

# CMMPO Travel Demand Model Overview



2024

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## General Overview

The Central Massachusetts Municipal Planning Organization (CMMPO) maintains a TransCAD based regional travel demand forecasting model to forecast average weekday travel. The model is based on 2010 Census geography with Transportation Analysis Zones (TAZs) based on Census Block Groups or Block Group sub-divisions. The base year is 2020, and the forecast years are: 2030, 2040, and 2050. The 2020 household and population data are scaled to match 2020 Census data. TAZ employment data is based on the Massachusetts Statewide Model which is based on 2011 Info USA data. Two sets of 2030, 2040, and 2050 land use projections are used in the model. The first set was developed (completed in 2023) by MassDOT and their consultants the UMass Donahue Institute and the Boston Metropolitan Area Planning Council (MAPC). The second set was developed by the CMMPO and reflects changes to assumptions made by the UMass Donahue Institute and MAPC.

The model simulates travel on all Federal Aid roads within the CMMPO region as well as travel in abutting communities.

The model estimates auto travel, truck travel, and transit passenger trips. On the auto and transit side, the model estimates travel for 5 trip purposes: Home Based Work (HBW), Home Based Personal Business (HBPB), Home Based Social Recreational (HBSR), Non Home Based Work (NHBW), and Non Home Based Non Work (NHBNW). Truck trips in the model are light truck (single unit, 6 tires or less), medium truck (single unit with more than 6 tires), and heavy truck (articulated vehicles).

Trip generation, trip distribution, and mode choice parameters are based on the 2011 Massachusetts Statewide Travel Survey funded by MassDOT.

Daily time periods simulated in the model are as follows:

- AM peak period (6AM-9AM)
- Midday (9AM-3PM)
- PM peak period (3PM-6PM)
- Night (6PM-6AM)
- Daily = the sum of these 4 time periods

Model output includes directional time period volumes for autos and the 3 truck types on all Federal-Aid roads in the CMMPO region. Community summaries of vehicle miles of travel (VMT), vehicle hours of travel (VHT), and volume to capacity ratios are standard outputs. Transit boardings and alighting by route and route-stop are also prepared for each time period.

## Travel Demand Model: History

During the period from 1977-1979, the CMMPO, at the direction of the Massachusetts Department of Public Works (MassDPW, now MassDOT), started to develop a regional travel demand forecasting model. The model was intended to run using the Federal Highway Administration's UTPS (Urban Transportation Planning Software) library on the IBM 360 mainframe computer at the Massachusetts Registry of Motor Vehicles. Due to poor accessibility to the IBM 360 and lack of staff training, the model was never completed.

In 1981, the CMMPO became one of the first regional agencies in the State to develop a community level model running on a 16K RAM microcomputer. By 1989 (reflecting greater computer capabilities), this model was expanded to cover all CMMPO communities. The model simply estimated daily auto travel on Federal Aid roads.

In 1994, MassDPW retained a consultant to develop a TransCAD based travel demand forecasting model for each of the State's regional planning agencies outside of Boston. The CMMPO model was completed by 1997. The model did not have a transit component and its' developed was based on the 1978 publication "Quick-Response Urban Travel Estimate Techniques and Transferable Parameters".

During the period from 1997-2009, the model continued to evolve into a more sophisticated model by including multiple daily time periods, an extended geographic model range (more abutting communities were added into the model), and the inclusion of a mode choice model with fixed route transit service for the Worcester Regional Transit Authority (WRTA).

Throughout the period 2010-to date, the CMMPO model continued to be updated with 2010 Census geography and data, as well as use of the 2011 Statewide Household Travel Survey conducted by MassDOT. Additionally, Transportation Analysis Zone (TAZ) employment data from the Massachusetts Statewide Model was used to update the CMMPO model. The Statewide Model employment data came from 2011 Info USA data purchased by MassDOT and MAPC (Boston, Metropolitan Area Planning Council). During this period model updates continued with, TransCAD software updates to reflect changes to the model structure; refinements to the transit system based on WRTA route changes; the addition of a truck model (based on the "Quick Response Freight Manual"); and network updates based on the Massachusetts Road Inventory Files (RIF, maintained by MassDOT).

Beginning in 2023, a major update was started to bring the model's TAZs from 2010 to 2020 Census geography. Currently, all population and household data are being updated to match 2020 Census data, and employment data from LODS (LEHD Origin-Destination Employment Statistics) will replace the 2011 Info USA data. Enhancements to the model to improve transportation equity analysis, and model output reporting are also underway.

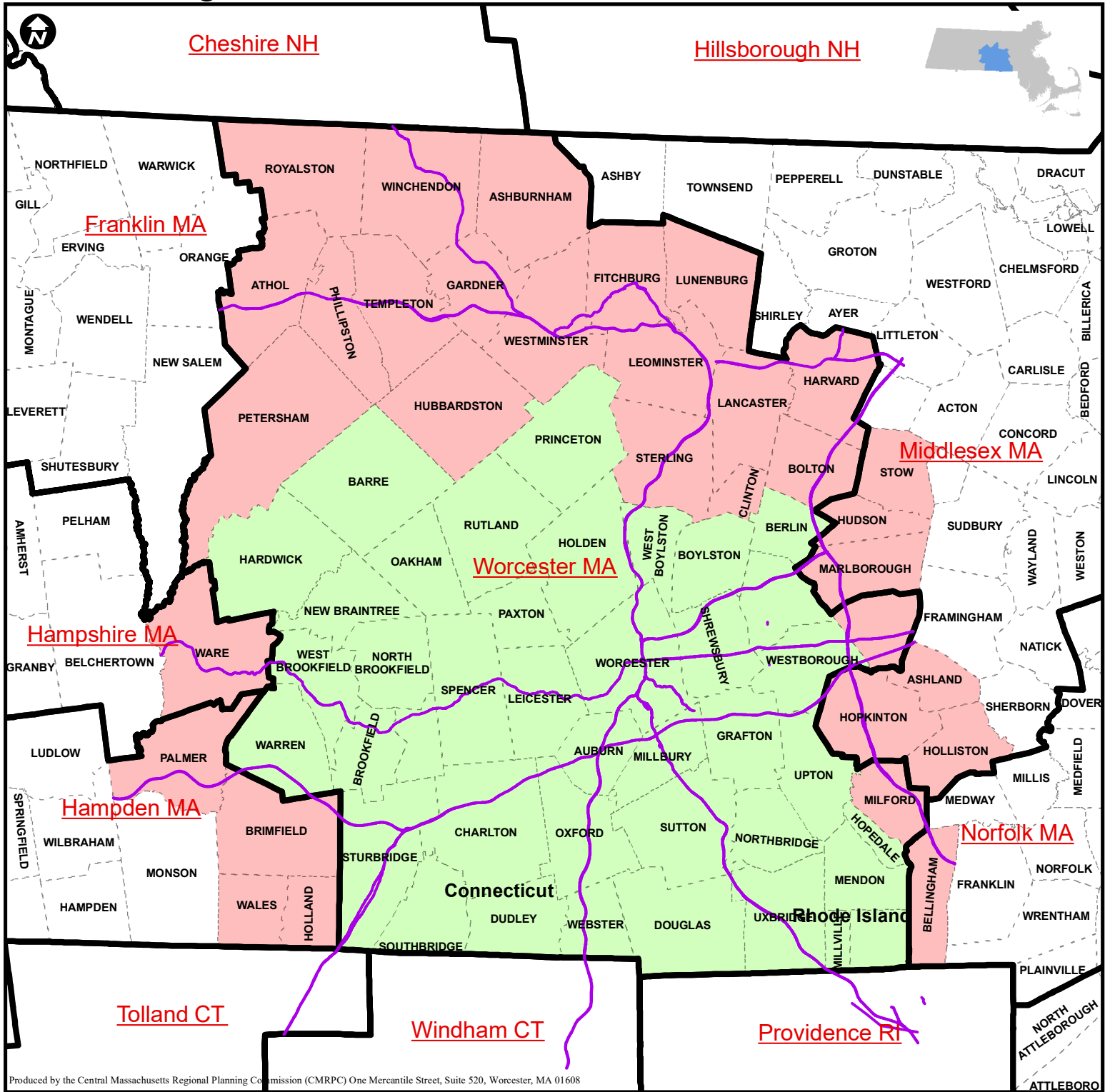
## Travel Demand Model: Geography

CMMPO maintains a TransCAD based regional travel demand forecasting model to forecast average weekday travel. The model is based on 2010 Census geography with Transportation Analysis Zones (TAZs) based on Census Block Groups or Block Group sub-divisions. The base year is 2020, and the forecast years are: 2030, 2040, and 2050. The 2020 household and population data are scaled to match 2020 Census data. TAZ employment data is based on the 2011 Massachusetts Statewide household travel survey conducted by MassDOT and the Boston MPO (Central Transportation Planning Staff).






The model covers all of Worcester County, as well as key abutting communities external to the County. The model covers 72 communities, of which, 40 are within the CMMPO. Four communities are in Hampden County to the southwest of Worcester County. One is in Hampshire County (west), six are in Middlesex County (east), and one from Norfolk County (southeast). The remaining 21 communities are in northern Worcester County. Some abutting geography in Connecticut and Rhode Island are also included to enhance the model's ability to simulate travel in southern Worcester County communities.

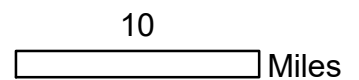
The 2020 population simulated in the model is 978,200, of which 561,000 is in the CMMPO (57%). The 2020 model employment is 393,300, of which 220,100 is in the CMMPO (56%). The Figure, "Central Massachusetts Metropolitan Planning Organization Regional Travel Demand Model Communities" on the following page displays the geography included in the model, with the CMMPO communities highlighted.

# Central Massachusetts Metropolitan Planning Organization Regional Travel Demand Model Communities



Information depicted on this map is for planning purposes only. Source: Data provided by the CMRPC, MassDOT, MassGIS and Commonwealth of Massachusetts, Information Technology Division.

-  County Boundaries
-  Massachusetts Towns
-  Modeled Communities
-  CMMPO Communities
-  Major Road Links



## Travel Demand Model: Data Inputs

The CMMPO model is continually being updated to reflect the availability of new data, new analysis techniques, and new MPO certification requirements. The current model is based on 2010 Census data and geography. Transportation Analysis Zones (TAZs) were created from 2010 Census block groups or block group sub-divisions. There are 983 TAZs in the current model, of which 891 are internal. The CMMPO has 600 of these internal zones. Population and household characteristics for the model base year of 2020 come directly from 2010 Census data but have been scaled to match 2020 Census community totals. The 2020 Census aggregate numbers were available prior to the release of 2020 Census detailed data. Only recently the 2020 Census detailed data has become available. TAZ employment data came from the Massachusetts Statewide Model which is also based on 2010 Census geography. The employment data in the Statewide Model is 2011 Info USA data purchased by MassDOT and the Boston MPO. The Info USA data was geocoded to TAZs using ESRI data products.

Forecast population and employment data came from MassDOT who retained the UMass Donahue Institute and the Metropolitan Area (Boston) Planning Council (MAPC). The forecasts were developed for 2030, 2040, and 2050. These forecasts were prepared by examining birth and death rates, migration trends (State and National), and the ability of the State to retain college students. These forecasts were prepared using a top-down projection method whereby State forecasts were first made and then distributed to regional planning agencies. The regional agencies allocated the regional growth to communities and then TAZs. Allocations to communities and TAZs were done by the CMMPO and considered building permit activity and zoning. Two sets of projections have been prepared for the CMMPO area. The first set of projections came from MassDOT and were the results of the UMass and MAPC efforts. These projections assumed a shift in historical trends, by way of projecting that the Boston region would usurp a higher share of the States growth than historic trends had shown. The CMMPO staff developed a second set of growth projections which assumed a continued relationship between CMMPO growth and State growth rates. Consequently, the CMMPO growth rates are higher.

The highway network was created from the MassDOT Road Inventory Files (RIF 2016). Only roads on the Federal-Aid System are included in the model. The RIF database at MassDOT is constantly updated. The CMMPO network is also constantly updated as construction projects are completed. The simulation includes 4,208 centerline miles of roadway, of which 2,117 miles are in the CMMPO region.

The Worcester Regional Transit Authority (WRTA) fixed route service is simulated in the model. There are 31 fixed routes in the modeling system.

## Travel Demand Model: Software

Since 1997, the CMMPO model has been prepared within the TransCAD software system. All input and output files are stored in native TransCAD format. All model's steps including output reports are developed using TransCAD GISDK script. Up until 2023, the CMMPO model user interface used the TransCAD dialog box interface. In 2023, the model was converted to run in TransCAD's flowchart interface. Caliper Corporation (TransCAD Vendor) had informed the CMMPO, that the dialog box interface would be phased out and all users should be converting to the flowchart interface. Conversion to this new interface did require an extensive amount of GISDK re-programming and this has all been completed.

The current model is running in TransCAD's Version 9, Build 32930, 64-bit, dated September 26, 2023.

## Travel Demand Model: Forecast Scenarios

A model scenario is constructed by altering land use, or the transportation system. The CMMPO model contains both land use changes and forecasts, as well as network changes. The first scenario is the existing conditions base year 2020 (existing 2020 US Census numbers combined with existing State employment numbers, and the current network). The model forecast years are 2030, 2040, and 2050. Within each of the forecast years, there are two default land use scenarios, MassDOT, and CMMPO. The MassDOT supplied land use forecast was prepared by MassDOT consultants: the UMass Donahue Institute, and the Metropolitan (Boston) Area Planning Council (MAPC). These MassDOT projections assume that in the forecast years, Boston's share of the State's population and employment growth will increase over past trends. Thus, these forecasts have a higher growth share in Boston, and a lower growth share throughout the remainder of the State. The CMMPO forecasts assume that growth share in CMMPO communities will be consistent with past trends. Thus, the CMMPO growth rates are higher in CMMPO communities than the MassDOT projections.

There are also two sets of transportation infrastructure scenarios in the model, "no-build", and "build". The "no-build" network scenario reflects the inclusion in the model of only projects which are funded and, in the design-construction pipeline. These projects can be funded by Federal, State, Community, or (in rare cases) private sources. "No-build" projects, are committed projects, with that commitment reflected in the designated funding. Since these are on-going "funded" projects, they have a variety of completion dates. Consequently, in each forecast year, the "no-build" project list is different and thus the networks are different. The "build" project list reflects projects that are in various stages of planning and are not committed. These may also have different completion years. With a combination of 3 forecast years, each with 2 land use scenarios, and each with 2



possible networks, there are 12 forecast scenarios in addition to the base year for a total of 13 scenarios programmed into the model. These scenarios are listed below.

**Base year 2020**

2030 No Build, MassDOT Land Use	2030 Build, MassDOT Land Use
2040 No Build, MassDOT Land Use	2040 Build, MassDOT Land Use
2050 No Build, MassDOT Land Use	2050 Build, MassDOT Land Use
2030 No Build, CMMPO Land Use	2030 Build, CMMPO Land Use
2040 No Build, CMMPO Land Use	2040 Build, CMMPO Land Use
2050 No Build, CMMPO Land Use	2050 Build, CMMPO Land Use

**Travel Demand Model: Active Model Enhancements**

The current model uses 2010 Census geography. Transportation Analysis Zone (TAZ) employment is based on 2011 Statewide Info USA data purchased by MassDOT and the Metropolitan Area Planning Council (MAPC). Population and household data is from aggregate 2020 Census data (mostly Tract and Block Groups). The 2010 and 2020 Census geography is different enough that it is difficult aligning current TAZs to Census geography. Additionally, there is newly released Census data which is aligned to 2020 geography.

The CMMPO staff is currently rebuilding the TAZ structure based on 2020 Census geography. The new TAZs will be based on Census Block Groups or Block Group subdivisions. As a guide, CMMPO staff has set the target population of a TAZ at 500-600. With this as a target, there will be approximately 1,050 TAZs within CMMPO, and another 790 in the remaining internal model area.

When the new TAZ structure is completed, it will be integrated into the modeling suite of databases and new TAZ centroid connectors will be defined. Following this work, TAZ population and household data from the 2020 Census will be developed based on Block and Block group data. Only Tract data will be used for those data items which do not exist at the smaller geographies.

TAZ employment data will then be created based on the Census LODES (LEHD Origin-Destination Employment Statistics (LODES) data product) data. LODES data is a combination of both census data and cell phone data and has 3 basic data files as follows:

- **OD** – Origin-Destination data, job totals are associated with both a home Census Block and a work Census Block
- **RAC** – Residence Area Characteristic data, jobs are totaled by home Census Block

- **WAC** – Workplace Area Characteristic data, jobs are totaled by work Census Block

Both the WAC and OD information will be used in the model update. The WAC data will be used to update the TAZ employment data, and the OD data will be used to calibrate and validate the trip distribution process.