APPENDIX #3
The Hyannis Access Study
Travel Demand Model

Hyannis Access Study Travel Demand Model

A-1 Background

FHWA and FTA regulations require that analytical methods be used as part of the transportation planning process to evaluate transportation projects. Over the course of time, computer simulation programs have been developed to meet this need.

A travel demand model portrays a transportation network in a given geography. Many pieces of information are included in the model. The transportation network and its attributes such as travel time and capacity are key inputs. Data on employment, population, and households as well as the average number of vehicles per household are inputs that determine the trips on the defined network. Through computer programs, models are used to portray both existing conditions and future conditions, and are especially useful for comparing various transportation alternatives to each other, to a future condition without any alternatives (the so-called “no-build” condition), and the current conditions.

In Massachusetts, there is a statewide travel demand model which includes all the major transportation networks across the state. The intent of the statewide model is to predict inter-community travel patterns using major state routes. To meet a more local need of planning for arterial and collector roads as well as intra-community travel, some metropolitan planning organizations, including the Cape Cod MPO, have developed their own regional model which provides more detailed information.

A-2 Travel demand model set up and calibration

Before a model can be used to forecast future travel demands and patterns, the model must adequately represent the current conditions. With the previously mentioned information regarding the network itself and key demographic factors such as employment and population, the model generates traffic patterns, volumes and speeds. These model results are compared to actual field counts and other observations to determine how well the model reflects “real” (measured) conditions. The model is adjusted so that these comparisons match within in a certain degree of error. The Federal Highway Administration has developed guidelines which form the basis for the validation of travel forecasting models. Statewide, regional, and project specific models are all designed to meet these guidelines before the models are used for planning activities. This process of developing the model to meet these guidelines is called calibration; and the resulting model is often referred to as the “base case”. The base case is not necessarily the present year, but rather the year for which there is sufficient actual traffic counts and other field observations available. The base case is not only useful for highlighting or providing insight on problem areas, but also for comparison purposes as explained in more detail later.

Once the model is properly calibrated, it can be used to forecast future travel demand and patterns. The future transportation network – with committed projects (a committed project is a project already on the transportation improvement program with funds allocated, as well as some level of design and environmental assessment) – is configured in the model, and future population and employment data is inputted. Background traffic growth outside the model area is also considered, and is represented by flows into and out of the area. Together, these factors prepare the model for the forecasting task, which is described below.

A-3 Four-step travel demand forecasting

The four-step travel demand forecasting process includes the following steps:

1. Trip generation: The model estimates the travel demand in terms of the number of person-trips for each of the traffic analysis zones (TAZ). TAZes are geographic boundaries that break the modeling area into smaller pieces and are based upon socio-economic data such as population, households, number of autos per household, income, employment, etc. See discussion below on TAZes.
2. Trip distribution: The model converts the generated trips at each zone into a matrix of origins and destinations.
3. Mode split: This step accounts for the use of different modes (autos, non-motorized, transit, etc.) and converts person-trips into vehicle-trips.
4. Traffic assignment: The model assigns the various origin-destination trips onto the network (accounting for any roadway improvement projects). The assignment process is dynamic in terms of iteratively considering how roadway segment congestion impacts travel route selection. The forecasted traffic volumes can then be used to forecast the level of congestion. This becomes the basis for assessing the performance of the transportation system.

Through an iterative process, the model reaches an equilibrium where the travelers have optimized their trips based on their needs and the constraints in the system. This is an important point: the model analyzes a static situation – when traffic has stabilized into a set pattern. This is often why other tools are used in conjunction with a travel demand model, so that the development of queues can be examined. These types of tools are discussed in detail in the document “Traffic Analysis Tools.”

Once the demand forecasting is complete, the model then reflects the “no-build” case. The “no-build” case includes improvements which have already been planned for, and are likely to exist in the future model year, but not the various alternatives which are developed through the planning process. These alternatives are then coded into the model, tested, and compared to the “no-build” and the base case. In this way, it can be determined whether a particular alternative will offer improvements over current conditions and/or the future “no-build”. It is particularly useful to compare alternatives to each other and to the “no-build”, with respect to the goals and objectives of the study.

A-4 Discussion of Traffic Analysis Zones

The purpose of the TAZes are to have disaggregated traffic loading points. In an ideal world, activities would be simulated at each individual household and business. Traffic would actually be loaded at existing driveways. However, due principally to resource limitations, parcel level data is usually not collected. Instead, community data is usually disaggregated into traffic zones.

The development of traffic zones follows some general guidelines as follows:

1) Where possible, TAZ boundaries are set to coincide with visible physical features such as rivers, roads, power lines, and wetlands.

2) Zone boundaries should not cross political boundaries, although they sometimes do.

3) Zones should have clear loading points such as neighborhoods or subdivisions having one or more clearly defined access/egress points.

4) Zones should ideally have common land use characteristics.

5) The number and size of the zones is based on the intended use of the model.

The zones were originally created as part of the statewide model to support various transportation activities across the state.

A-5 Application of forecasting process to the Hyannis Access Study

The study area for the Hyannis Access Study is roughly bounded by Route 6A, exits 6 and 7 on Route 6, and Barnstable's growth incentive zone (including Main Street, the ferry area, and the Cape Cod Hospital), and the west end rotary.

The travel demand model for this study is a customization of the more general Cape Cod Commission's regional model, which is in turn a customization of the statewide model. The Cape Cod regional model will still be utilized as part of this process and referenced to examine system-wide impacts from changes to the transportation network. However, closer examination of the impacts in the immediate Hyannis area will be analyzed with the specific model developed for this purpose.

The base case for this study model is considered to be the year 2006, although employment and population projections for 2007 are included, since 2006 numbers were not available.

The future year to be analyzed is 2030 for this study. As is typical in transportation planning studies, this timeframe reflects the goal of developing projects that have a "useful" life of at least 20 years. In addition, projections beyond a 25 year time frame are too uncertain to make modeling useful.

The following traffic improvement projects are included in the future year "no-build" model:

1 – Willow Street reconstruction, widening and Exit 7 signal and safety improvements
2 – Bearses Way reconstruction
3 – Route 132 reconstruction and widening
4 – Route 28 widening between Yarmouth Road and the Airport Rotary
5 – Attucks Lane extension

More detailed descriptions of these projects can be found under the "Meeting Summaries and Notices" section of the web site www.hyannis-access.com in the June 20, 2006 meeting summary.

The original zones in the model were created as part of the statewide model. If the sole focus of the Hyannis Access Study was Route 6, the statewide zones may have sufficed. However, based on the goals and objectives of the study, and the various intersections to be evaluated, the zones were split into smaller pieces with this analysis in mind. Subdividing larger statewide model zones is common practice for developing a sub-regional model. For the Hyannis study, this subdividing occurred within the study area as well as within the GIZ. Through this subdividing process, a specific group of zones can be selected to exclusively represent the study area, and/or the GIZ.

The zone subdividing process (zone-splitting) was done within TransCAD, a geographic information software. The GIZ boundaries used for the splitting were taken from the Barnstable growth incentive zone application produced by Vollmer Associates, LLP in early January 2006. The zone splitting was performed by examining the GIZ boundaries as an overlay to MassHighway's road inventory line layer and MassHighway's aerial photography. There are a total of 28 zones in the study area, 8 of which are in the GIZ.

A-6 Other considerations

Results of a model are not intended to provide an exact picture of future conditions. Forecasted volumes on specific roadways should not be considered exact, but rather should be compared

in an order of magnitude approach to help determine if estimated traffic growth would necessitate improvements.

Models provide one possible picture of the future, given the assumptions made at the time of its development. There are many assumptions made in the development of any model. For example, trends on vehicular ownership and usage as well as traveler's inclination towards transit are all built into the model, often based on past trends and expected future trends. However, there are many unknowns about the future and travelers' behaviors may change unexpectedly or in unpredictable ways. Therefore, it is better to use the model to compare alternatives to each other and to existing conditions, with an understanding of the assumptions made.

For example, in the case of the Hyannis Access Study, it may be determined that one alternative may benefit traffic flow better than another alternative, given the assumptions about traffic trends and employment growth. At the time that this model was developed, these assumptions were reasonable. World events, natural disasters, major climate change or major economic and demographic shifts may affect the local area and change the outlook completely.

Models can help decision makers understand how growth in population and employment, development patterns, and investments in transportation infrastructure are likely to affect travel and congestion.

Sources:
Ed Bromage, Travel Demand Modeler
http://www.caliper.com/tcovu.htm
http://www.planning.dot.gov/documents/BriefingBook/BBook.htm#10BB
http://tmip.fhwa.dot.gov/about/
http://ops.fhwa.dot.gov/wz/resources/final_rule/wzi_guide/appb.htm
http://web.smtcmpo.org/extranet/smtc/publications/DIRECTIONS-Fall2003.pdf

More information on the Travel Demand Model

For the Hyannis Access Study transportation planning model, EOT started with the Community and County growth projections previously estimated in a cooperative planning effort between EOT and the Cape Cod Commission. This previous effort was conducted to support the Federal mobile emission air quality planning programs.

This previous effort is known as a top down methodology. This forecasting process begins at the State level where population and employment growth is forecast based on national and historical trends, market conditions, and relationships between the number of households with workers and the number of jobs. This top down method is then applied at a County level with the sum of the State's County projections bounded by State Control totals.

Within each County, historical trends, market conditions, and local planning inputs are used to allocate County growth to the member Communities. Within each community, population and employment growth is then allocated to areas within the community based on available local input.

For the Hyannis Access Study, the growth allocations within the Towns of Barnstable and Yarmouth were re-examined in order to fine-tune the previous efforts. The re-examination was based on a detailed review of aerial photography; a windshield survey to identify vacant buildings; an assessment of market conditions; interviews with Town officials; and in-depth interviews with key property owners. As a result of this effort, the forecasts were prepared based on the best available data at that time. These forecasts show that the population growth for the Towns of Barnstable and Yarmouth (from 2007 to 2030) will be

approximately 12,900 and 2,600 respectively. The Towns of Barnstable and Yarmouth have a projected employment growth of 6,100 and 2,000 for this same period. Within the Town of Barnstable, the employment in the Independence Park Industrial area will double. The majority of the remaining employment growth in the Town of Barnstable is projected to occur in the Growth Incentive Zone.

A recent review of the Town of Barnstables latest assessment of the Industrial Park has shown that the Towns latest vision for this area is in keeping with the previously developed 6 1/2 estimates.

Basic information on travel demand models and background information on the model for this study is discussed in the Spring 2007 paper “The Travel Demand Model”. This paper is also available on the study web site at:

https://www.commentmgr.com/projects/1166/docs/TravelDemandModel.pdf