MORRIS COUNTY

FY 2008-2009 SUBREGIONAL STUDY PROGRAM
FINAL REPORT

Other Participating Agencies

Federal Highway Administration
Federal Transit Administration
New Jersey Institute of Technology
North Jersey Transportation Planning Authority

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INTRODUCTION

This report contains the summary of Morris County's Transportation Planning Model funded by the North Jersey Transportation Planning Authority (NJTPA) during federal fiscal years 2008 through 2009 by the Federal Transit Administration and the Federal Highway Administration of the U.S. Department of Transportation. The model, which has been completed, was intended to address goals and issues in the NJTPA's Regional Transportation Plan. It was approved by the NJTPA Board of Trustees and administered by the NJTPA Central Staff through the Subregional Study Program. The information in this document identifies the funding amount, purposes, results and regional significance of this funded project.

As a result of this project, Morris County has a completed subregional transportation model known as the Morris County Transportation Model (MCTM). Supporting materials, including the MCTM Development Manual and the MCTM Training Manual created by Citilabs, now known as Systra Mobility, the contracted subconsultant for this project. The model software and hard copies of the mentioned documents are hosted at the offices of the Morris County Division of Transportation in Morristown, New Jersey. Electronic copies have been provided on CD along with this report. This final report derives information about the model from these documents.

PROJECT DESCRIPTION

Morris County undertook the FY 2008-2009 SSP to complete development of the Morris County Transportation Model (MCTM), a countywide transportation planning computer model designed to assist county planners and policy makers in the decision-making process regarding land use and transportation decisions within the county. The consultant selected for this project was URS, and the development of the model was sub-contracted to Citilabs, now known as Systra Mobility. The MCTM will be used to determine the impact of land use developments on the current and future infrastructure needs and will be used to identify a series of specific projects that may eventually be part of the NJTPA's project pipeline. The model is be structured specifically to address the planning goals and objectives of the NJTPA's Regional Transportation Plan (RTP), *Access and Mobility 2030* and will provide procedures to analyze specific strategies identified in the Plan. The policies and projects recommended will be consistent with the RTP and strategy evaluations and will promote consistency between the NJTPA, county, and municipalities.

To best utilize existing resources and to be compatible with the regional planning model, the county model was developed using the latest version of the NJTPA's North Jersey Regional Transportation Model - Enhanced (NJRTM-E). The Morris County area of the NJRTM-E was modified to include additional roadway network and the existing census-tract level zones were disaggregated into smaller zones. For implementation purposes, the county model used the entire Northern New Jersey Study Area and a full four-step process with extensive detail within Morris County. As part of the project, the revised county model was developed using Cube/Voyager package in order to take advantage of the available GIS capabilities.

The final task that Systra Mobility performed was training for the county technical staff. Local expertise for maintenance and efficient use of the county model is essential. The training focused on the use of model and other functions provided by the software package. A model training manual was developed for future training by county staff to new division employees. The training included the necessary information to interface with the county GIS system.

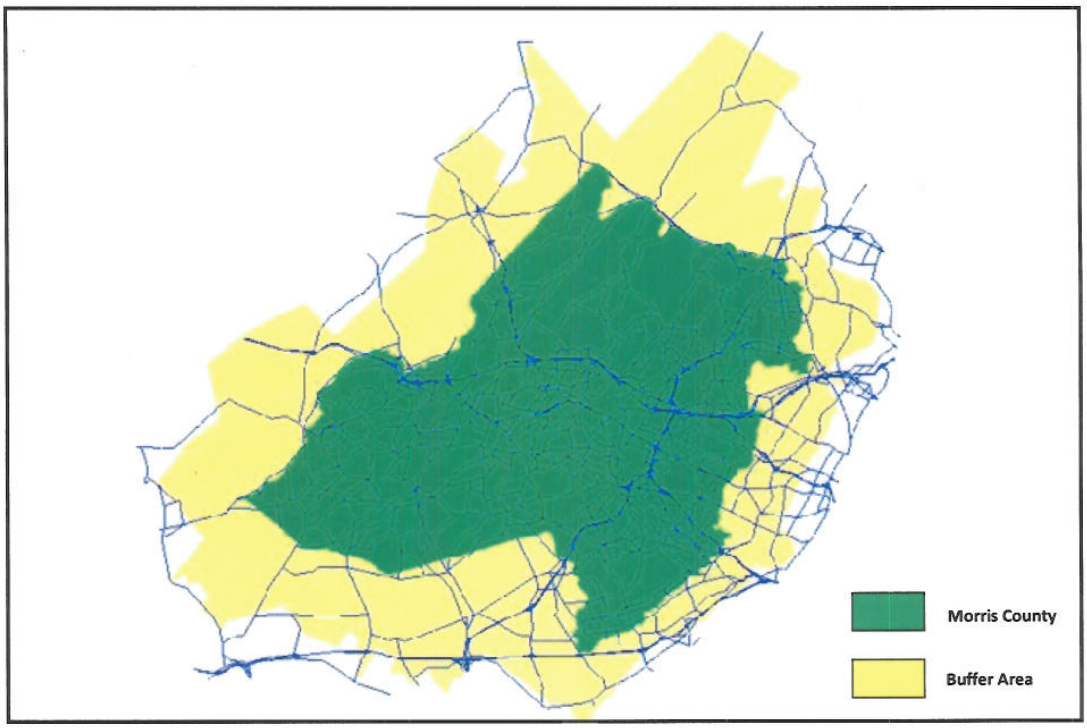
Morris County's commitment to this project was demonstrated by the use of county funds for the upgrading of TP+/Viper to the newest software, Cube/Voyager. URS was hired for both Phase I and Phase II of the project. The MCTM will be maintained by the county and utilized on a desktop computer acquired through the NJTPA Technology Grant.

The county will be funding consultant services for additional support of the model in future years. These funds will be used to help refine the model as needed, as well as to providing additional training. The county is committed to keeping the model up to date and relevant.

METHODOLOGY AND DATA

The Morris County Transportation Model (MCTM) was developed as a traditional four-step model within the Cube Voyager environment. The model's study area consists of a core region encompassing all of Morris County and a "buffer" region including the surrounding the counties. The buffer region comprises portions of Essex, Hunterdon, Passaic, Somerset, Sussex, Union, and Warren counties. Figure 1 shows the study area with Morris County region shaded in green and the buffer area shaded in yellow.

Figure 1
Morris County Transportation Model's Study Area



Morris County is located within the North Jersey MPO's region (NJTPA), therefore the model was developed to closely mimic the NJTPA's regional model, NJRTM-E, both in model structure and input data structure. The purpose of maintaining this consistency is to streamline any data sharing between the two models. The anticipated data-sharing between the two models include the preparation of external trips for the Morris County Transportation Model that are obtained from a subarea extraction of the NJRTM-E. Other potential data-sharing include socioeconomic data, such as population, household, and employment data. Although the Morris County Transportation Model was developed to closely mimic the NJRTM-E, there are a few model components that were developed differently. For example:

1. The input and output highway networks are presented in geodatabase format.

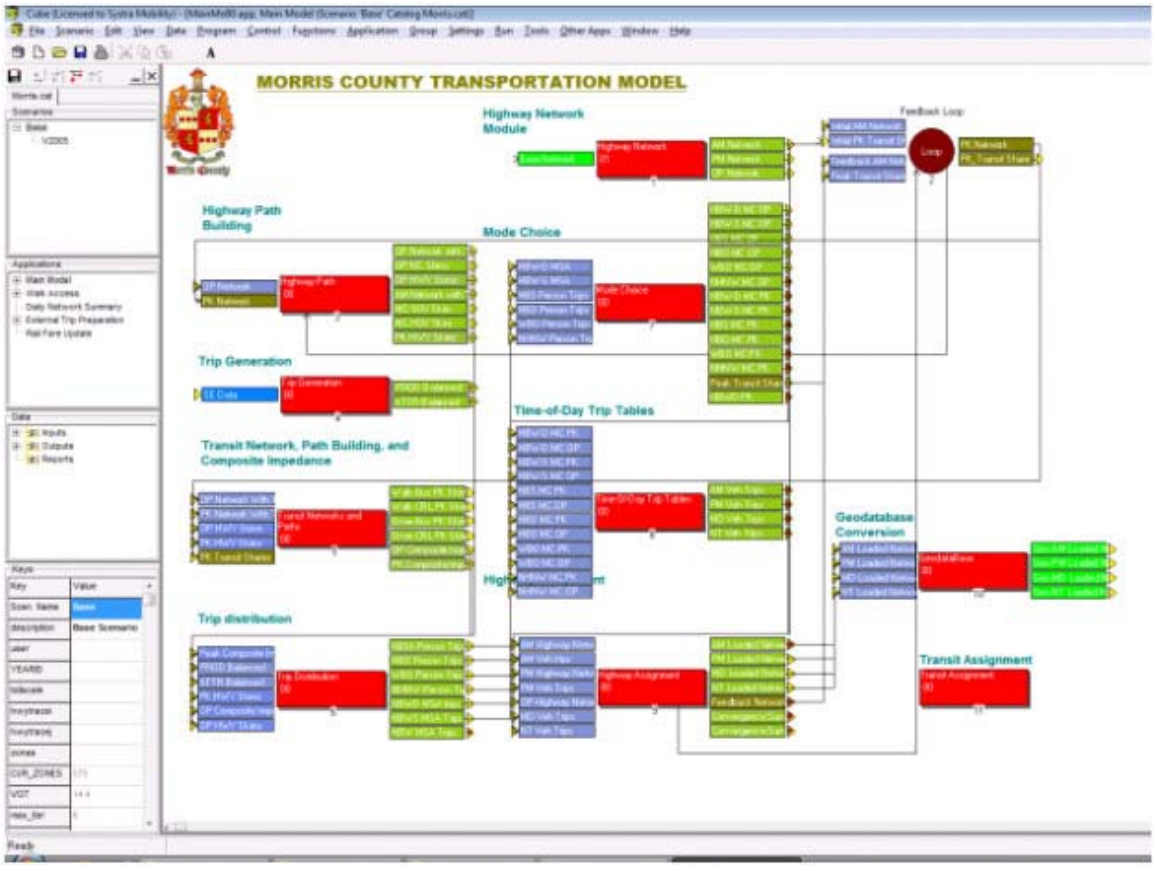
2. The transit model component was developed using Public Transport (PT) module instead of “Tranbuild”.

3. The implementation of Junction Analysis to estimate additional delay due to traffic control devices (TCDs), such as stop signs, yield signs, traffic signals, etc.

4. The mode choice model component was built using XCHOICE from Cube Voyager’s Matrix module instead of NJRTM-E’s Fortran program.

The Morris County Transportation Model was developed within the CUBE Voyager environments the model was presented in a series of flowcharts with one main application model and four application sub-models. Figure 2 depicts the main flowchart of the model. This model has a feedback loop with an iterative process from trip distribution to highway assignment. This iterative process allows the trip distribution to utilize the congested time and speed from the results of highway assignment of the previous iteration to give a more realistic representation of the level of congestion in the network. The model also implements the time-of-day highway assignment. There are four distinct assignment periods used in this model, AM Peak, Midday, PM Peak, and Night periods. Having different time-of-day period assignment enables the model to emulate highway speed to be as realistic as possible. The realistic representation of the speed is important in obtaining a better and more accurate analysis during the feedback process.

Figure 2
Morris County Transportation Model’s Main Flowchart



The main flowchart panel shown in Figure 2 consists of several windows:

1. The flowchart window, occupying the largest portion of the panel, contains the flowchart of certain process, from main module to various sub-modules.

2. The scenario window contains the list of existing scenarios.

3. The application window contains various applications of the model. There are currently five applications built into this model:

    a. Main model is the primary application that contains the complete modules of the Morris County Transportation Model.
    b. Walk-access sub-model is used to revise transit walk-access coverage every time the transit lines are updated.
    c. Daily network summary sub-model calculates daily statistics, such as daily total volumes, daily auto volumes, daily truck volumes, daily VMT, daily VHT, etc.
    d. External trip preparation sub-model converts the sub-area trip tables generated by the NJRTM-E to external trip tables compatible and consistent with the Morris County Transportation Model.
    e. Rail fare update sub-model allows the analysts to revise the commuter rail fare as necessary.

4. Data window is not used in this model.

5. Keys window contains general information pertaining to each scenario. The key window consists of numerous key variables, such as:
    a. Scenario name
    b. Scenario description
    c. User (user name or initial)
    d. YEARID (scenario year)
    e. Tollscale (scaling for toll values, default is 1. This value is currently not used because Morris County does not have toll facilities. This is prepared for future use).
    f. Hwytracei (I value or origin zone for highway load tracing purpose. This is used to check the path building or skimming process).
    g. Hwytracej (J value or destination zone for highway load tracing purpose. This is used to check the path building or skimming process).
    h. Zones (number of total zones, internal and external zones. It is currently defined as 2000).
    i. Cur_zones (number of total internal zones, currently defined as 575).
    j. VOT (value of time used in the highway assignment diversion model).
    k. Max_iter (maximum iteration, currently set to 5. Maximum iteration allowed is 10).

Highway Network Development

The original Morris County highway network was derived from the GIS shape-file provided by Morris County staff at the beginning of this project. The GIS shape-file only included roadways within the Morris County region. This shape-file was then converted into a Cube Voyager highway network format before being expanded to include the buffer region. The expanded portion of the highway network was obtained from the North Jersey Regional Transportation Model Enhanced (NJRTM-E) highway network via subarea extraction process. Zonal connectors were then added to the highway network.

Socioeconomic Data

The MCTM was validated to the 2005 condition. The socio-economic data used in this validation scenario was obtained mainly from the NJTPA. The 2005 data was developed for the MPO's Regional Model, the NJRTM-E, as well as for the MPO's conformity determination projects.

The Morris County socioeconomic data was developed mainly from the NJTPA's socioeconomic data. The data was then disaggregated to the Morris County zonal system. In the NJRTM-E, Morris County is represented by 99 traffic-analysis zones (TAZ's), while in the MCTM, Morris County is divided into 501 TAZ's. The disaggregation process was performed using several different sources such as:

1. Block-group and block level population and household data from Census 2000 were used to develop population and households disaggregation factors.

2. Dunn and Bradstreet block-group employment data was used to disaggregate NJRTM-E employment data into Morris County's zonal level socio-economic data.

The socioeconomic data consists of the following information:
1. Population
2. Households
3. Income
4. Employments

Transit Network Modes

There are a total of 9 transit and non-transit modes introduced in the model. The first four modes represent the non-transit modes such as: walk-access, drive-access, transfer-access, and park and ride-to-bus stops/stations access. The last five modes represent the transit modes. They are: Morris County Metro (MCM) buses, Shuttle buses, NJ Transit buses, Private bus carriers, and NJ Transit rail. The transit operators are used during the construction of the transit fare system. Each operator usually has its own transit fare system, such as flat fee or transit zone-based fee, boarding fee, or transfer fee.

Highway Path Building

The highway path-building procedure is used to accumulate impedances for use by the trip generation, trip distribution, and the mode choice model components. The impedances include auto travel time, terminal time, and toll cost (for future use – Morris County currently does not have toll facilities) for each origin-destination zonal pair. These impedance values are stored as a series of matrix files, often referred to as "skim" files. The content of each skim table is structure for use by one or more of the model component referenced above.

Trip Generation

The MCTM trip generation process was developed to follow the NJRTM-E to maintain the consistency between the two models. This consistency is important especially if the two models will share or depend on each other's results. This is particularly true for the MCTM, which depends on the NJRTM-E's subarea extraction process for its external trips estimation for both highway and transit.

The trip generation was developed and stratified for the following trip purposes:

1. Home-based Work Direct (HBWD) – includes work trips that travel directly between home and work, without any intermediate stops.
2. Home-based Work Strategic (HBWS) – includes "strategic" work trips that have intermediate stops of limited duration, usually to serve another passenger, which may influence mode choice.
3. Home-based Shop (HBSH) – defined as trips with one trip end at home and the other at a retail location.
4. Home-based Other (HBO) - defined as trips with one trip end at home and the other at a non-retail location other than a college/university or airport.
5. Home-based University (HBU) - defined as trips with one trip end at home and the other at a college or university.
6. Work-based Other (WBO) – defined as a non-home-based trip with one trip end at work.
7. Non-Home Non-Work (NHNW) – defined as a non-home based trip with neither trip end at work.
8. Airport - defined as trips with one trip at Newark Liberty International Airport.
9. Truck Trip Purposes (Heavy, Medium, and Commercial)

Trip Distribution

Trip distribution links trip productions in the model region with trip attractions to create matrices of inter-zonal and intra-zonal travel flows. The results of trip distribution will be input to mode choice, and later assigned to highway and/or public transportation systems

to determine the travel demand constrained by the supply capacities of the underlying facilities.

The MCTM adopted the trip distribution models from the NJRTM-E, considering that the MCTM region falls within the NJRTM-E region, it is assumed that the MCTM's distribution pattern is somewhat similar to the NJRTM-E's distribution pattern. Therefore, the calibration was not performed as part of the model development. The friction factors and other parameters were obtained directly from the NJRTM-E.

Mode Choice

The mode choice model for the MCTM is adopted from the NJRTM-E. However, unlike in the NJRTM-E where the mode choice model was developed using a Fortran-based program, the MCTM's mode choice was developed using "XCHOICE" command from Cube Voyager's Matrix module.

The mode choice is a typical step within a traditional four-step travel forecasting model. In this step, trips in each zone-to-zone cell of the person trip table are divided among the different available travel modes. The selection of travel mode is a function of the characteristics of each mode that is available for that particular origin-destination zonal pair and the characteristics of the traveler, the production zone, and the attraction zone.

Time-Of-Day Trip Allocation

The trip generation process was developed on a 24-hour basis. Similarly the trip distribution process used one condition, either peak or off-peak, to control the distribution of trips. Prior to mode choice, the daily trips were partitioned into peak and off-peak periods. The transit trips predicted by the model were retained in these two designations for purposes of assignment, but the peak and off-peak auto trips were merged together to create the specific peak and off-peak period trip tables. The final highway trip assignment was performed by time-of-day for four periods covering the a.m. and p.m. peaks, the midday period, and the other off-peak periods. Highway assignment is performed by time-of-day to account for congestion effects and the subsequent diversion of trips caused by that congestion. Transit assignment was performed by time-of-day or period-specific to account for differences in the amount of transit services available for different time of day.

Highway Assignment

One of the important components of the highway assignment is the selection of volume delay function (VDF) which shows the relationship between the decay of speed as the volume increasing toward capacity. The MCTM's highway assignment module adopted the VDF from the NJRTME to maintain consistency. However, the intersection delay added to the VDF function in the NJRTM-E was not used, instead an intersection delay from junction model used in the highway assignment. The highway assignment module

also allowed adjustment to period capacity, as mentioned in the previous chapter, to mimic the peak spreading process.

Model Validation

This section is dedicated to the discussion of the model validation. In the model validation, the estimated results from each model component, trip generation, distribution, model choice and traffic assignment, are compared to the observed data. The observed data for this validation process was mostly a synthetic observed data developed from the 2005 NJRTM-E model run. Occasionally, the observed data from NYMTC/NJTPA household survey data was also used for alternative comparison. The main reason a synthetic observed data was used, was because the household survey only contains data for the Morris County region sporadically. This caused difficulties in creating a complete and meaningful observed data. The 2005 NJRTM-E's synthetic data was deemed to be adequate for this purpose for twofolds:

- Morris County is located inside the NJRTM-E region; therefore, it can be assumed that it has similar trip patterns as the NJRTM-E's trip patterns.

- The NJRTM-E model was validated using the household survey data, data this model implicitly mimics the trip patterns from the household survey data.

In the highway assignment validation process, the estimated loaded network was compared to the traffic counts. The traffic counts were provided by the Morris County Staff and other sources, such as the New Jersey Straight Line Diagram. The field traffic count collection effort was not part of the scope of this project, but is a component of Morris County's annual Subregional Transportation Planning Program.

NEXT STEPS

Future in the Pipeline Process

The specific purpose of the Morris County Transportation Model is to provide an unbiased mechanism to identify future growth and its implications to the transportation system. It is expected that deficiencies identified from the process would, based on jurisdiction, be either dealt with by Morris County, or transmitted to NJTPA for its consideration as a future study in the capital planning process (TIP). Potential projects will then be cross-referenced against the goals, objectives, and recommendations identified in the *Morris County Circulation Element* by the appropriate implementing agency.

The Morris County Transportation Model will develop projects for inclusion in the pipeline process in compliance with Regional Transportation Plan. From the county plan, problem statements will be developed with concrete projects ready to enter the project pipeline. These specific projects, because they will be coordinated with the NJTPA and the NJ Transit Model will also be able to address air quality issues. Projects and policy developed during the planning process will be in accordance with *NJTPA's Regional Transportation Plan 2035.* Therefore, this plan will provide a foundation for project development that will directly address the needs identified in the Strategy Evaluation.

Regional Impact

Morris County is one of the fastest developing counties in the state; consequently, the impacts to its landscape as well as the transportation system are a major concern to the entire region. There are many regional benefits from the transportation model. The Morris County Transportation Model can serve the region as a transportation and land use model for other counties. Its fine-grained transportation and land use examination will highlight the interconnected relationship between land use and transportation and identify potential transportation deficiencies as well as opportunities. The transportation model will also give local planning boards a quantitative assessment of transportation impacts from current zoning practices. Lastly, it will serve policy makers by providing justification for future investment.

The NJRTM-E provides a macro level of analysis, while the MCTM provides a micro level of detail for county and municipal review. The greater level of review will be used to gauge the relative importance of a capital project and can also aid in the prioritization of projects based on need. The MCTM provides an additional tool to permit comparisons at a finer level of detail.

The MCTM is truly regional in the sense that the borders of the model are expanded beyond the borders of Morris County. In order to accurately project movement of

roadway traffic and transit, the border was expanded in the areas of many highway and transit corridor to ensure the correct capture zone.

ADDITIONAL INFORMATION

The following items are available in hard copy format at the hosted location of the Morris County Transportation Model in the offices of the Morris County Department of Planning & Technology, Division of Transportation at 30 Schuyler Place, Morristown, NJ 07963. These documents have also been supplied in electronic format on a DVD accompanying this report:

1) Quarterly Reports
2) Model Development Manual
3) MCTM Training Manual
4) Technical Memorandum 1 – SE and Highway Network
5) Zone-Block Equivalency
6) Junction Coding
7) County Level SE Comparison
8) App 2 - 2005 POPULATION AND HOUSEHOLD COMPARISONS
9) App 3- 2005 EMPLOYMENT COMPARISONS
10) App 4 - 2005 SOCIOECONOMIC DATA