

# **A COMPARATIVE STUDY OF EMME/2 AND QRSII FOR MODELING A SMALL COMMUNITY**

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## **ABSTRACT**

The availability of so many computer-based travel demand forecasting models has provided transportation planners with powerful and flexible tools in the modeling phase of their planning or traffic impact studies, but also confused users in their selection of an appropriate model for a particular study. It is commonly recognized that none of the existing travel demand models is perfectly suited for all network scenarios and traffic conditions. A particular model, which is strong in one application scenario, may be weak in a different application scenario. This paper presents a comparative study of two widely used travel demand forecasting models: EMME/2 and QRS II for applications to a small community. Structural comparison of as well as modeling a real world small network by EMME/2 and QRS II are performed in this study to help identify specific features and limitations of each model. The areas for the comparison include model structure, drawing of the network, data input, network modification, parameter calibration, and modeling output. This study does not intend to provide a recommendation of either model to transportation planners for a practical application to a small community. Instead, this study intends to identify the major differences and common features of two models, which can help planners clearly understand what they can expect from a certain model when they decide to use it.

Keywords: EMME/2, QRS II, Travel Demand Forecasting, Traffic Impact Study, Traffic Count, Model Calibration

## INTRODUCTION

With the rapid development in small communities, new or expanded land uses generate new or additional traffic: new shoppers, new residents, and new employees. To quantify the transportation implications of new land uses in these small communities, a travel demand forecasting model is often used to estimate traffic volumes on roads and at intersections for capacity analysis purposes. A computer-based travel demand forecasting model is an automatic version of the traditional four-step travel demand forecasting process including trip generation, trip distribution, modal split, and traffic assignment [1]. Such models include EMME/2, QRS II, TRANPLAN, MINUTP, TransCAD, TP+, Visom, and many others. To use these models, users usually have to input a large amount of data, such as a full description of the network and land-use information. The major advantage of using a computer-based travel demand forecasting model is that after inputting the data, complex analyses can be undertaken and a large number of alternatives can be evaluated in a short time period.

Despite the existence of so many travel demand forecasting packages, however, it is commonly recognized that none of them is perfect for all application scenarios, including the application to small communities. A particular model, which is strong in one application, maybe weak for a different application. According to an informal survey by Horowitz et. al. [2], which was conducted to 45 out of 50 states, the application of travel demand forecasting models was used unevenly across states, including data collection methods, calibration procedures, range of modes, network structure, and individual model steps.

Islar, et. al. [3] evaluated and rated four travel demand forecasting software: QRS II, System II, TRANPLAN, and MINUTP, with respect to 14 characteristics. All four software could be used for travel demand forecasting. However according to the total evaluation points, the two top-rated models were System II and QRS II. Despite the effort by Islar, et. al., the selection of a suitable travel demand forecasting is continuously a challenge to transportation planners. While each existing model has reported successful stories of its applications, there has been no research that systemically compared strengths and limitations of various travel demand forecasting models, especially for applications to small communities.

This research intends to conduct a comparative study of two widely used travel demand forecasting models: QRS II and EMME/2 with respect to their structures and applications to modeling a small community network. QRS II, as a traditional four-step urban transportation planning model, has been used extensively for traffic impact studies. QRS II is easy to understand and operate with few exceptions [4]. EMME/2 is a multimode travel demand forecasting model designed for interactive use. It is more comprehensive than other interactive graphic models that have been developed to date [5]. Although both EMME/2 and QRS II can be used to model a small community network, there are some unique and different features of two models for different application scenarios. Existing literatures have reported many successful applications of both EMME/2 and QRS II [6]. However, none of research has attempted to identify specific features and limitations of each model in modeling a real-world small network in a comparative manner.

In order to have a better understanding about what features are important in the evaluation of different models for small and medium sized communities, the authors conducted a survey to 14 planners, most of whom represent small and medium sized communities. This survey was conducted in Georgia in October 2002. Eight of the 14 planners are from MPOs in the state of Georgia and six from the Office of Planning at Georgia Department of Transportation. All

participants filled out a survey form personally based on their experience on the use of travel demand forecasting model. Based on the survey, the percentages of responses that ranked different criteria as important are: 92.86% on Ease of Drawing Networks, Ease of Modifying Network, and Ease of Data Input Using Graphic Interface; 85.71% on Ease of Learning; 78.57% on Ease of Plotting Network and Capability to Compare Different Scenarios; 64.26% on Ease of Performing Modeling Procedure and Ease of Performing Peak Period Assignment; 57.14% on Flexibility in Controlling All Parameters in the Procedures; 50% on Capability to Provide Default Parameters; 42.86% on Ease of Developing and Modifying Transit Networks and Matrix and Link Calculations; 35.71% on Ease of Data Input Using Batch Processing; and finally 28.57% on Capability to Performing Highway and Transit Assignment Simultaneously.

With the above survey results in mind, this research will compare such areas of QRS II and EMME/2 as model structure, network drawing, network modification, parameter calibration, and model output. It should be noted that the research does not intend to result in a recommendation of either model to transportation planners for a practical application to small communities. Instead, the research attempts to identify the major differences and common features of two models so as to help planners clearly understand what they can expect from either of the two models when they decide to use it.

## **DESCRIPTION OF QRS II AND EMME/2**

QRS II, Quick Response System II, was developed and upgraded at the Center for Urban Transportation Studies of the University of Wisconsin at Milwaukee [7]. Its latest version is QRS II 6. QRS II was interfaced with a powerful interactive graphics General Network Editor (GNE) for data entry [8]. GNE's newest version is GNE 6. Algorithms for trip generation, trip distribution, modal split, and traffic assignment are parts of QRS II. Default equations and parameters are provided for three trip purposes. QRS II produces many reports as results.

The main feature of QRS II is the availability of a comprehensive set of default parameter values provided by the model. This feature provides inexperienced users with tremendous easiness in setting up their modeling networks, especially for those who intend to pursue a quick modeling analysis for small community networks. When the trip generation step estimates the trip productions and trip attractions of each zone as person-trips per day, the embedded default trip production model first calculates the total zonal productions based on average household trip rates. Either household income or household automobile ownership may be selected as the independent variable. The total zonal productions are then split into three purposes (home-based work, home-based nonwork, and non-home-based) according to embedded default split percentages. The trip distribution model is accomplished by a gravity type of model with options as to the choice of the friction factor function: the power function or the exponential function. QRS II is capable of performing all-or-nothing, iterative capacity restrained, and through a feature that averages the results of successive iterations, a true equilibrium traffic assignment. Finally, the package provides tools for exporting QRS-formatted files to the spreadsheet and ASCII formats. Because of this feature, it is possible to perform some calculations (e.g. trip generation) using other programs (such as spreadsheet), that can be interfaced with other components of QRS II.

EMME/2, which stands for equilibre multimodal/multimodal equilibrium, was first developed in the late 70's at the Center for Research on Transportation (CRT) of the University of Montreal

[9]. The newest version of EMME/2 is release 9. The major advantage of EMME/2 is its incorporation of multimodal equilibrium: in all applications both auto- and transit-related characteristics can be modeled simultaneously, which closely approximates real-world conditions (i.e. auto and transit modes are competing in an urban environment). This property not only offers the ability to assess the impact of transit services on road networks, but also aids in the identification of more efficient routes for transit services. EMME/2 provides a platform in which users have to input most of their own model parameters and calculation procedures. This may increase the budgets needed for performing a less comprehensive modeling task for a small community network.

The inputs required by EMME/2 include network representations that can be input either by coordinates, or by digitization directly from maps. EMME/2 provides a framework for implementing a wide variety of travel demand forecasting methodologies from simple highway/transit network assignments, the classical four-step model to the implementations of multimodal equilibration procedures that integrate demand functions into the assignment procedures (i.e., multimodal traffic assignment under constant or variable demand conditions). The main output of EMME/2 is the overall network equilibrium assignment and the presentation of comprehensive results (most in a graphical and interactive way). This output can be used in traffic simulation models for the establishment of signal setting and evaluation of network performance [3]. Applications of outputs include performance estimates of HOV lanes and truck traffic, location analysis of existing and future transit and roadway facilities, and computation of least-cost paths according to any desired cost function.

## **STRUCTURAL COMPARISON OF QRS II VERSUS EMME/2**

### **Network Drawing**

In using either QRS II or EMME/2 for travel demand forecasting, the first task is always drawing a network. QRS II is interfaced with GNE, which can be used to quickly draw and modify highway and transit networks on the computer screen and to display and plot networks and the results of travel demand analysis. All data needed by QRS II are entered through GNE. EMME/2 provides two methods to draw a network: using batch entry (e.g. module 2.11 Input/modify base network using batch entry) or using interactive graphics (e.g. module 2.12 Input/modify base network interactively).

When using GNE for drawing a QRS II network, the very first task is to load a prepared application schema file, which tells GNE about general characteristics of the network to be drawn. These characteristics include node types and link types in the network, as well as their colors and the number of attributes. Users can either use a default application schema or create a new application schema by themselves. EMME/2, on the other hand, uses a concept of data bank. The EMME/2 databank includes network scenarios, matrices, and functions.

### **Travel Demand Forecasting Procedures**

To implement the four-step process of trip generation, trip distribution, modal split, and traffic assignment, QRS II and EMME/2 provide different methods. In QRS II, users can either input parameters or use default parameters provided by QRS II. In EMME/2, users must create travel demand matrices and define functions that are needed in the calculation.

QRS II has a large number of parameters, which are automatically set when the size of the urban area and the time period for modeling are specified. Users can change the default parameters, which can be done through dialog boxes from the parameter menu. Most parameters are numbers, while some may be set by checking a box, selecting an item from a list, or clicking a radio button. The bulk of the parameters is found in several text files. It is seldom necessary to change them. If necessary, they can be easily modified with Windows' Notepad.

The parameters to be set in QRS II include trip generation parameters, trip distribution parameters, vehicle occupancy parameters, trip table parameters, fundamental assignment parameters, intersection parameters, transit disutility parameters, and path finding parameters.

In EMME/2, users should create matrices and functions to specify the actual functions and calculation procedures to be used. Matrices in EMME/2 hold data related to zones. There are four types of matrices in EMME/2: full, origin, destination, and scalar. EMME/2 provides a matrix editor to manipulate, display, and calculate matrices. An EMME/2 function is described by an algebraic expression. There are six function classes: volume delay, turn penalty, transit time, auto demand, transit demand and user. Specific keywords denote the relevant variables for each function class. EMME/2 also provides a function editor, by which users can add, delete, and modify functions using batch entry or interactively.

The auto assignment implemented in EMME/2 is an equilibrium assignment. To carry out an auto assignment, all matrices, functions and network attributes that are to be used for the assignment must be available at the preparation stage (module 5.11). Then users can execute traffic assignment by a couple of choices. An important feature of the EMME/2 assignment modules is that the auto assignment may use data related to the transit network, and the transit assignment may use data that results from the auto assignment.

### **Transit Network**

Users can use QRS II to forecast ridership on transit routes in the study area. QRS II can forecast ridership for the whole network, ridership on each route in the network, and ridership on individual links. It can also forecast transfer volumes between routes at transfer points. In order to perform transit ridership forecasting, users first must draw a QRS II transit network showing the various transit routes, transfer points, and stops. QRS II does not perform transit ridership forecasting unless it is told to do so by checking "Do Mode Split" on the menu.

Users can also use EMME/2 to forecast ridership on transit routes. To do this, the first task is still drawing a transit network. Users can draw a transit network using batch entry or interactively. The transit network depends on the base highway network. Different from the QRS II transit network, the EMME/2 transit network is identified as the part of the base network that includes transit routes. Users need to set up matrices and functions to indicate the ridership forecasting procedures and parameters.

Like highway network assignment, QRS II provides a number of default values for parameters to perform transit network assignment. Users can use the default values or set up their own values for transit network assignment parameters. Using EMME/2 users need to set up matrices and functions to indicate transit network assignment procedures and parameter values.

## Outputs

Both QRS II and EMME/2 provide numerous reports of results in text files and can plot the results in the network. Table 1 is a comparison of output forms of QRS II and EMME/2 for 11 selected attributes.

### *Link Volumes and Travel Times*

Users can view the results of link volumes and travel times either in graphics or in text files in both QRS II and EMME/2. In a QRS II network, a link is defined by the link name such as Lake Olympia East of SH 6. The link volumes in the text file are shown at directions from A-node to B-node and from B-node to A-node. The determination of A-node or B-node of a link depends on how this link was created. Thus users must be careful in drawing a link in order for directions of links are not confused. For example, if a link is created from west to east, this direction becomes A to B. Then, the direction from east to west becomes B to A automatically. In an EMME/2 network, a link is defined by two nodes' numeric codes: a beginning node and an ending node such as a link from 2001 to 2023 and a link from 2023 to 2001. The link volumes and travel times in the text file are shown at directions from the beginning node to the ending node instead of A to B and B to A, so the link volumes and travel times in the text files in EMME/2 are easier to read than in QRS II.

### *Turning Volumes at Intersections*

After QRS II calculates the requested turning volumes, it places them in a text file called TURNMOVE.TXT. If a requested turning volume is zero, QRS II does not list it in TURNMOVE.TXT. This may bring some problems when a spreadsheet such as EXCEL is used to post-process the turning volume data. In addition, to identify all turning volumes at selected intersections is a time consuming process, especially when the modeling network is big and TURNMOVE.TXT becomes large.

In EMME/2, turning volumes may be output in three different forms: as a plot, a report or a punched data table. Comparing with QRS II, the output forms of turning volumes in EMME/2 are easier to use for various analyses. This is because it is easier to identify left-turn, through and right-turn volumes between a pair of links by using an intersection plot. In addition, there are no problems to use a spreadsheet to post-process the data, because all turning volumes including zero are placed in the output text file.

### *Comparing Auto Volume and Transit Volume*

As Table 1 shows, two of the 11 selected attributes, comparing auto volumes and comparing transit volumes, are only provided by EMME/2. Two modules in EMME/2 (6.13 and 6.23) can compare traffic volumes and transit volumes between scenarios. So users can compare traffic volumes and transit volumes of different years in either actual difference form or percentage form. It is always useful for users to compare traffic volumes and transit volumes of a design year with those of the base year or different design years.

## **A Feature of Macro Language in EMME/2**

To execute EMME/2, users have to interactively answer a series of questions in a dialog fashion. If users want to model multiple scenarios of a network, the lengthy dialog process has to be carried out every time a scenario is pursued. To simplify and accelerate this dialog process, EMME/2 provides a feature of macro language, which is a simple method to provide answers to

dialog questions automatically. In other words, a macro provides a sequence of instructions on what users want EMME/2 to perform. The feature of macro language in EMME/2 provides a high flexibility for the model to automate any pre-designed calculation procedures and network scenarios.

## **COMPARISON FOR MODELING A SMALL COMMUNITY NETWORK**

In this section, both QRS II and EMME/2 are used to model a small community network: South Missouri City (SMC) Network. SMC is located in the suburban of the Greater Houston Metropolitan Area (GHMA), which is experiencing a rapid growth in both residential and commercial land uses. SMC network was initially developed to support a traffic impact study for three design years using QRS II [10]. In that study, the year 1998 was used as the base year in which the model was calibrated. In this research, the same network is also developed using EMME/2. Based on land uses in this area, 40 residential zones and 19 commercial zones are defined [10]. There are 9 external stations, which define the boundaries between this study area and outside areas. The finished networks drawn by QRS II and EMME/2 are shown in Figure 1 and Figure 2 respectively.

### **Network and Data Input**

When drawing the QRS II network, data related to zones are input at nodes of centroid, external station, and production/attraction tag. The data input to centroids are average autos per household, number of retail employees, number of non-retail employees, and number of dwelling units. The data input to external stations and production/attraction tags are three purposes of trip production or attraction: home-based work, home-based non-work, and non-home-based, which were derived externally [10]. The data input at links are approach code, speed, and capacity. The speed uses the post speed limit on road, and the capacity is derived from Chapter 9 of 1994 Highway Capacity Manual [11]. The capacities of narrow lanes (10 feet), wide lanes (18 or 20 feet), and on-street parking lanes are adjusted according to the real-world conditions. The data at signal controlled intersections include cycle lengths, and at stop signs controlled intersections are minimum unsignalized capacities.

When drawing EMME/2 network, no data input at regular nodes and centroids are needed as all needed data are input by using matrices. The data input to links are mode, link type, number of lanes, volume delay function, speed, and capacity adjustment factor. There are three modes defined in EMME/2 for SMC network, which include mode c that stands for car, mode b that stands for bus, and mode p that stands for pedestrian (not used). Four link types are defined: link type 9 represents minor arterial; link type 10 collector; link type 11 major arterial; and link type 12 centroid connector. Accordingly, four volume delay functions are defined. As a total of 19 intersections are included in the SMC base year traffic network, a turn table for EMME/2 network is created.

QRS II calculates intersection delays using the equations that are specified by HCM. In EMME/2, users have to specify turn penalty functions for all types of intersections. For simplicity, this research has used all constant values for the turn penalty functions, which are fine-tuned at the model calibration stage.

In drawing the SMC network, QRS II and EMME/2 used a similar amount of times. The only difference is that when the network is drawn in QRS II, the data is also input simultaneously. By

the end of network drawing, the model is ready for run, as all necessary functions are embedded in QRS II. For EMME/2, however, the model is far from being ready by the end of network drawing, as all functions and matrices for the calculations of four steps except for traffic assignment have to be defined and input by users. This feature of EMME/2 provides flexibility to users who want to set up their own network parameters and functions.

Theoretically, EMME/2 can replicate the results of trip generation, trip distribution and modal split of QRS II, if the relevant matrices and functions are set up in the same logic as those in QRS II. In running the SMC modeling network, however, this research will focus on the traffic assignment step of QRS II and EMME/2, as which does not require the manipulation of too many matrices and functions in EMME/2. The origin-destination matrix of traffic demand in EMME/2 for SMC network is derived from QRS II. QRS II creates a binary temporary file, which is called AUTOTRIP.TMP. It contains the zone to zone vehicle trip table. It has to be converted to a text file using QRSTOOLS. Then it is edited to the batch input format of traffic demand matrix for EMME/2.

### **Model Calibration**

The model calibration is very important in travel demand forecasting models. The model calibration determines the numerical values of basic parameters used in the base year model, and adjusts network settings in order for the results of link volumes match 24-hour traffic volume counts and for the results of peak-hour turning volumes match the peak-hour turning volume counts. For the SMC network, 24-hour traffic counts were collected from 24 locations and peak-hour turning counts were collected from 19 intersections as detailed by Yu and Yue [10].

As the EMME/2 model for SMC uses the O-D matrix that was produced by QRS II, the only comparable component of two models is traffic assignment. The calibration of QRS II in steps other than traffic assignment can be found in Yu and Yue [10]. The link delay functions in EMME/2 are made to use the same ones as used in QRS II: BPR functions. As stated earlier, QRS II uses the procedure of HCM to calculate intersection delays, while EMME/2 is made to use constant values. In running both QRS II and EMME/2, the assignment results can be fine-tuned by changing free travel times of affected links. The turning penalty values in EMME/2 can also be adjusted to influence the turning volumes at the problem intersections. In this manner, both QRS II and EMME/2 models have demonstrated the ability to produce promising assignment results as shown in the following sections.

### *Comparison of Link Volumes*

24-hour traffic counts were collected at 24 selected locations within the study area including 9 external stations. The 24-hour link volumes forecasted by QRS II and EMME/2 from original SMC network at 24 locations are shown by Table 2 and Figure 3. In Table 2, Column 3 is the 24-hour traffic counts. Column 4 is the forecasted link volumes by EMME/2, while column 5 is the relative error. Out of 24 locations, 12 locations result in errors higher than 10% between link volumes by EMME/2 and traffic counts. Column 6 is the forecasted link volumes by QRS II, while column 7 is the corresponding relative error. A total of 6 out of 24 locations result in errors higher than 10% between link volumes by QRS II and traffic counts.

Each location with an error higher than 10% is analyzed. As indicated by Yu and Yue [10], most of errors in QRS II are caused by the wrong selection of minimum paths in the traffic assignment module. By manually adjusting the free travel times of affected links in QRS II as well as EMME/2 networks, the path travel times can be affected and thus the traffic volumes on the

affected links can be altered. Table 3 is a comparison of 24-hour link volumes forecasted by QRS II and EMME/2 after several iterations of free travel time adjustments. Except for the error at location 19, all locations have shown an error less than 10% between link volumes by EMME/2 and traffic counts. For QRS II, all errors between link volumes and traffic counts are below 10%. Figure 4 illustrates the comparison of traffic counts, and the results from calibrated networks by EMME/2 and QRS II at 24 locations.

It is shown from Table 3 and Figure 4 that both QRS II and EMME/2 can be calibrated to assign traffic that match the real-world 24-hour traffic counts after careful adjustment of network parameters.

### *Comparison of Turning Volumes*

The morning peak-hour is run for both QRS II and EMME/2. Turning volumes at 19 intersections are output from the two models. Nine of these intersections are controlled by signals, and others by stop signs. QRS II outputs turning volumes in a text file. There are three columns in the file. The first column shows the link name from which the turning volume comes; the second column shows the link name to which the turning volume goes; and the third column shows the turning volume. EMME/2 outputs turning volumes in a text file too. EMME/2 also provides a plot with turning volume for each turn of the selected intersections. Figure 5 is an example of an intersection plot by EMME/2, which clearly presents the turning movements and values at the intersection. Figure 6 is a turning volume comparison for QRS II and EMME/2 at the same intersection as Figure 5. Although turn penalty functions use constant values in EMME/2, users can still get turning volumes that match the traffic counts by fine-tuning the turn penalties.

### **Transit Network**

Two artificial transit routes are incorporated into and tested in the QRS II and EMME/2 networks. QRS II transit network is drawn graphically using GNE, which is independent from the original highway network. On the other hand, EMME/2 transit network is drawn using the batch entry method based on the base highway network. QRS II transit network can only consist of the centroids and nodes that are related to the routes and the transit stops, while all other nodes that appear on the base highway network should not be included. Differently, EMME/2 transit network can consist of not only the nodes and centroids that are related to routes and stops, but also the other nodes on the routes that appear on the base highway network. As mentioned earlier, default functions and parameters are used to execute ridership forecasting in QRS II, while a transit demand matrix and transit time functions need to be defined to perform ridership forecasting in EMME/2 transit network. Both QRS II and EMME/2 are shown to produce similar results of transit volumes, ridership boarding and alighting at stops, and transit transfer volumes.

### **Features in EMME/2**

EMME/2 has a useful comparing feature, in which users can compare graphically the results of traffic assignments of two different scenarios using module 6.13 (module 6.23 for comparing transit volume). The difference between any two scenarios is displayed either in actual difference or in percentage on the EMME/2 network. An example of this feature is shown in Figure 7, which shows the difference in percentage of traffic volumes from calibrated network and pre-calibrated network.

## CONCLUSIONS

This research compared two widely used travel demand forecasting software: QRS II and EMME/2 for modeling a small community network. QRS II is relatively an easy-to-use model for inexperienced users, as it includes a comprehensive set of default functions and parameters. EMME/2, on the other hand, provides a platform in which users can manipulate their own calculation procedures and parameter values, and thus is more flexible for experienced users.

While QRS II is interfaced with GNE in drawing a network graphically, EMME/2 can draw a network either graphically or using the batch entry method. It is found that it took a similar amount of time to draw the SMC network with QRS II and EMME/2.

In QRS II, network, parameters, and the result files are placed as separate files, and thus the size of each related file is always small and can be easily transferred between computers. EMME/2, on the other hand, has only one file EMME2BAN, which contains all network input and output data, matrices and functions, which makes the file easy to manage but also results in relatively a very large file in the computer.

When a network drawing using GNE is completed, most of data can also be input simultaneously. However, an EMME/2 network is far from being ready for run when the network drawing is completed, as extra time and effort have to be spent on manipulating matrices and functions.

In modeling the SMC network, it has been shown that by fine-tuning free travel times and turning penalties, both QRS II and EMME/2 are capable of assigning traffic that match both 24-hour link volumes and peak-hour turning volumes with real-world traffic counts. This means that both QRS II and EMME/2 are reliable and practical models.

While both QRS II and EMME/2 provide many outputs graphically and in text files, EMME/2 provides a better output format for turning volumes at intersections because not only it provides a graphical output of turning movements but also its turning volume outputs are in a format that can be easily post-processed in a spreadsheet such as MS EXCEL.

QRS II and EMME/2 have different features in handling transit network. QRS II transit network is independent of the base highway network, while EMME/2 transit network is related to the base highway network. While QRS II can only perform highway and transit network assignment separately, EMME/2 can perform highway and transit assignments either separately or simultaneously, which is a powerful feature of the model.

It is recommended that a continuous effort be made to systematically explore more features of QRS II and EMME/2 for their applications in various traffic network scenarios. It is also recommended that comparisons of QRS II and EMME/2 be pursued with other existing travel demand forecasting models to help transportation planners clearly understand what they can expect to get from either of the existing models when they decide to use it.

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Figure 2: EMME/2 Network for South Missouri City (SMC)

Figure 3: Comparison of 24-hour Link Volumes from Original SMC Network at 24 Locations for the base year 1998

Figure 4: Comparison of 24-hour Link Volumes from Calibrated SMC Network at 24 Locations for the base year 1998

Figure 5: A Plot of Intersection at Hurricane Alley and SH 6 by EMME/2

Figure 6: Comparison of Turning Volumes at Intersection Hurricane Alley and SH 6

Figure 7: An Example of Comparing Traffic Volumes in EMME/2

Table 1: Comparison of Output Forms of EMME/2 and QRS II

FILES	EMME/2		QRS II	
	PLOT	TEXT	PLOT	TEXT
Auto Volumes	Yes	Yes	Yes	Yes
Turning Volumes	Yes	Yes	No	Yes
Travel Time	Yes	Yes	Yes	No
Vehicle Trips	No	Yes	No	Yes
Trip Production/Attraction	No	Yes	No	Yes
Shortest Paths	Yes	No	Yes	Yes
Comparing Auto Volumes	Yes	No	No	No
Transit Volumes	Yes	Yes	Yes	Yes
Transit Time	Yes	Yes	No	Yes
Transfer Volumes	No	Yes	No	Yes
Comparing Transit Volumes	Yes	No	No	No

Table 2: Comparison of 24-hour Link Volumes from Original Network

1	2	3	4	5	6	7
Loc #	Location Name	Count	EMME/2	EMME/2 Error	QRS II	QRS II Error
1*	Coen Road E of FM521	673	672	0%	682	1%
2*	Commonwealth N of Oilfield Road	3996	3990	0%	3996	0%
3*	Commonwealth S of Oilfield Road	4040	4034	0%	4040	0%
4	Flatbank W of SH 6	3971	3980	0%	3931	-1%
5*	FM521 N of SH 6	7866	7864	0%	7895	0%
6*	FM521 S of Sienna Point Drive	4532	4530	0%	4531	0%
7	Glenn Lake E of SH 6	9815	7858	-20%	5808	-41%
8	Hillcroft N of Vicksburg	3498	3598	3%	3687	5%
9	Lake Olympia E of SH 6	6722	9072	35%	6562	-2%
10	Lake Olympia W of SH 6	2600	2570	-1%	2587	-1%
11	McKeever E of Sienna Parkway	1691	7338	334%	1438	-15%
12*	Murphy Road N of SH 6	14119	13999	-1%	14121	0%
13	Murphy Road W of SH 6	1024	2989	192%	1046	2%
14	Peninsulas N of SH 6	926	13950	1406%	1490	61%
15*	SH 6 SE of FM 521	21249	21217	0%	21228	0%
16	SH 6 SE of Hillcroft	14069	7491	-47%	15941	13%
17	SH 6 SE of Sienna Parkway	19415	8489	-56%	20592	6%
18	SH 6 SE of Teal Bend Blvd.	11789	7477	-37%	12441	6%
19	SH 6 NW of Lake Olympia	27338	21162	-23%	23667	-13%
20*	SH 6 NW of Murphy Road	25000	24890	0%	25187	1%
21	SH 6 SE of Lake Olympia	25154	17995	-28%	25706	2%
22	Sienna Parkway S of SH 6	3232	5778	79%	6867	112%
23*	Trammel-Fresno E of Hurricane	4029	4000	-1%	4103	2%
24	Trammel-Fresno W of Hurricane	3228	5541	72%	3090	-4%

\* External Station

Table 3: Comparison of 24-hour Link Volumes from Calibrated Network

1	2	3	4	5	6	7
Loc #	Location Name	Count	EMME/2	EMME/2 Error	QRS II	QRS II Error
1*	Coen Road E of FM521	673	672	0%	682	1%
2*	Commonwealth N of Oilfield Road	3996	3990	0%	3997	0%
3*	Commonwealth S of Oilfield Road	4040	4034	0%	4040	0%
4	Flatbank W of SH 6	3971	3875	-2%	3929	-1%
5*	FM521 N of SH 6	7866	7864	0%	7895	0%
6*	FM521 S of Sienna Point Drive	4532	4530	0%	4531	0%
7	Glenn Lake E of SH 6	9815	9261	-6%	10016	2%
8	Hillcroft N of Vicksburg	3498	3598	3%	3659	5%
9	Lake Olympia E of SH 6	6722	7175	7%	6269	-7%
10	Lake Olympia W of SH 6	2600	2644	2%	2569	-1%
11	McKeever E of Sienna Parkway	1691	1813	7%	1838	9%
12*	Murphy Road N of SH 6	14119	14239	1%	14134	0%
13	Murphy Road W of SH 6	1024	1102	8%	1055	3%
14	Peninsulas N of SH 6	926	930	0%	898	-3%
15*	SH 6 SE of FM 521	21249	21217	0%	21218	0%
16	SH 6 SE of Hillcroft	14069	15465	10%	14771	5%
17	SH 6 SE of Sienna Parkway	19415	20205	4%	19303	-1%
18	SH 6 SE of Teal Bend Blvd.	11789	11915	1%	11993	2%
19	SH 6 NW of Lake Olympia	27338	23818	-13%	24851	-9%
20*	SH 6 NW of Murphy Road	25000	24890	0%	25206	1%
21	SH 6 SE of Lake Olympia	25154	24796	-1%	24281	-3%
22	Sienna Parkway S of SH 6	3232	3155	-2%	3165	-2%
23*	Trammel-Fresno E of Hurricane	4029	4000	-1%	4095	2%
24	Trammel-Fresno W of Hurricane	3228	3093	-4%	3027	-6%

\* External Satation

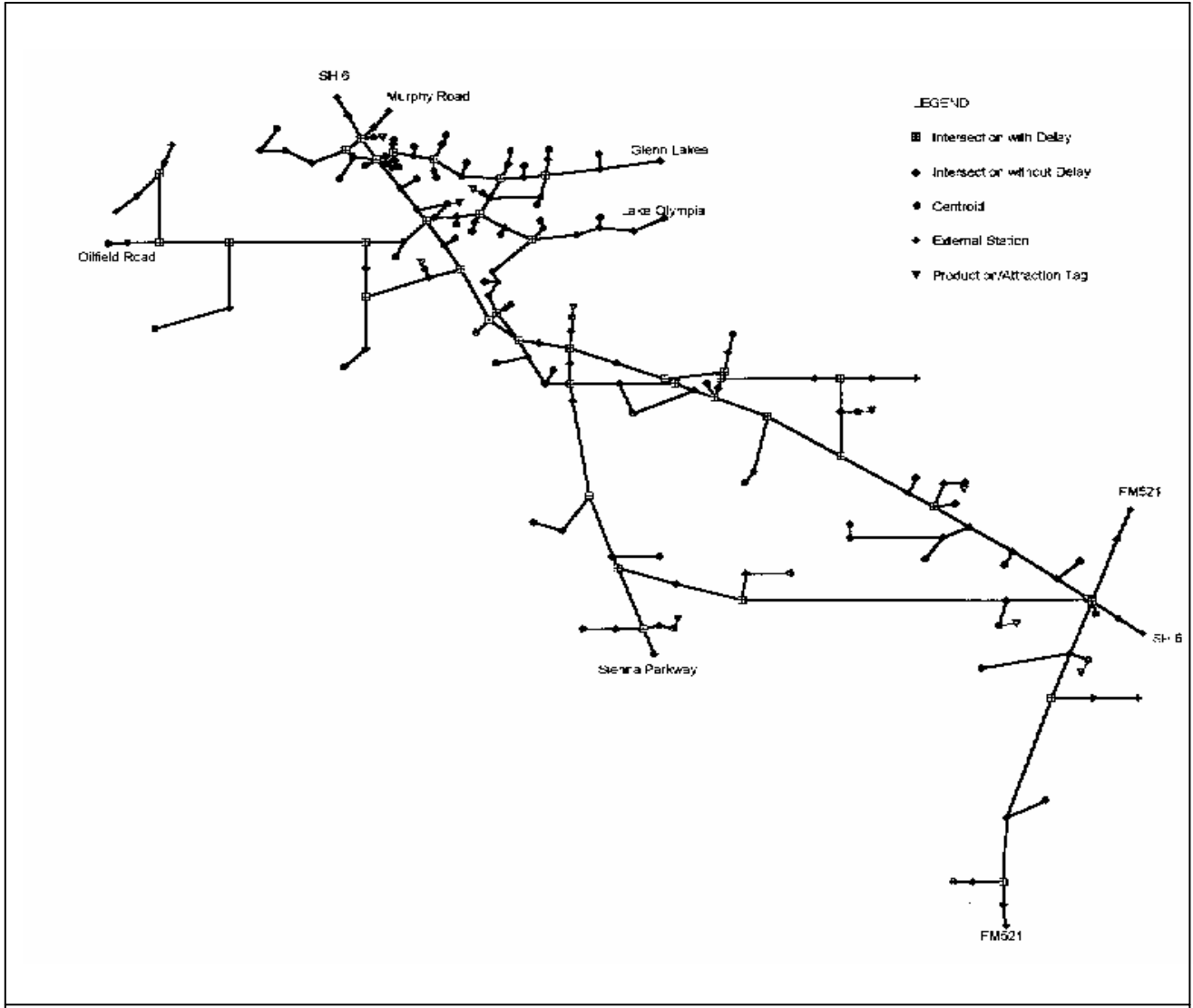


Figure 1: QRS II Network for South Missouri City (SMC)

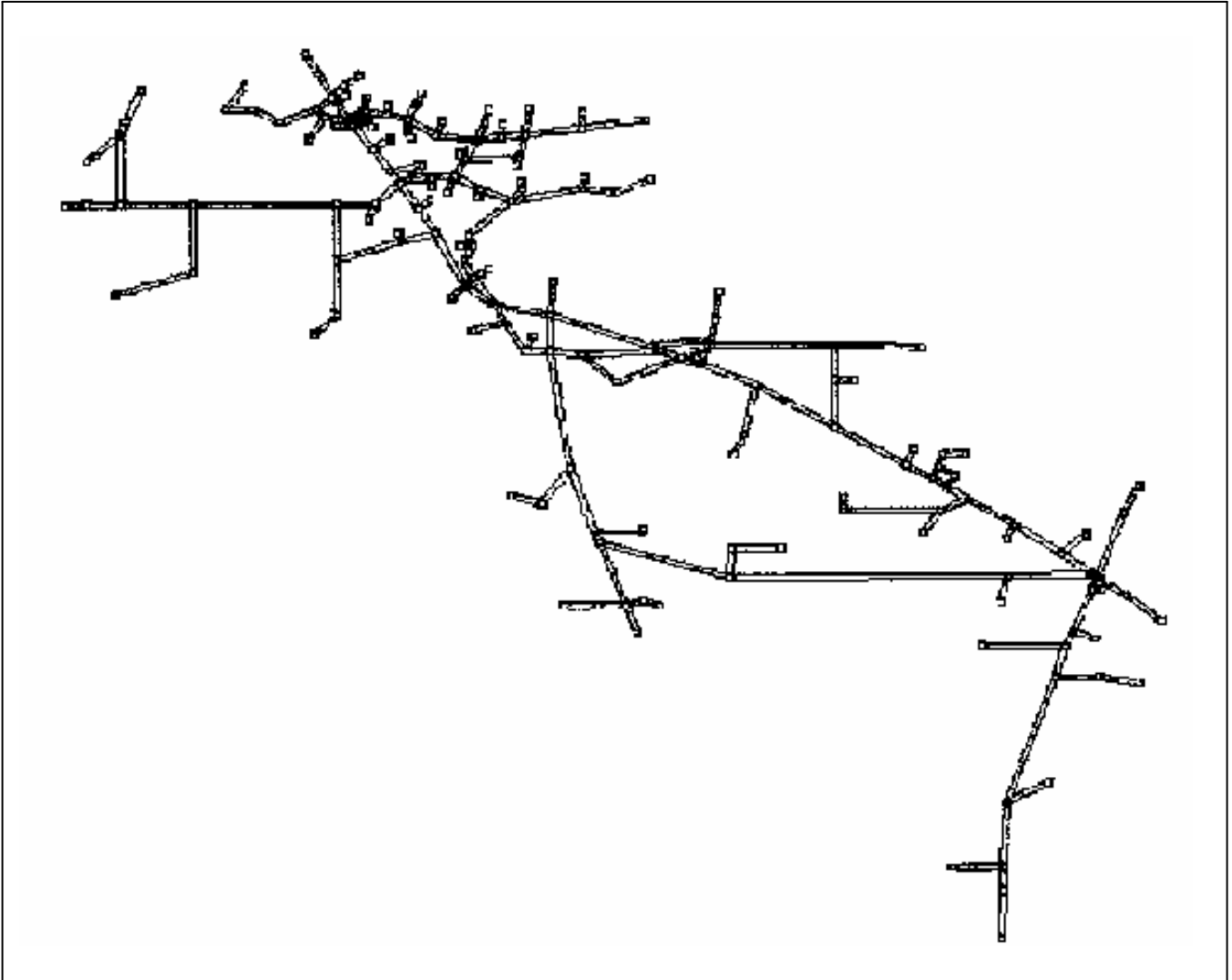


Figure 2: EMME/2 Network for South Missouri City (SMC)

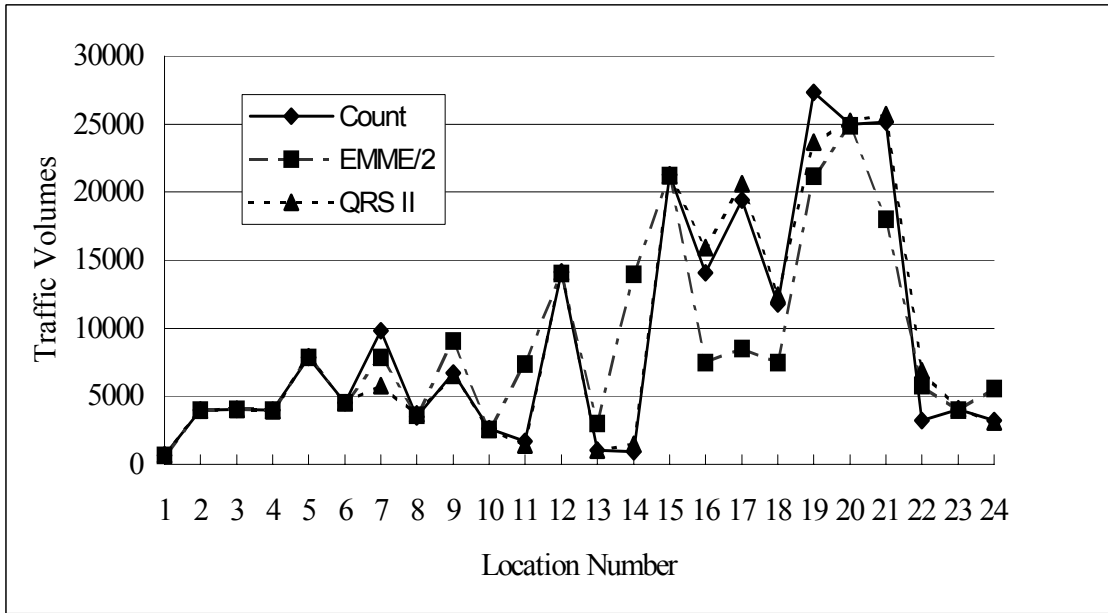


Figure 3: Comparison of 24-hour Link Volumes from Original SMC Network at 24 Locations for the Base Year 1998

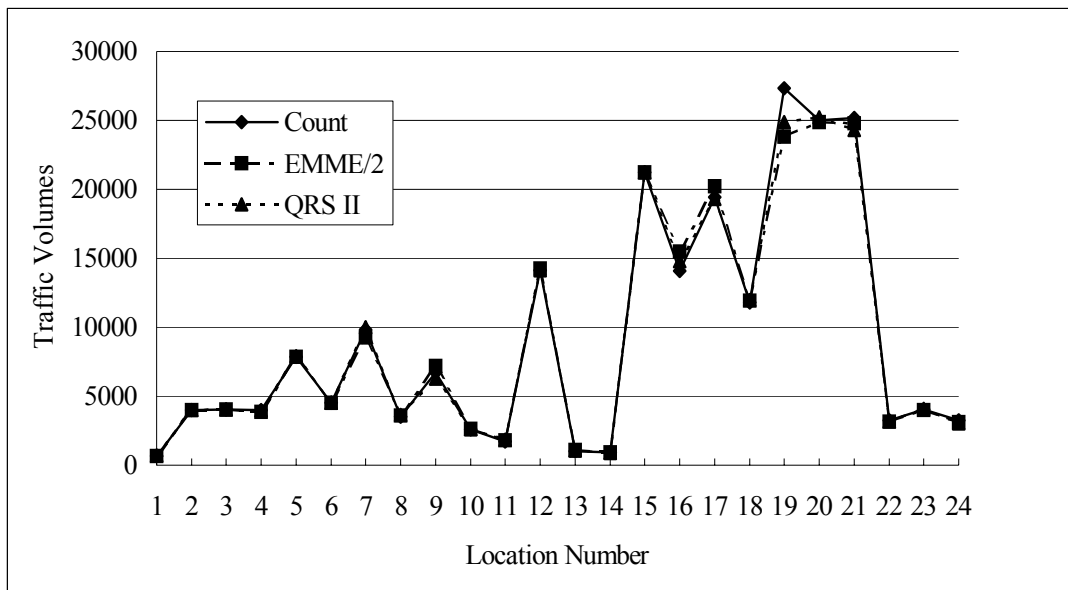


Figure 4: Comparison of 24-hour Link Volumes from Calibrated SMC Network at 24 Locations for the Base Year 1998

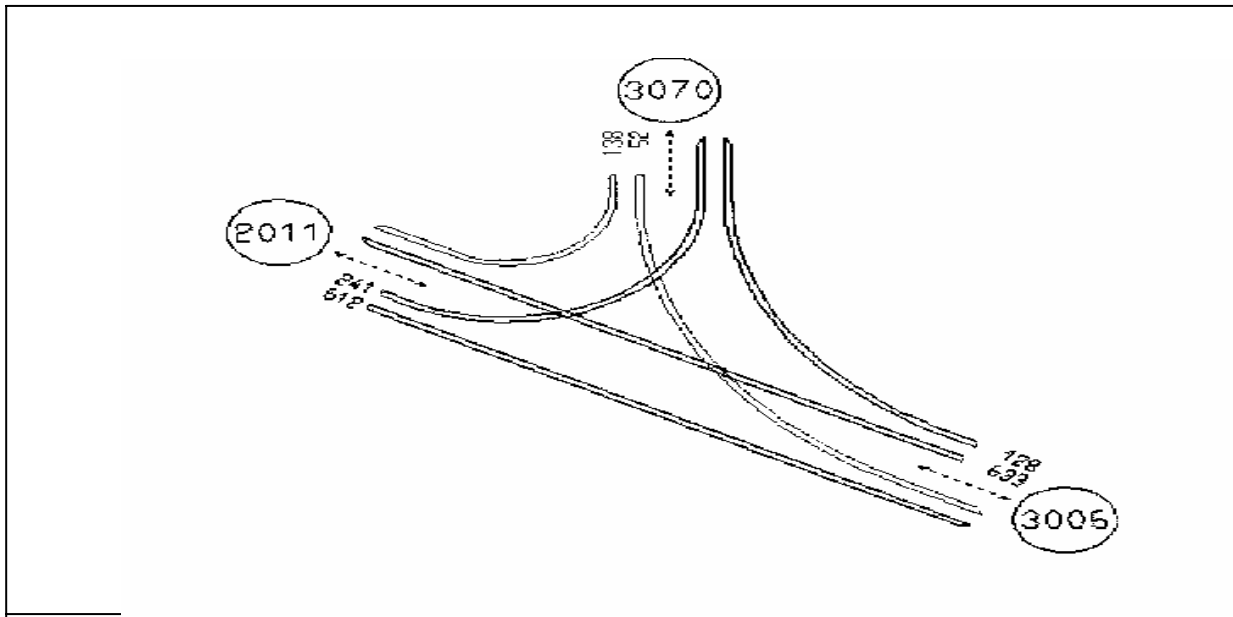


Figure 5: A Plot of Intersection at Hurricane Alley and SH 6 by EMME/2

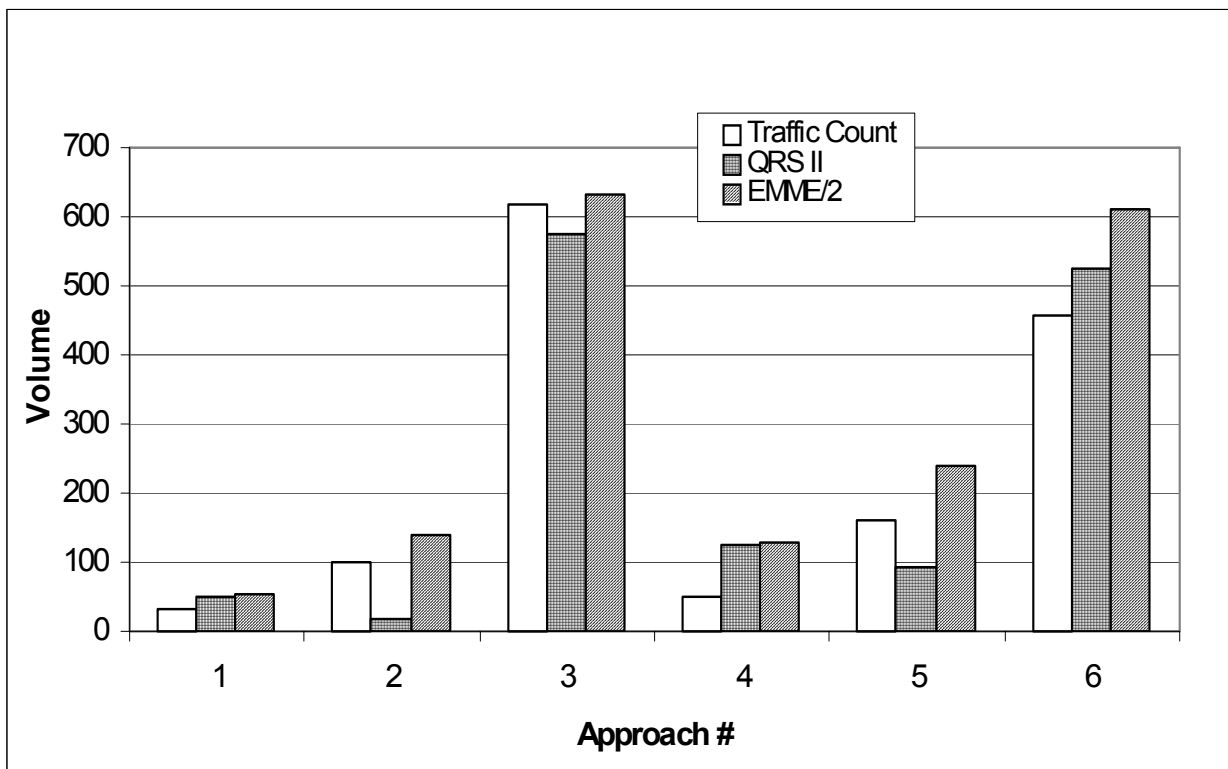


Figure 6: Comparison of Turning Volumes at Intersection Hurricane Alley and SH 6

