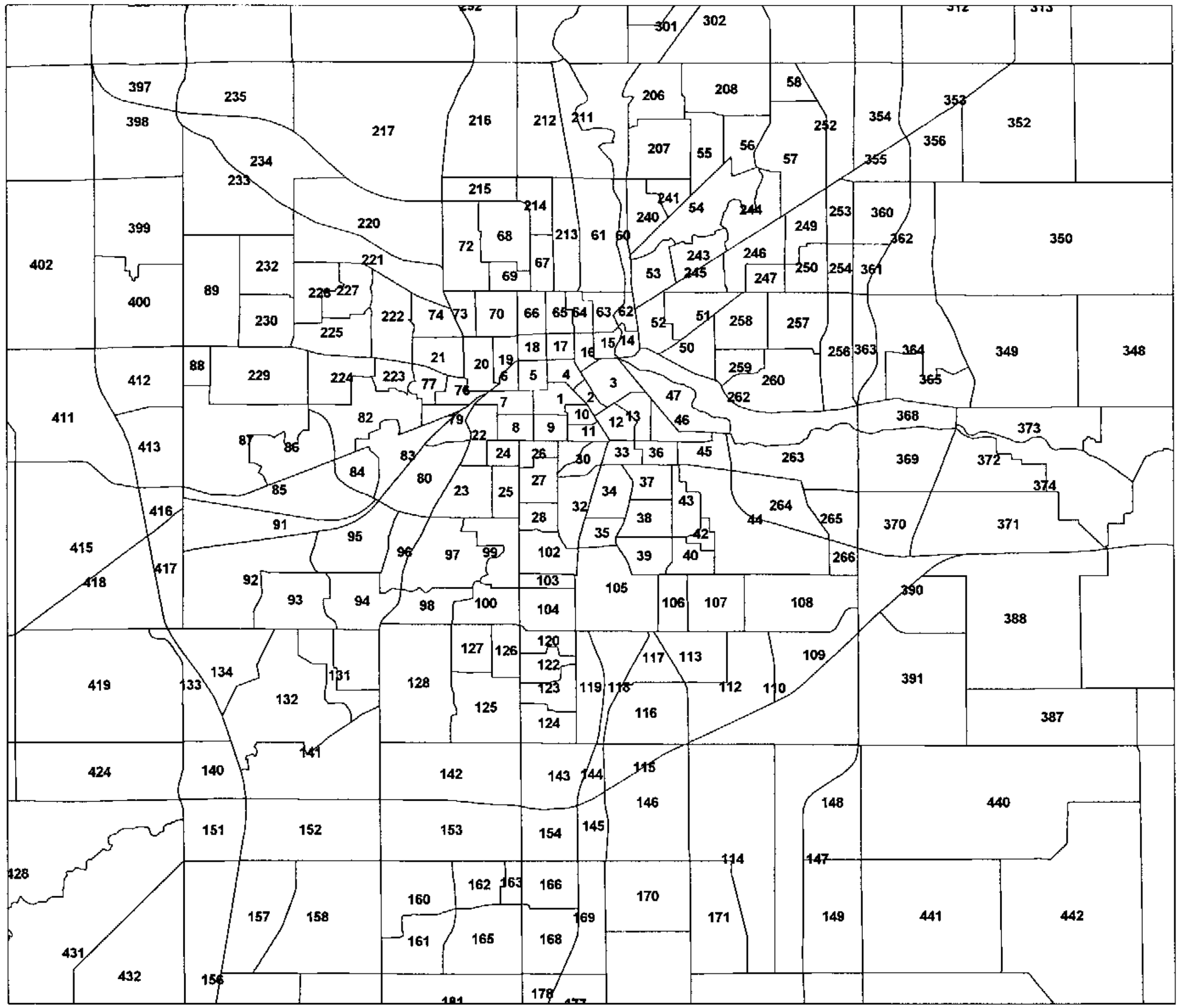


**Figure H - 4**
**Traffic Analysis Zones**
**Expanded Scale**

## TRIP GENERATION

The trip generation process calculates the number of person-trips produced from or attracted to a zone, based on the socio-economic characteristics of that zone. The urban transportation forecasting models do not consider travel characteristics such as direction, length, or time of occurrence as part of trip generation. The relationship between person-trip making and land activity are expressed in equations for use in the modeling process. The Kalamazoo model uses the trip generation formulas specified in the Travel Estimation Techniques for Urban Planning to generate productions and attractions.

The formulas were derived from transportation study data and other research throughout the United States. Productions were generated with a cross-classification look-up process based on autos and dwellings. Attractions were generated with a regression approach. Detailed discussions on the development of the formulas is provided in the Travel Estimation Techniques for Urban Planning by National Cooperative Highway Research Program (NCHRP), dated January 1996. Productions and attractions were generated for trip purposes:

- Home-Based Work Productions (HBW-P)
- Home-Based Work Attractions (HBW-A)
- Home-Based Non-Work Productions (HBNW-P)
- Home-Based Non-Work Attractions (HBNW-A)
- Non-Home-Based Productions (NHB-P)
- Non-Home-Based Attractions (NHB-A)

Preliminary analysis concluded that some zones containing certain productions or attractions were under or over generating trips. The socio-economic data was reviewed and more detailed information was collected. Special generator adjustments were developed for these zones considering various benchmark reports, physical location within the study area, and existing nearby traffic counts. The special generator zones and their adjustments are found in Table H-4 and H-5.

Table H-4
1998 Special Generator Zones and Adjustments

| REASON | ZONE | Method | P-NHB | A- HBW | A-HBNW | A-NHB |
|---|---|---|---|---|---|---|
| Western Michigan University | 22 | replace | 2300 | | 3600 | 2300 |
| | 80 | replace | 3800 | 2000 | 1500 | 3800 |
| | 79 | replace | 1000 | | 1750 | 1000 |
| | 91 | replace | 4200 | | 18500 | 4200 |
| | 83 | replace | 4250 | 4000 | 6650 | 4250 |
| | 82 | replace | 8200 | | 12800 | 8200 |
| | 84 | replace | 8200 | | 12800 | 8200 |
| | 134 | add | 0 | 0 | 0 | 0 |
| Shopping | 143 | replace | 4500 | | 29200 | 4500 |
| | 355 | replace | | | 6000 | |
| | 165 | replace | | | 40000 | |
| | 400 | replace | | | 25000 | |
| Community College | 428 | replace | 5500 | 1200 | 6400 | 5500 |

Table H-5
2025 Special Generator Zones and Adjustments

| REASON | ZONE | Method | P-NHB | A- HBW | A-HBNW | A-NHB |
|---|---|---|---|---|---|---|
| Western Michigan University | 22 | replace | 3038 | | 4756 | 3038 |
| | 80 | replace | 5177 | 2725 | 2043 | 5177 |
| | 79 | replace | 1335 | | 2336 | 1335 |
| | 91 | replace | 3789 | | 16690 | 3789 |
| | 83 | replace | 5789 | 5448 | 9058 | 5789 |
| | 82 | replace | 11019 | | 17200 | 11019 |
| | 84 | replace | 9794 | | 15288 | 9794 |
| | 134 | add | | 435 | 2745 | 2745 |
| Shopping | 143 | replace | 4838 | | 31393 | 4838 |
| | 355 | replace | | | 7531 | |
| | 165 | replace | | | 43561 | |
| | 400 | replace | | | 25858 | |
| Community College | 428 | replace | 5420 | 1182 | 6307 | 5420 |

Trips that begin or end beyond the study area boundary are called “cordon trips.” These trips are made up of two components: external to internal (EI) or internal to external (IE) trips, and through-trips. EI trips are those trips which start outside the study area and end in the study area. IE trips start inside the study area and end outside the study area. Through-trips are those trips that pass through the study area without stopping. A summary of the cordon volumes and distribution of those volumes is shown in Table H-6 (following pages).

In order to develop a trip table, productions (P's) and attractions (A's) must be balanced. To accomplish this, the study area's total attractions are factored to equal the study area's total productions for the HBW, and HBNW purposes. This is called normalization. The A's are normalized to the P's because the production equations use household data which generally provide a more accurate estimate of home based trip making. The NHB productions are set equal to the NHB attractions because attractions provide greater reliability. The Kalamazoo Area Trip Generation Summary (Tables H-7 and H-8) identifies productions, attractions, and normalization factors for the study area, for both 1998 and 2025.

Table H-6
Kalamazoo Cordon Information

| | | 1999 | | | 2025 | | |
|---|---|---|---|---|---|---|---|
| STATION # | LOCATION | IE & EI TRIPS | CORDON TOTAL | THROUGH TRIPS | IE & EI TRIPS | CORDON TOTAL | THROUGH TRIPS |
| 500 | Ravine Road | 5,133 | 5,500 | 367 | 9,000 | 8,399 | 601 |
| 501 | US-131 (north) | 30,355 | 44,024 | 13,669 | 60,000 | 41,371 | 18,629 |
| 502 | N. 12th St | 3,269 | 3,498 | 229 | 5,000 | 4,673 | 327 |
| 503 | Douglas Ave | 5,044 | 5,402 | 358 | 6,000 | 5,602 | 398 |
| 504 | Riverview Dr | 3,177 | 3,400 | 223 | 4,500 | 4,205 | 295 |
| 505 | N. 22nd St | 1,216 | 1,300 | 84 | 1,800 | 1,684 | 116 |
| 506 | M-89 | 4,548 | 6,000 | 1,452 | 7,300 | 5,533 | 1,767 |
| 507 | 32nd St | 951 | 1,034 | 83 | 1,400 | 1,288 | 112 |
| 508 | M-43 / 4th St | 7,071 | 8,010 | 939 | 14,000 | 12,359 | 1,641 |
| 509 | Gull Lake Dr | 1,310 | 1,402 | 92 | 1,500 | 1,402 | 98 |
| 510 | 40th St | 2,415 | 2,600 | 185 | 3,000 | 2,787 | 213 |
| 511 | E. C Ave | 1,130 | 1,204 | 74 | 1,500 | 1,408 | 92 |
| 512 | M-89 | 4,546 | 5,800 | 1,254 | 7,700 | 6,035 | 1,665 |
| 513 | Augusta Dr | 2,731 | 2,906 | 175 | 3,000 | 2,819 | 181 |
| 514 | M-96 | 7,103 | 7,604 | 501 | 10,000 | 9,341 | 659 |
| 515 | I-94 (east) | 14,682 | 40,008 | 25,326 | 60,000 | 22,019 | 37,981 |
| 516 | Mercury Dr | 4,880 | 5,000 | 120 | 7,500 | 7,050 | 450 |
| 517 | S. 42nd St | 940 | 1,000 | 60 | 1,500 | 1,410 | 90 |
| 518 | S. 32nd St | 752 | 800 | 48 | 1,500 | 1,410 | 90 |

| | | 1998 | | | 2025 | | |
|---|---|---|---|---|---|---|---|
| STATION # | LOCATION | IE & EI TRIPS | CORDON TOTAL | THROUGH TRIPS | IE & EI TRIPS | CORDON TOTAL | THROUGH TRIPS |
| 519 | S. 24th St | 3,941 | 4,198 | 257 | 6,000 | 5,633 | 367 |
| 520 | US-131 (south) | 10,710 | 19,004 | 8,294 | 25,000 | 14,089 | 10,911 |
| 521 | W. W Ave | 1,805 | 1,900 | 95 | 1,500 | 1,425 | 75 |
| 522 | W. U Ave | 2,090 | 2,204 | 114 | 3,500 | 3,319 | 181 |
| 523 | W. S Ave | 665 | 700 | 35 | 1,000 | 950 | 50 |
| 524 | Q Ave | 3,135 | 3,306 | 171 | 5,000 | 4,741 | 259 |
| 525 | I-94 (west) | 19,350 | 43,000 | 23,650 | 55,000 | 24,750 | 30,250 |
| 526 | Stadium Ave | 9,503 | 10,010 | 507 | 14,000 | 13,291 | 709 |
| 527 | Almena Dr | 3,800 | 4,008 | 208 | 7,000 | 6,637 | 363 |
| 528 | W. M-43/ West Main St | 11,900 | 14,022 | 2,122 | 20,000 | 16,973 | 3,027 |
| 529 | D Ave | 1,045 | 1,102 | 57 | 4,500 | 4,267 | 233 |

Table H-7
1998 Kalamazoo Area Trip Generation Summary

| | Production | Attraction | Normalization Factor |
|---|---|---|---|
| HBW | 208,550 | 242,533 | 0.8599 |
| HBNW | 507,340 | 508,217 | 0.9983 |
| NHB | 283,457 | 283,457 | none |

Table H-8
2025 Kalamazoo Area Trip Generation Summary

| | Production | Attraction | Normalization Factor |
|---|---|---|---|
| HBW | 273,374 | 270,274 | 1.0115 |
| HBNW | 656,345 | 576,762 | 1.1380 |
| NHB | 323,796 | 323,796 | none |

## TRIP DISTRIBUTION

Trip distribution involves the use of mathematical formula which determine how many of the trips produced in a zone will be attracted to each of the other zones. It connects the ends of trips produced in one zone to the ends of trips attracted to (in) other zones. The equations are based on travel time between zones and the relative level of activity in each zone. Trip purpose is an important factor in development of these relationships. The trip relationship formula developed in this process is based on principals and algorithms commonly referred to as the Gravity Model.

The process which connects productions to attractions is called trip distribution. The most widely used and documented technique is the “gravity model” which was originally derived from Newton's Law of Gravity. Newton's Law states that the attractive force between any two bodies is directly related to the masses of the bodies and inversely related to the distance between them. Analogously, in the trip distribution model, the number of trips between two areas is directly related to the level of activity in an area (represented by its trip generation) and inversely related to the distance between the areas (represented as a function of travel time).

Research has determined that the pure gravity model equation does not adequately predict the distribution of trips between zones. In most models the value of time for each purpose is modified by an exponentially determined “travel time factor” or “F factor” – also known as a “Friction Factor.” F factors represent the average area-wide effect that various levels of travel time have on travel between zones. The F factors used were developed from the process described in the Travel Estimation Techniques for Urban Planning, NCHRP. The matrix is generated in TransCAD during the gravity model process.

The primary inputs to the gravity model are the normalized P’s & A's by trip purpose developed in the trip generation phase. The second data input is a measure of the temporal separation between zones. This measure is an estimate of travel time over the transportation network. Zone-to-zone travel times are referred to as “skims.”

In order to more closely approximate actual times between zones and also to account for the travel time for intra-zonal trips, the skims were updated to include terminal and intra-zonal times. Terminal times account for the non-driving portion of each end of the trip and were generated from a look-up table based on area type. They represent that portion of the total travel time used for parking and walking to the actual destination. Intra-zonal travel time is the time of trips that begin and end within the same zone. Intra-zonal travel times were calculated utilizing a nearest neighbor routine.

The Gravity Model utilizes the by-purpose P’s & A's, the by-purpose F factors, and the travel times, including terminal and intra-zonal. The by-purpose P’s & A's (trip table) is combined with the through-trip table and then balanced so that the zonal P&A's are equal. The resulting total trip table is used for subsequent analysis.

## TRAFFIC ASSIGNMENT

The traffic assignment process takes the trips produced in a zone (trip generation) and distributed to other zones (trip distribution) and loads them onto the network via the centroid connectors. A program examines all of the possible paths from each zone to all other zones and calculates all reasonable time paths from each zone (centroid) to all other zones. Trips are assigned to paths that are the shortest path between each combination of zones. As the volumes assigned to links approach capacity, travel times on all paths are recalculated to reflect the congestion and the remaining trips are assigned to the next shortest path. This process continues through several iterations until no trip can reach its destination by taking the next shortest path. This is a user equilibrium assignment method and reflects the alternative routes that motorists use as the shortest path become congested. The assignment produces an assigned volume for each link.

## MODEL CALIBRATION/VALIDATION

Model calibration/validation verifies that the assigned volumes simulate actual traffic counts on the street system. When significant differences occur, additional analysis is conducted to determine the reason. At this time, modifications may be made to the network speeds and configurations (hence paths), trip generation (special generators), trip distribution (F factors), socio-economic data, or traffic counts.

The purpose of the model calibration phase is to verify that the base year assigned volumes from the traffic assignment model simulate actual base year traffic counts. When this step is completed, the systems model is considered statistically acceptable. This means that future socio-economic data can be substituted for base (existing) data, the trip generation, trip distribution, and traffic assignment steps can be repeated, and future trips can be simulated for systems analysis. It is assumed that the quantifiable relationships modeled in the base year will remain reasonably stable over time.

## CALIBRATION RESULTS

The initial accuracy check involves making comparisons of the assigned-vehicle miles of travel (VMT) to traffic-count-VMT. VMT's are calculated by taking the link distance and multiplying it by the assigned link volumes and the link traffic counts, respectively. These calculations were made only for those links on the network where actual volume counts were available. The value of the analysis is that it provides a good measure of how well the model predicts the total number of trips and how well it assigns those trips to the street network. The Kalamazoo 1998 model meets the MDOT targets by areawide vehicle miles traveled and VMT by most link classifications. The collector category is slightly outside the target range (3%). Given these are low volume roads this should not adversely affect the model but should be considered during project level analysis.

Table H-9
VMT Comparisons vs. Targets by Link Classification
(on links where actual volume counts exist)

| | Assignment | Count | Variation | Target |
|---|---|---|---|---|
| Areawide | 4087162 | 4021577 | 1.02 | 0.95–1.05 |
| Freeway | 1851471 | 1750952 | 1.06 | 0.94–1.06 |
| Ramps | 44047 | 46599 | .95 | No standard |
| Trunkline | 658161 | 650905 | 1.01 | 0.94–1.06 |
| Major Arterial | 739179 | 781150 | 0.95 | 0.93–1.07 |
| Minor Arterial | 547010 | 591551 | 0.92 | 0.90–1.10 |
| Collector | 247294 | 200422 | 1.23 | 0.80–1.20 |

Based on the validation results, the Kalamazoo model will serve as an accurate tool for estimating the transportation impact that future proposed development might have on the street and highway system. It will also serve as a useful tool for testing future transportation system changes and major development proposals for the KATS area.

## APPLICATIONS OF THE CALIBRATED/VALIDATED MODEL

Forecasted travel is produced by substituting forecasted socio-economic and transportation system data for the base year data. This forecasted data is provided by the MPO. The same mathematical formulae are used for the base and future year data. The assumption is made that the relationships expressed by the formulae in the base year will remain constant over time (to the target date).

After either base year or future trips are simulated, other types of modeling studies can be conducted.

- Network alternatives to relieve congestion can be tested for the 2025 Transportation Plan. Future traffic can be assigned to the existing network to show what would happen in the future if no improvements were made to the present transportation system. This process is often referred to as deficiency analysis. From this, improvements can be planned that would alleviate demonstrated capacity problems.

- The impact of planned roadway improvements or network changes can be assessed.

- Links can be analyzed to determine what zones are contributing to the travel on that link. This can be shown as a percentage breakdown of total link volume.

- The network can be tested to simulate conditions with or without a proposed bridge. The assigned future volumes on adjacent links would then be compared to determine traffic flow impacts. This, in turn, would assist in assessing whether the bridge should be replaced and/or where it should be relocated.

- The impacts of land use changes on the network can be evaluated.

Two issues are critical in using the modeling tools and processes:

- The modeling process is most effective for system level analysis. Although detailed volumes for individual intersection and "links" of a highway are an output of the model, additional analysis and modification of the model output may be required for project level analysis.

- The accuracy of the model is heavily dependent on the accuracy of the socio-economic data and network data provided by the local participating agencies, and the skill of the users in interpreting the reasonableness of the results.

Generally, three different alternative scenarios are developed for the Transportation Plan:

- Existing trips on the existing system. This is the calibrated, existing network/ scenario. This is a prerequisite for the other two scenarios.

- Future trips on the committed system. Future trips are assigned to the committed network. This alternative displays future capacity and congestion problems if no improvements to the system are made. This is called the "do nothing" alternative and usually includes the existing system, plus any projects which are committed to be built in the future.

- Future trips on the future system. This scenario is the future Transportation Plan network. It includes suggested improvements to alleviate congested subareas or corridors.

Applications of these basic procedures are both important for identifying deficiencies as well as examining and evaluating the impacts of alternate solutions.