1. Introduction

1.1 Background

The Elgin O'Hare – West Bypass (EOWB) is a comprehensive study undertaken to identify major transportation improvements to address the key congestion and mobility problems in northeastern DuPage and northwest Cook counties, near the O'Hare Airport in Chicago. The need for major investments and improvements has been cited in regional transportation plans since the 1960s. This report details the development and implementation of the EOWB subarea focus travel demand model. It describes the steps undertaken in modifying procedures, networks, and traffic analysis zones used in adapting the Chicago Metropolitan Agency for Planning (CMAP) regional model for use in development of the EOWB subarea focus model. The purpose of developing the subarea focus model is to better understand travel patterns and origin-destination (O-D) trip patterns within the study area, and those between the area and the rest of the Chicago metropolitan region.

This report provides a summary and overview of the model development, application and validation process, as well as, extensive detail on technical methods used and the datasets developed and applied for travel modeling. The intent of the first section of this report is to overview the process while simultaneously providing information regarding where in this report more detailed data and discussion can be found.

1.1.1 Project Study Area Details

The study area for the EOWB project is approximately bounded by the Jane Addams Memorial Tollway (I-90) to the north, the Tri-State Tollway (I-294) to the east, the Eisenhower Expressway (I-290) /US 20 on to the south, and the western terminus of the existing Elgin O'Hare Expressway to the west. The study area is shown in Exhibit 1-1 and the existing roadway network in Exhibit 1-2.

1.1.2 Philosophy and Approach

The Chicago area has a sophisticated regional travel forecasting model maintained by the designated regional planning agency (CMAP) that has been designed and locally calibrated to be used in evaluating major regional multimodal transportation investments and projects. The model is extensively documented and has been actively used as a tool with proven value for over 40 years. For this project, it was determined to take maximum advantage of the procedures, database and known capabilities of that model while adding in the further necessary detail and functionality needed to focus on the EOWB and surrounding area.

This approach allowed direct application of the procedures and assumptions used in the CMAP model while refining network and zone assumptions in the project area, as well as developing techniques to improve localized accuracy of the travel forecasting process by vehicle class and time of day.

1.1.3 Application of Chicago Metropolitan Agency for Planning Model

The approach used to develop the subarea model takes full advantage of the existence and capabilities of the CMAP model, while refining the model outputs to match the requirements of the Tier 1 EIS addressing needed transportation system improvements in the study area. Current CMAP model documentation "Transportation Conformity Analysis for the PM2.5 and 8-hour Ozone National Ambient Air Quality Standards, Appendix B and Travel Demand Modeling for the Conformity Process in Northeastern Illinois" October 12, 2006, was used for this project.

Forecasting was performed for both auto and transit modes, to be responsive to the full range of complexities that characterize traveler behavior in the Chicago region. This approach employs extensive support by the CMAP organization in performing selected model runs for all transit mode share estimates. CMAP was also involved in performing model runs for auto modes as a starting point for the focused forecasts needed for this project; thus allowing the subarea model to be based directly on intermediate CMAP model outputs. Trip tables from the CMAP model representing regional O-D travel demand patterns were used as a starting point in developing the EOWB subarea focus model. Trip tables were obtained from CMAP for use in the modeling and evaluation of transportation demand.

1.1.4 Model Overview

The EOWB model was designed as a refinement of the CMAP model's traffic assignment. Details of data sources, methods, and specific inputs are described in sections noted for each bullet point. To refine the CMAP model, the following steps were undertaken:

- While retaining the level of detail in both the highway network and the traffic analysis zone system for the rest of the region, the street network and zone definition in the project area were extensively disaggregated and refined (Section 2.2 and 2.4);

- A database of traffic count information for most streets in the project area and for major facilities throughout the region was developed to support the adaptive assignment process (link-OD estimation) described below and as an input to the model validation process (Section 2.5);

- Procedures were developed to reallocate person trip interchanges in the input CMAP trip tables to the new more detailed subarea zone system (Section 2.6);

- CMAP procedures for allocating vehicle person trips by time of day and type of vehicle were replicated and applied to the new subarea trip tables (Section 2.6);

- Adaptive assignment procedures which allow adjustments in the input trip tables to be made to establish better consistency with observed traffic counts were used to adjust trip interchanges for specific vehicle modes and time of day periods (Section 2.6);

- Procedures used in the CMAP model to assign traffic to specific travel routes while considering delays and congestion were replicated to be used with the subarea model. The specific CMAP developed volume-delay functions used in the regional model were coded for use in the subarea model (Section 2.6).

The EOWB subarea focus model's features described above maintain compatibility and consistency with CMAP regional forecasting, while providing additional refinements in detail and localized accuracy in the project study area. To ensure that the subarea model provided accurate results and would adequately support the forecasting needs of this project, an extensive validation of model outputs and results was performed. This is described in Section 3.

Forecasting travel demand for proposed alternatives took advantage of these refinements by developing future travel interchange forecasts as a function of the adjusted base condition trip tables and expected growth in trip interchanges between specific areas. This process, which supplemented the above model refinements, is further described in Section 4. The distribution process was designed to address estimation of the effects of changes in accessibility on expected O-D flows. The methodology to support this capability is also discussed in Section 4.

2. EOWB Subarea Focus Model

Implementation of the EOWB Subarea Focus Model can be broadly divided into four categories:

- Traffic Analysis Zone Refinements and Network Adjustment
- Traffic Count Database Development
- Trip Table Expansion, Factoring, and Adjustments
- O-D Estimation, Traffic Assignments and Transit Mode Share Estimates

The basic modeling platform for all model operation is TransCAD software. TransCAD was chosen over CMAP native EMME/2 environment because of its database management capabilities, its GIS interface, and tools developed for other projects that helped speed and facilitate development of this model. Regional travel model data from CMAP were obtained in the native CMAP EMME/2 format and translated into TransCAD.

2.1 Traffic Analysis Zone Refinements and Network Adjustment

Since the CMAP highway network is fairly well defined in the project study area, the required refinement is generally to decrease traffic analysis zone sizes by disaggregating the CMAP zones to better represent land use within the study area. In addition to zone refinements, some network adjustment, centroid connector location updates and attribute enhancements were addressed to improve network connectivity within the project study area.

2.1.1 Traffic Analysis Zone Refinements

The purpose for zone disaggregation is to better represent land uses within the study area while maintaining the CMAP zone structure for remainder of the CMAP region. The proposed approach refined the CMAP traffic analysis zones by disaggregating zones to better represent land use patterns within the project study area. The subzones were split within the CMAP zone boundary structure to establish easy data manipulation and transfer between subzones and CMAP zones. On the edges of the project study area, zones were split to provide a buffer around the project area, to ensure reasonable distribution among the roadways entering and exiting the modeled subarea. The remainder of the CMAP zone system outside the project study area was used "as-is" to maximize compatibility and simplify data import and export between the CMAP model and subarea focus model. The basis for splitting zones was aerial coverage and roadway connectivity, which helped define land use characteristics and physical barriers to traffic movement within the project study area. Once new subzone boundaries were identified, socioeconomic data from the parent CMAP zone were allocated to subzones primarily through review of aerial imagery identifying patterns of development within the zone and percentage of area represented by the subzone. The subzone allocation process uses the CMAP socioeconomic zone boundary definitions and data inputs.

The CMAP regional model traffic analysis zone (TAZ) system, consisting of 1,877 zones and 14 external stations, was used as the basis for zone disaggregation into the EOWB subarea focus model. The CMAP TAZ system that was used represented the 2004 Zone system that was used by CMAP to develop the 2030 regional transportation plan. It should be noted that CMAP has since revised their TAZ numbering and structure that is being used for their model updates. However, for the purposes of this study the CMAP 2004 Zone system was used in the development of the 2007 existing travel model.

The EOWB zone disaggregate boundaries were created by using railroads, streets, rivers, lakes, and natural reserves as boundary limits. Exhibit 2-1 shows the CMAP 2004 TAZ structure and Exhibit 2-2 the 2007 EOWB TAZ structure.

Appendix A presents details of the zone disaggregation and subzone definitions. Table A-1, Split TAZ Details, summarizes the original zones in the study area and the changes after splitting them. The table describes the approximate roadway, natural feature or other landmarks along which the original TAZ is split and the new EOWB TAZ and associated zone numbers. The CMAP regional model had allocated 180 zones within the study area. Zone disaggregation resulted in 542 additional zones in the EOWB subarea focus model, resulting in 722 EOWB subarea focus model study area zones. The original zones were disaggregated from 1 to 11 new zones for each original zone. Table A-2, Subzone Centroid Assumptions, lists the CMAP regional model TAZ, correlating EOWB subarea TAZ, location of centroid connections, and the total number of centroid connections per study area zone. The number of centroid connections for each EOWB TAZ varies from 1 to 4.

2.1.2 Network Adjustment

Network adjustment, centroid connector location updates, and attribute enhancements were performed to improve representation of network connectivity within the study area. The 2007 regional CMAP model network was used as a basis for development of the EOWB subarea focus model network. The surrounding regional model area remains consistent with CMAP information, but updates and refinements have been made within and on the boundaries of the study area. The CMAP regional model will not adequately represent the roadway network within the denser focus area. To address this issue, a more detailed network was developed to better characterize the study area. The intent of this task was to access the external networks, including additional links essential to be represented for project study purposes. The result of this process is the 2007 EOWB subarea focus model network.

Several attributes were added to the CMAP travel model: directional name, count location and references to count location IDs, area type flags, generic link names and locations, exterior link flags, and Illinois Roadway Information System (IRIS) functional classification codes and names.

- **AB_NAME/ BA_NAME:** Directional names used to link count IDs and location, and to provide ability to report VMT, VHT, VHD, loading, and LOS by roadway and direction (Examples: I244_NB, I244_SB, I90_EB, I90_WB).

- **AB_COUNTID/ BA_COUNTID:** Attributes used to dynamically link a point shape layer containing geographically referenced count data with coordinating directional link names by time period.
- **AREA_FLAG:** Flags used to distinguish the study area boundary from the rest of the region:
  - Project study area = 1
  - A 6-mile area surrounding and outside the study area = 2
  - Rest of the area, lying outside the above two areas = 3
- **LINK_NAME and LOCATION:** Generic link names (Examples: HA_1, HA_2, I83_1) with location references for segments (example: between 25th and 26th). Used to link roadway segment loading information from TransCAD output data to GIS mapping.
- **IRIS_FCC_CODE and IRIS_FCC_NAME:** Codes and functional classification name as stated by the IRIS network.

The regional CMAP travel model is coded using the Volume Delay Functional (VDF) codes listed in Table 2-1.

For the study area only, the IRIS functional classification codes (Table 2-2) were used. The EOWB model does not include nonurban minor arterials, nonurban major collectors, or nonurban minor collectors. Few local roads or streets were used in the model. IRIS functional names were assigned to the roadway networks. Discrepancies in the network and Link IDs between the TransCAD and GIS networks were resolved. All links in the study area were assigned an IRIS functional code and functional name.

TABLE 2-1
Type of Facility by Volume Delay Function Code

Volume Delay Function (VDF) Code	Type of Facility
1	Arterial
2	Freeway
3	Ramp Freeway/Arterial
4	Expressway
5	Ramp Freeway/Freeway
6	Centroid Connector
7	Toll Collection link
8	Metered Ramp

TABLE 2-2
IRIS Functional Class and Names

IRIS Functional Class	IRIS Functional Name	EO-WB Functional Name/ Comments
10	Interstate	Freeway; to be included in freeway
20	Freeway and expressway (urban)	Freeway
30	Other principal arterial	Principal arterial
40	Minor arterial (nonurban)	Not included in EO-WB network
70	Minor arterial (urban)	Minor arterial
50	Major collector (nonurban)	Not included in EO-WB network
80	Collector (urban)	Collector; includes one link for local road or street (urban)

TABLE 2-2
IRIS Functional Class and Names

IRIS Functional Class	IRIS Functional Name	EO-WB Functional Name/ Comments
55	Minor collector (nonurban)	Not included in EO-WB network
90	Local road or street (urban)	Not included in EO-WB network
60	Local road or street (nonurban)	Not included in EO-WB network

The master highway network maintained in the Arc/GIS environment by CMAP was used to provide geographic and attribute definition for the CMAP regional network, as well as the EOWB subarea focus model study area. Specific time period links in the 2007 base year network were identified and flagged using time period attributes in the Arc/GIS master highway network. Changes and additions needed to represent future networks were derived in a similar fashion and supplemented by updates from the CMAP Transportation Improvement Program database.

The second source of data was additional new network coding of more detailed streets and zonal access (centroid connectors) within and surrounding the study area. Most streets within the project study area are part of the CMAP model, and so additional coding was limited primarily to adding centroid connectors. The network links were added to the EOWB subarea focus model master highway network file, along with all necessary link and node attributes flagged to identify presence or absence of specific links in each scenario. Use of the master database concept eliminated the need to recode the focus model elements in each time period scenario and facilitated automation of the eight CMAP time period assignment processes.

Details on updates to the network are given in Appendix B, Network Updates, which includes unique link ID, roadway name, and functional code and name in the study area.

2.2 Traffic Count Database Development

In conjunction with the network development and the zone refinement process, a traffic database was developed to gather and maintain extensive traffic count information. Traffic data was collected for a typical weekday 24-hour period by direction and vehicle class and on an hourly basis. A combination of field data gathering efforts, existing IDOT count information, Illinois Tollway count data, and data from local municipalities was used for developing the traffic count database. The methodology used to gather and summarize traffic count data at the 272 locations with vehicle classification counts at 101 locations is summarized herein. Count locations were within four different functional classifications of roadways: expressways, interstates, major arterials, and minor arterials. Data were gathered from five sources:

- IDOT–HDM count database
- Illinois Tollway
- Regina Webster and Associates (sub consultant)
- Illinois State Tollway Highway Authority (ISTHA) 2006 Lane Closure Guide
- IDOT Web site

Table 2-3 summarizes the data tabulated from each source.

The traffic count data were used to support and validate the 2007 base year EOWB subarea focus model, thereby evaluating the travel model. Twenty-four hour field vehicle classification counts by hour were collected for more than 100 locations within the study area. Appendix C describes the process of gathering and tabulating the traffic count database for the EOWB project.

TABLE 2-3
Count Data Sources

Authority / Source	Locations
Sub Consultant	101
IDOT–HDM database	86
IDOT 2006 data	33
Regional Tollway Authority	30
IDOT Web site AADT data	22
Total	**272**

2.2.1 Traffic Data Application

The traffic data were extracted and processed in two steps. The first step was performed to extract the hourly counts from the raw data files. The second step was performed to extract the vehicle classification count data and obtain truck percentages. Appendix D contains details of vehicle and truck classification and aggregation.

The count data provided by different sources was processed using Excel spreadsheets and Visual Basic for Applications (VBA) macros. Since the raw data were provided by different sources, there were four different data formats for the hourly count data. All counts were summarized directionally; therefore, if one count represents two-way traffic, it was disaggregated into directional counts, and each count location contains a directional identification called “CountID” (example: 0160062EB and 0160062WB). All data points also contain a “ReferenceID”, which is the corresponding directional link name associated with the underlying highway network (example: I90_EB and I90_WB).

2.2.2 Traffic Data Referencing

A reliable way to map count data to the travel model’s link database was developed by using the directional link naming convention in the network, and the geographically linked GIS point file, and an intermediate count reference database. Each link in the network is geographically located with a ReferenceID associated with each link (discussed under network adjustment). Each GIS data point is geographically located with a ReferenceID and a directional CountID.

The two-criterion method allowed the location of a specific link to be identified, along which the attributes are specific to the direction of flow. The model is designed to provide an unambiguous means to map point and link information from external sources to the TransCAD link layer used to describe the area streets and highways. The intermediate table consists of three referencing elements: CountID, ReferenceID, and x–y location. The table also contains AADT and other time period count data, and can be used to reference all historical, current, and future count data for a given location. The reference included a method to match specific flow direction. Intermediate table records were created for each unique point for both directions of flow. Therefore, each record has only a single route name identifier. A snippet of the intermediate table follows. It contains AADT for eastbound and westbound North Avenue from 7:00 A.M. to 8:00 A.M., for CountID 0160062.

ID	COUNTID	REFERENCE_ID	AADT	0700AM
3	0160062EB	NorthAve_EB	28190	1571
4	0160062WB	NorthAve_WB	29785	1772

By referencing the external record index to access data, the data (or a temporary index/reference) can be transferred to the link database. This is achieved by using the route name that locates both a contiguous linear set of links with a specific flow direction and the point coordinates that identify the unique link in the link set being referenced. This eliminates mistaken references to parallel or crossing streets, and ensures the links selected have a correct flow direction.

2.3 Trip Table Expansion, Factoring and Adjustment

The regional trip tables for existing conditions (2007) received from CMAP required three transformations before they could be used as input to the traffic assignment process to generate a 2007 base year model for the focus study area. Trip table entries for the CMAP regional model zone system (1,877 internal and 14 external zones) were expanded to represent the additional 542 zones within the EOWB project study area. The reallocated socioeconomic percentages were used as the basis for disaggregating the CMAP trip tables.

2.3.1 Allocation of Socioeconomic Data to EOWB Traffic Analysis Subzones

This section describes the methodology of reallocating EOWB sub-data to subzones within the study area. After the zone splits of the EOWB study area were completed, assignment of percentages of households and employment to each subzone was performed based on existing land use within the project study area. Reallocation of socioeconomic data was completed using GIS overlay of TAZ and geo-referenced aerials provided by the Illinois Department of Transportation (IDOT) and by using Google Earth.

CMAP 2007 and 2030 RTP socioeconomic data were reallocated to the EOWB subzones using visual review of aerial photos and assessing the type of land use for each subzone. The proportion of households and employment was allocated based on available area and type of land use that dominated the subzone characteristics. Quality control checks were established to ensure subzone allocations procedures equaled the input totals for each CMAP zone. The total employment was proportioned to each subzone based on various employment types that included industrial, commercial, retail, airport, and educational employment.

2.3.2 Trip Table Expansion and Factoring

CMAP vehicle class and time of day factors were used to allocate daily vehicle mode trips to the same eight time periods used in the CMAP modeling process. CMAP four truck classifications (B-plate, light, medium and heavy) were used to represent three truck classifications based on field data collection efforts for the modeling process. The B-plate classification from CMAP was included as a passenger vehicle in the EOWB model. Details of vehicle and truck classification and aggregation are included in Appendix D.

The expanded trip tables were input to the Link O-D estimation and traffic assignment process to generate vehicle mode and time period specific traffic volumes for existing conditions.

A spreadsheet-based application along with the TransCAD matrix disaggregate process was used to expand the CMAP regional travel model trip tables with 1877 zones into a 2433 zones for EOWB subarea focus model. The trip table expansion was based on the socioeconomic quantities (population, households and employment) that were reallocated from CMAP zones to EOWB subzones described in the previous step to generate trips to allocate parent zone trips to subzones. CMAP procedures for auto occupancy factors and time-of-day allocations were applied to generate separate trip tables by vehicle class. The expansion process resulted in the 2007 base year EOWB subarea trip tables that would be used in the traffic assignment process.

2.4 O-D Estimation and Traffic Assignment

The expanded EOWB subarea trip tables were the primary input into the 2007 EOWB existing travel model. The O-D Estimation process used the expanded trip tables as input along with traffic assignment for model estimation to develop a validated and calibrated 2007 existing EOWB travel model. Appendix E outlines the travel forecasting methodology that was proposed and accepted for this project.

2.4.1 O-D Estimation

A procedure called O-D estimation was used to create a reasonable consistency between existing ground counts and model estimated traffic volumes. This process uses an iterative process built around traffic assignment to achieve convergence with the input traffic count data provided by all count data sources mentioned in the report. The O-D estimation procedure was applied to each hourly set of count data, resulting in operational conditions in the peak period or peak hour correlating well between the model volumes and ground counts. The full compliment of volume-delay functions (VDF) used by the CMAP model was coded to represent congestion and system-wide effects in the traffic assignment process. The assignments used consecutive processing to "seed" the assignment for each period with travel times from the previous time period (off-peak uses free flow times).

The O-D estimation process resulted in new trip tables for existing conditions by reassigning zones for two trip interchanges based on comparison to link level traffic counts during the traffic assignment process. The new adjusted tables served as the final 2007 EOWB existing subarea trip tables for purposes of future travel forecast estimations.

2.4.2 Traffic Assignment

In conjunction with the O-D estimation procedure, a multi-class equilibrium assignment was used to generate traffic volume loads in the study area. The disaggregated EOWB study area trip tables and the field traffic volumes were used as inputs to the process. The new adjusted trip tables resulting from the O-D estimation process and the traffic assignment describe the existing conditions in terms of travel demand at the link level based on observed traffic counts. The O-D estimation allowed very good correlation between existing and modeled traffic volumes.

TABLE 2-4
CMAP Time Period Stratifications

Time Period	Duration
Off-peak	8:00 P.M.–6:00 A.M.
Pre-A.M. peak	6:00 A.M.–7:00 A.M.
A.M. peak	7:00 A.M.–9:00 A.M.
Post-A.M. peak	9:00 A.M.–10:00 A.M.
Midday	10:00 A.M.–2:00 P.M.
Pre-P.M. peak	2:00 P.M.–4:00 P.M.
P.M. peak	4:00 P.M.–6:00 P.M.
Post-P.M. peak	6:00 P.M.–8:00 P.M.

Source: CMAP Transportation Conformity Analysis—Appendix B, October 2006.

The highway traffic assignments were performed for the eight time periods by vehicle class (auto, light trucks, medium trucks, and heavy trucks). Table 2-4 lists the CMAP time period stratifications. The link attributes used to drive these assignment functions were taken directly from the CMAP data and translated to additional new links in the study area to provide maximum compatibility and comparability with CMAP travel model outputs.

2.4.3 Transit Mode Share Estimations

Transit mode shares for the project study area were assessed using CMAP mode split assumptions and assignments. The CMAP mode split (transit mode share) estimation was used for addressing transit performance in the project study area. Specific mode choice applications and model runs were not performed within the subarea focus model framework for the project during the initial alternatives screening stages. During the initial alternatives screening and evaluation process, the best case transit mode share estimates were assumed to be the 2030 baseline condition, since the baseline incorporates all the assumptions used in the 2030 CMAP RTP relating to transit improvements. This allowed transit to provide the maximum benefit in terms of minimizing need for expanded road capacity.

As part of the finalist build alternatives evaluation, the projected transit mode share reflecting additional transit improvements proposed as part of the EOWB project will be established with assistance from CMAP.

3. Model Validation

3.1 Validation

The O-D estimation procedure is expected to adjust zone to zone trip tables to match ground counts for the study area using the master count database and the traffic assignment process. The model validation was performed to QA/QC the O-D estimation process. Model validation was done by comparing the ground field counts to the assigned volumes for links within the study area. Three time periods (daily, A.M. peak period and P.M. peak period) were used to compare the modeled functional class traffic counts to the assigned field counts.

In the project study area, all modeled volumes were compared to the actual ground counts using spreadsheet analysis. USDOT *Travel Model Improvement Program Model Validation and Reasonableness Checking Manual* defines target values for assessing model systems. The observed versus estimated counts for this project were checked by facility type. The FHWA defines targets for daily volumes by facility type, as shown in Table 3-1.

TABLE 3-1
Targets for Daily Volumes by Facility Type

Facility Type	FHWA Targets
Freeway	± 7%
Major arterial	10%
Minor arterial	15%
Collector	25%

Source: FHWA, Calibration and Adjustment of System Planning Models, 1990

The mean squared error (MSE) was calculated in order to determine the root mean squared error (RMSE) for count locations by facility type. The MSE value is the squared distance vertically between the count and the volume. The smaller the MSE, the closer the fit is to the data. The RMSE is the square root of the MSE. The RMSE is the distance, on average, of a data point from the fitted line measured along a vertical line. For model validation purposes, the percent RMSE by facility class was calculated using the equation

$$\%\ RMSE = \frac{\left(\sum_j (Model_j - Count_j)^2 / (Number\ of\ Counts - 1)\right)^{0.5} * 100}{\left(\sum_j Count_j \,/\, Number\ of\ Counts\right)}$$

An appropriate aggregate % RMSE, as suggested by the Montana DOT, is less than 30 percent.

Another useful aggregate statistic on the validity of the traffic assignment is the calculation of the correlation coefficient or coefficient of determination (R^2). This correlation measures the strength of the linear relation between x and y. and the higher the coefficient, the better the correlation between x and y. This coefficient is used for comparing region wide observed traffic counts versus estimated volumes. For a region wide comparison R^2 should be greater than 0.88, as suggested in USDOT *Travel Model Improvement Program Model Validation and Reasonableness Checking Manual.*

For all practical purposes the O-D estimation process validated the existing subarea focus model by matching model volumes to ground/field counts. Additionally, specific network adjustments and implementation of the CMAP volume-delay function calibrated the existing travel model to better replicate field counts in the project study area.

3.2 Count versus Model

The link-OD estimation process establishes reasonable consistency between observed and model estimated traffic volumes within the project study area. Comparison between field counts and model derived volumes by IRIS functional classes and acceptable ranges are shown in Table 3-2. The percentage of volumes to counts for all facility classes and the %RMSE values are both low.

Exhibit 3-1, shows the "Comparison between Count Versus Modeled Volumes (Example: Thorndale and IL 72 Corridors)" and Exhibit 3-2, depicts the "Comparison of Modeled Versus Actual Count Data on Arterials: All Day Volume."

TABLE 3-2
Comparison of Field and Estimated Counts in Project Study Area

IRIS Functional Class	AADT (GC)	AADT (LOADS)	%AADT	R2	%RMSE
Interstate	7,706,500	7,898,500	+2.50	0.76	19
Freeway and expressway (urban)	1,001,600	962,400	-3.90	0.99	8
Other principal arterial	2,442,100	2,404,700	-1.50	0.92	11
Minor arterial (urban)	2,660,300	2,673,400	+0.50	0.91	18
Collector (urban)	525,300	516,700	-1.60	0.81	36
Totals	**14,335,800**	**14,455,700**	**+0.80**	**0.97**	**25**

Note: Scenario 2007 Existing Conditions: daily volume comparison. Non urban and local functional classes omitted.

4. 2030 Baseline Scenario

4.1 2030 Baseline Highway and Transit Projects

This section describes the 2030 baseline transportation system. The baseline system represents a level of improvement that corresponds to a committed level of investment but does not include major improvements being considered in the study. The 2030 baseline transportation system represents the No-Action Alternative, and will serve as a basis for evaluating the relative performance of system improvement alternatives. The baseline transportation system was established with input from area transportation agencies, including consideration of ongoing project development. It includes projects that the agencies expect to be in place by 2030. The baseline transportation system consists of the existing transportation network plus the following:

- Roadway and transit improvements identified in the 2030 Regional Transportation Plan, excluding the major improvements being considered for this study
- Programmed roadway, transit, and aviation improvements within the study area included in current transportation improvement programs
- Roadway, transit, and aviation improvements located within the study area expected to be completed beyond the end date of current Transportation Improvement Programs

4.1.1 2030 Baseline Roadway Network

The 2030 baseline roadway network identifies roadway capacity improvement projects that are to be in place by 2030 but without the major transportation improvements to be considered by this study. For the purpose of this study, the 2030 baseline roadway network was developed with input from each transportation agency in the study area (IDOT, ISTHA, Cook County, DuPage County) and a review of regional and agency plan information. The 2030 baseline roadway network consists of the existing transportation network plus the following:

- Roadway improvements identified in the 2030 RTP, excluding the extension of the Elgin O'Hare Expressway and West O'Hare Bypass
- Programmed roadway capacity improvements located within the study area and included in published Transportation Improvement Programs
- Roadway capacity or access improvements within the study area expected to be built and funded beyond the end date of current Transportation Improvement Programs through 2030.

Programmed and expected roadway projects within the 2030 baseline roadway network are listed in Table 4-1, on the following page, and depicted in the 2030 Baseline Roadway Projects Map (Exhibit 4-1).

4.1.2 2030 Baseline Transit Network

The baseline transit network was developed by review of long-range transit projects identified in the 2030 RTP. Candidate baseline projects were then evaluated by transit providers on the basis of current agency priorities and expected funding. Programmed and expected transit projects included in the 2030 baseline transit network are listed in Table 4-2 and depicted in the 2030 Baseline Transit Projects Map (Exhibit 4-2).

TABLE 4-2
2030 Transit Baseline Projects

CTA	Pace	Metra	Other
Blue Line service from Block 37 to O'Hare; no dedicated rail	*Note:* Pace projects will be examined as alternatives in a later phase of this study.	UPW Line capacity upgrades UPNW Line capacity upgrades and extension STAR Line: O'Hare to Joliet segment	CREATE—New crossovers and signals in Franklin Park; track additions to the Union Pacific Line in Bellwood and track additions to the Union Pacific Line in Melrose Park (projects programmed and in process)

Note: The projects listed were compiled from both the 2030 RTP (as revised in 2006) and from feedback from the Transit Service Boards.

TABLE 4-1
Roadway Baseline Projects

Name	Project Type	To	From
Balmoral Avenue	New interchange, extend roadway	Bessie Coleman Drive	East of US Route 12/20/45
Des Plaines River Road	Bidirectional turn lane, utility/drainage relocation	River Street	Lawrence Avenue
IL Rte 53 (Rohlwing Road)	Add lanes, bridge replacement	Elgin O'Hare Expressway	Army Trail Road
I-290	Corridor improvement, HOV, auxiliary lanes	St. Charles Road	IL Route 50 (Cicero Avenue)
I-294 (Tri-State Tollway)	Widening, reconstruction	Balmoral Avenue	Dempster Street
I-90 (Jane Addams Memorial Tollway)	Add lane, reconstruction	I-294 (Tri-State Tollway)	IL Route 53
Meacham Road	Add lanes	IL Rte 62 (Algonquin Road)	Old Plum Grove Road
Meacham Road	Add lanes, traffic signals	IL Rte 62 (Algonquin Road)	IL Route 72 (Higgins Road)
Meacham Road	Add lanes, reconstruction w/change lane width	Kirchoff Road	IL Route 62 (Algonquin Road)
Medinah Road	Reconstruction, bidirectional turn lanes, channelization	IL Rte 19 (Irving Park Road)	US Route 20 (Lake Street)
Thorndale Avenue	Add lane	I-290	York Road
US 12/20/45 (Mannheim Rd)	Widen Mannheim to three lanes in each direction	IL Rte 19 (Irving Park Road)	IL Route 72 (Higgins Road)
Wood Dale Road	Reconstruction, channelization	Montrose Avenue	N of US 20 (Lake Street)
Arlington Heights Road	Intersection improvement	Landmeier Road	
Arlington Heights Road	Intersection improvement	Oakton Avenue	
Devon Avenue	Intersection improvement	Arlington Heights Road	
Grand Avenue	Intersection improvement	York Road	
IL Rte 58 (Golf Road)	Intersection improvement	New Wilke Road	
IL Rte 62 (Algonquin Road)	Intersection improvement	New Wilke Road	
York Road	Intersection improvement	IL Rte 19 (Irving Park Road)	
West Terminal Entrance	Intersection improvement	Thorndale Avenue	
Wood Dale Road	Intersection improvement	IL Rte 19 (Irving Park Road)	
I-294 (Tri-State Tollway)	Add interchange ramp	Balmoral Road	

4.2 2030 Baseline Socioeconomic Estimates

The 2030 baseline scenario consists of the 2007 existing highway network plus committed projects using input from IDOT, Illinois Tollway, DuPage County, and other studies of the study area. The master regional CMAP travel model highway network was updated to reflect existing and committed projects correlating with the Regional Transportation Plan (RTP) to develop a 2030 baseline network. A 2030 baseline socioeconomic and land use forecast was developed to reflect the known changes in land use resulting from existing conditions and committed projects (highway and transit). The 2030 baseline forecast was developed by adjusting socioeconomic and land use data from the 2030 CMAP RTP with input from socioeconomic assumptions made for the DuPage West O'Hare Economic Development Study. The 2030 baseline forecast was transmitted to CMAP requesting a regional CMAP travel demand model run and 2030 baseline trip tables for the analyzed vehicle classifications. Note that the 2030 baseline socioeconomic forecasts reflect accessibility changes based on 2030 baseline highway and transit projects within the study area.

The 2030 baseline socioeconomic forecast was adjusted only as it relates to the study area and the 2030 endorsed RTP forecasts were used for the rest of the CMAP regional area.

Appendix F documents the meeting discussions as a technical memorandum at which the 2030 baseline socioeconomic data assessment was discussed with CMAP.

4.3 2030 Baseline Trip Tables Development

Development of the 2030 baseline future year trip tables for the subarea focus model was based on an incremental application process. The 2030 CMAP RTP trip tables were used as the starting point to generate the 2030 baseline trip tables for the subarea focus model. The change in accessibility and socioeconomic forecast assumptions was used to adjust the 2030 CMAP RTP trip tables to generate the 2030 baseline CMAP trip tables. The difference between the CMAP 2007 existing and 2030 baseline CMAP trip tables resulted in a delta change growth trip table. The growth trip table was expanded to the EOWB subarea zones system using socioeconomic reallocation assumptions. The growth trip table was added to the 2007 existing subarea focus trip table to generate 2030 baseline subarea focus trip tables that were used to estimate 2030 baseline traffic forecast for the project study area. With this method, the 2007 existing subarea focus trip tables are used as the starting point to generate traffic forecasts, thus deviating from the standard forecasting process of directly using the 2030 CMAP trip tables. The 2007 existing subarea focus trip table plus the growth trip table is the 2030 future subarea focus trip table.

Note that the growth factor method was used only to develop the 2030 Baseline Trip Tables which was used to estimate 2030 Baseline travel demand and to evaluate initial set of alternatives considered for the project.

Once the final build alternatives were selected a new set of build alternative specific trip tables was generated with the support of CMAP using alternative specific socio-economic forecasts.

4.4 2030 Baseline Traffic Assignment

The 2030 baseline subarea focus trip tables were assigned using a multi-class equilibrium assignment process. The traffic assignment process relies on a number of assumptions and parameters regarding how different vehicle classes are treated, and how estimated congestion effects route choice. The full compliment of volume-delay functions used by CMAP that was implemented in the existing subarea focus model will be applied for the 2030 baseline scenario. The highway traffic assignments were performed for each of the eight time periods matching the CMAP time period categories and four vehicle classes (auto, light trucks, medium trucks, and heavy trucks) to forecast traffic demand for the project.

5. Use of Model Output for Performance Analysis

A detailed set of performance measures was calculated for the study area using outputs from the EOWB subarea focus model. Comprehensive, useful, and easy to interpret performance measures were developed to evaluate transportation system performance. Calculations were made primarily in Excel using direct traffic model outputs.

5.1 Description of Performance Measures

Performance measures were established to assess traffic congestion and travel characteristics choices for all scenarios; existing roadway conditions and all future scenarios. The tools used in calculating performance measurements for the existing and future transportation roadway networks were Excel spreadsheets, Visual Basic for Applications macros, and direct output in database from the TransCAD travel demand model.

The *Transportation System Performance Report* (TSPR) presents an inventory of each mode in the transportation system, including highways, public transportation, freight movement, and non-motorized modes. The quality of service on each mode has been defined to help identify constraints and performance issues.

5.2 Traffic Congestion Measures

To better represent and facilitate evaluation of the roadway network, summary statistics were developed by aggregating the link data. Variables were added to the roadway network that can identify specific routes and corridors of interest. Route, segment, location, and direction codes were developed to identify corridors for analysis.

Additional evaluation measures to assess corridor/system level performance were developed as part of the alternatives development and analysis methodology. The weighted average speed for each segment were determined by the ratio of vehicle miles traveled (VMT) on each link to the total VMT over the route segment and thus accounting for exposure at different speeds along the route segments. In addition to these performance measures, level of service (LOS) was computed based on average travel speed, and a weighted percent congestion measure was calculated using weighting factors to reflect different degrees of congestion based on Highway Capacity Manual (HCM) procedures.

Congestion measures match a calculated performance value, such as speed or travel time, to a corresponding level of congestion. One applicable congestion measure relates average operating speed to a determined desirable speed for different functional classes of roadway and different time periods. Desirable speed is the maximum speed for the roadway class under uncongested conditions. In the traffic assignment process, this is the initial speed assigned to each link when establishing the network. Travel time and, hence, congested speed is obtained from the output of each model assignment. A system wide or link-by-link speed performance, weighted by the vehicle miles of travel (VMT) can be calculated by summing the product of speed times VMT for each link, and then dividing by total VMT.

5.2.1 Level of Service

Traffic service commonly is measured in terms of LOS. For roadway segments, average delay and speed along with other factors enter into the LOS determination. For freeways, LOS is related directly to the volume to capacity (v/c) ratio. LOS measures the quality of traffic service and may be determined for each arterial roadway segment on the basis of delay, congested speed, v/c ratio, or vehicle density by functional roadway class.

LOS is one of the key indicators of traffic service performance calculated for each roadway segment for the P.M. peak period (4 P.M. to 6 P.M.). The TSPR describes congested locations on the existing network, labeled "congestion," "severe congestion," and "extreme congestion." Network segments expected to operate at a congested level in the 2030 P.M. peak period for the baseline network and areas of congestion and congestion increases (2007–2030) are also described in the TSPR.

Appendix G describes the methodology used to calculate LOS for arterials and freeways.

5.2.2 Accessibility

Accessibility is the ability of the roadway system to provide safe, convenient routes for motorists both within the EOWB study area, and between the EOWB study area and the remainder of the CMAP area. The usual measure of accessibility is travel time. This considers both the availability of a convenient route and travel speed on the available path.

Accessibility of traffic generators in the EOWB study area to locations throughout the CMAP region depends on the availability of a freeway connection. A tool commonly used to measure accessibility is the isochronal map, on which travel time is calculated between a location within the study area and various locations throughout the region. The TSPR illustrates travel time between West O' Hare Areas, and other locations both within and outside the study area.

Travel time contours for freeway interchanges are also shown in the TSPR. Sizable parts of the study area are 10 or more minutes distant from the nearest freeway access. Exhibits that are included in the TSPR also depict the daily traffic flow to and from O'Hare International Airport.

5.2.3 Vehicle Miles of Travel, Vehicle Hours of Travel, and Vehicle Hours of Delay

Traditional performance measures were calculated within the transportation planning model and added to the link attributes. These measures were readily developed from the data produced in the loaded network. They are link-based statistics that account for specific links on the network. Performance measures used to evaluate travel performance include:

- Vehicle miles of travel (VMT) = volume × distance traveled
- Vehicle hours of travel (VHT) = volume × travel time
- Vehicles hours of delay (VHD) = volume × (congested travel time – free flow travel time)
- Average speed (time period–specific) = VMT/VHT

Although these measures are informative, the statistics are limited to link levels (e.g., specific corridors and routes) and thus provide only a limited understanding of the overall transportation network performance.

Delay is an important measure of congestion. The results are similar to those obtained from the speed analysis, and may be even more descriptive of traffic operating conditions. The amount of delay (VHD, or vehicle hours of delay) can be calculated for each link. The system wide delay was calculated by summing the delays for all links within the study area. Separate summaries were also produced by functional class or by individual route.

Table 5-1 summarizes total existing VMT, VHT, and VHD within the study area by functional class. The total of roadway miles in the study area by functional classes, including freeways, principal arterials, minor arterials, and collectors, is 483.83 miles. Table 5-2 summarizes existing VMT, VHT, and VHD within the study area by functional class and eight time periods within a 24-hour period.

Exhibits 5-1 through 5-12 also describe various VMT, VHT and VHD information.

5.2.4 Trip Origins and Destinations

An understanding of regional and local travel patterns is vital to understanding current traffic routing choices, and to identifying the potential causes of current system performance issues. Travel in the study area is a component of total travel in the metropolitan region and, as such, is a function not only of trips having origins and destinations within the study area ("internal" trips) but also of those with one or both trip ends outside the study area ("external" trips). For analysis purposes, travel may be described as follows:

- Internal-Internal—Trips with both origin and destination inside the study area
- Internal-External—Trips originating in the study area with a destination outside
- External-Internal—Trips originating outside the study area with a destination within
- External-External—Through trips with neither origin nor destination inside the study area

The distribution of daily trips (2007) in these categories and the proportion of trips in each category for daily travel and during the A.M. and P.M. peak periods are shown in the TSPR.

TABLE 5-1
Study Area Summary for the Total VMT, VHT, and VHD by Functional Class: Existing Conditions (2007) AM Peak Period, PM Peak Period and Daily

	Highway Miles in Study Area	
Functional Class	**Total Miles**	**Lane Miles**
Freeway	130.83	447.86
Principal arterial	88.20	407.18
Minor arterial	149.89	526.01
Collector	114.91	302.84
Total	**483.83**	**1683.89**

	Vehicle Travel Measures in Study Area								
	A.M. Peak Period (7 A.M. to 9 A.M.)			P.M. Peak Period (4 P.M. to 6 P.M.)			Total Daily		
	VMT (miles)	**VHT (hr)**	**VHD (hr)**	**VMT (miles)**	**VHT (hr)**	**VHD (hr)**	**VMT (hr)**	**VHT (hr)**	**VHD (hr)**
Freeway	1,759,000	60,800	29,900	1,693,000	54,400	24,600	12,711,000	322,100	98,500
Principal arterial	432,000	21,400	8,600	529,000	32,200	16,200	3,299,000	133,100	37,000
Minor arterial	441,000	23,900	9,400	585,000	41,000	21,300	3,436,000	158,100	46,600
Collector	189,000	11,700	4,700	259,000	23,700	13,800	1,487,000	81,400	27,400
Total	**2,821,000**	**117,800**	**52,600**	**3,066,000**	**151,300**	**75,900**	**20,933,000**	**694,700**	**209,500**

TABLE 5-2
Study Area VMT, VHT and VHD by Functional Class: Existing Conditions (2007) All Time Periods

Functional Class	Off Peak (8 p.m.–6 a.m.)	Pre a.m. Peak (6 a.m.–7 a.m.)	a.m. Peak (7 a.m.–9 a.m.)	Post a.m. Peak (9 a.m.–10 a.m.)	Midday (10 a.m.–2 p.m.)	Pre p.m. Peak (2 p.m.–4 p.m.)	p.m. Peak (4 p.m.–6 p.m.)	Post p.m. Peak (6 p.m.–8 p.m.)	Total Daily
Vehicle Miles of Travel									
Freeway	2,437,000	724,000	1,759,000	695,000	2,589,000	1,549,000	1,692,000	1,266,000	12,711,000
Principal arterial	519,000	161,000	432,000	158,000	704,000	424,000	529,000	370,000	3,299,000
Minor arterial	473,000	154,000	441,000	168,000	746,000	455,000	585,000	414,000	3,436,000
Collector	188,000	65,000	190,000	72,000	333,000	199,000	259,000	182,000	1,487,000
Total	**3,617,000**	**1,104,000**	**2,822,000**	**1,093,000**	**4,372,000**	**2,627,000**	**3,065,000**	**2,232,000**	**20,933,000**
Vehicle Hours of Travel									
Freeway	45,000	21,000	60,800	15,200	55,400	43,800	54,400	26,400	322,100
Principal arterial	14,000	6,300	21,400	5,000	24,400	16,900	32,200	12,800	133,100
Minor arterial	13,900	6,400	23,900	5,900	30,200	20,500	41,000	16,200	158,100
Collector	6,200	3,800	11,700	2,900	14,700	10,700	23,700	7,700	81,400
Total	**79,100**	**37,500**	**117,800**	**29,000**	**124,700**	**91,900**	**151,300**	**63,100**	**694,700**
Vehicle Hours of Delay									
Freeway	2,000	8,300	29,900	3,000	10,000	16,600	24,600	4,200	98,500
Principal arterial	100	1,700	8,600	500	3,900	4,300	16,200	1,800	37,000
Minor arterial	0	1,500	9,400	500	6,000	5,400	21,300	2,600	46,600
Collector	2,400	700	1,700	700	3,200	1,700	2,100	1,400	13,700
Total	**22,600**	**6,400**	**16,200**	**6,200**	**28,100**	**15,700**	**19,100**	**13,600**	**127,900**

6. Summary

The EOWB transportation demand model uses an innovative, rigorous technical approach to identify the transportation system performance. Data from CMAP formed the foundation of the traffic model development, resulting in localized refinements of the highway network within and surrounding the EOWB project area. The EOWB 2030 baseline network with supporting socioeconomic forecasts and trip tables will be used to develop and evaluate a range of alternatives. The initial, finalist, and build alternatives were evaluated using their respective socioeconomic and travel demand forecasts described in this report, as well as described methodologies and analysis procedures. Where appropriate, additional performance measures were used to help differentiate the performance characteristics of alternatives. Detailed results of each step of the alternatives evaluation process will be described in the *Alternatives Report*.