Baltimore Metropolitan Council

PRIMER FOR DEVELOPING BMC TRAVEL DEMAND MODEL SOCIO-ECONOMIC INPUTS

TASK REPORT # 08-2

December 2007

Baltimore Metropolitan Council ■ 2700 Lighthouse Point East, Suite 310 ■ Baltimore, Maryland 21224

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This paper is the work of the Baltimore Metropolitan Council Transportation Planning Division staff and is intended for informational use at staff level and documentation of staff work. Opinions and conclusions expressed are those of the authors and do not represent official policies of the Baltimore Metropolitan Planning Organization. Funding for this report has been provided by the U.S. Department of Transportation, the State of Maryland, and the Baltimore Metropolitan Council.

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Introduction

The Baltimore Metropolitan Council (BMC) serves as the Metropolitan Planning Organization (MPO) for the Baltimore region (Anne Arundel County, Baltimore County, Carroll County, Harford County, Howard County and Baltimore City). In its federally designated role as the MPO for the Baltimore region, the BMC conducts transportation planning and analysis for the Baltimore Regional Transportation Board (BRTB). Much of the work of the MPO is accomplished through the use of a travel demand forecasting model that simulates traffic volumes on the region's traffic network which can be analyzed and used to form the basis for transportation system infrastructure investments throughout the metropolitan area. Results generated by the BMC travel demand model are only as accurate and credible as the inputs that are fed into the model.

The BMC travel demand model uses exogenous (outside the model) socio-economic inputs that indicate human activity in a traffic zone system to generate projected traffic volumes and vehicle miles of travel. The current travel demand model generates other variables internally that are used in the four step process. The four step travel demand forecasting process consists of (1) trip generation, (2) trip distribution, (3) mode choice, and (4) trip assignment. The operation of the BMC travel demand model and how it uses the socio-economic data are detailed extensively in two documents: Baltimore Region Travel Demand Model Version 3.3: 2000 Validation (January 2007) and Travel Forecasting Model Calibration Report (August 2006). Both documents are available on the BMC website under the Travel Demand Forecasting link located at the following URL: http://www.baltometro.org/reports/ValidationV3point3.pdf

This document will outline the data sources and techniques used to generate the necessary socio-economic inputs that are used by the travel demand model. The types of information needed by the travel demand model have changed during the past three decades (1970's until the present). The travel demand model migrated from its original computer mainframe environment to the microcomputer. The travel demand model algorithms have been refined and in some cases new features have been added. When these changes occurred the number and type of input variables could increase and some data items were dropped. This primer will detail the development of socio-economic data that is used in the most current version (3.3) of the BMC travel demand model. This document will detail the input variables that are most susceptible to updating on an annual basis. Other travel demand model inputs such as the Land Use Classification by Area Type and Total Acreage have already been determined and usually remain as a constant in the forecast set throughout the decade.

DEVELOPING TRAVEL DEMAND MODEL INPUTS

The development of socio-economic input data is grounded on forecasts produced by the Cooperative Forecasting Group (CFG) which was created in 1978. Since 1978, local governments have provided a variety of socio-economic inputs to the travel demand process. Those data provided during the past 29 years range from providing no forecast data at all to submitting all of the travel demand model variables by small area. The BMC and its predecessor agencies have always accepted what was locally submitted and/or developed any missing data that was needed.

A companion document accompanying this primer (Appendix A) is a flow chart created in 2002 for the Cooperative Forecasting Group that depicts every input variable and its origin and its relationship to other variables throughout the data development process during the 25-year period. Each round of data development is more or less complex depending on the addition or removal of variables, the increase in the number and structure of transportation analysis zones, and the availability of base data by small area for each variable.

The methodological documentation for the development of small area model inputs has been created periodically and can be found in the following documents (available in the BMC Regional Information Center [RIC]):

1. Technical Memorandum Number 5: 1970 Socio-Economic Data Summarized by Transportation Zones, October 1973, Regional Planning Council.

2. Procedures for Generating 1975 Socio-Economic Data by Transportation Zone, February 1978, Regional Planning Council.

3. Technical Memorandum #50, Round II Cooperative Forecasts Methodologies, July 1984, Regional Planning Council.

4. Staff Paper # 60, Socio-Economic Forecast Methodologies, July 1989, Regional Planning Council.

5. Technical Committee Memorandum; Travel Demand Model Data Development, January 2006.

Cooperative Forecasting Process

The Cooperative Forecasting Group with its cooperative forecasting process is the chief architect of socio-economic data sets. The membership of the Cooperative Forecasting Group includes representatives from each local government that is a member of the Baltimore Regional Transportation Board (City of Annapolis, Anne Arundel County, Baltimore City, Baltimore County, Carroll County, Harford County, and Howard County). The Maryland Department of Planning, the Maryland Department of Transportation, the

Maryland State Highway Administration, the Metropolitan Washington Council of Governments, and the Baltimore Metropolitan Council staff may also participate in the deliberations of the CFG. The mission of the CFG is to develop a set of population, household, and employment controls and small area forecasts that will be used for transportation planning purposes and may be used internally by other federal, state, and local government agencies. BMC staff members provide staff support to the CFG.

Socio-economic forecasts and their major updates are classified as "Rounds". A new "Round" of socio-economic forecasts will be labeled with a number and no suffix (e.g. Round 1 or Round 7). "Rounds" of socio-economic data are usually created for the following reasons:

1. Availability of new U.S. census information at a small area level
2. Two or more local governments in the Baltimore region complete and release Master Plans and plan updates and/or complete major comprehensive rezoning
3. Completion of a regional Master Establishment File [MEF] update (an inventory of businesses and organizations operating in the Baltimore region)

The Baltimore Regional Transportation Board adopted a resolution in 2000 that allowed for annual updates to the Cooperative Forecasts to account for new or unexpected changes in households and/or employment when a new complete "round" of socio-economic forecasts is not warranted. These forecast set updates are usually labeled with a suffix such as "A" (e.g. Round 6-A or Round 6-C). Intermediate forecasts may also extend the planning horizon beyond that of the existing forecasted "round".

Generally, local planning agencies that comprise the CFG will develop their own estimates and projections of population and households based on local comprehensive plans, adopted zoning maps and regulations, and an inventory of available residential holding capacity. These forecasts by small area are submitted to the BMC staff for incorporation into the full round of socio-economic inputs to the travel demand model. Local governments may develop small area projections of employment on their own or they may develop these forecasts with the assistance of BMC staff. Most updates to small area employment are based on the creation of a base year Master Establishment File that can be used to create small area employment distributions by economic sector. The creation and use of a Master Establishment File will be detailed later in this document.

Once, the small area population, household, and employment forecasts have been developed, submitted to the BMC and reviewed for quality control and consistency; these forecasts are forwarded to the Technical Committee for endorsement and ultimately to the BRTB for adoption as official regional forecasts. The CFG has adopted as a bylaw that all small area socio-economic forecasts developed and submitted by local planning agencies should be accompanied by a narrative documenting the methodologies used and the assumptions governing the projections.

Current Travel Demand Model Input Variables, Origins and Statistical Geography

This section will detail variables developed, their origin and the level of statistical geography at which they are produced. Descriptions of the socio-economic variables that follow are relevant to the current operation of the BMC Travel demand Model (Version 3.3). Bear in mind that many other variables were developed for earlier versions of the BMC Travel Demand Model as shown in the forecasting flowchart mentioned earlier in this document, however; the following variables are used in the currently validated BMC model. The base year for the currently validated BMC Travel Demand Model is 2000. This means that many of the equations governing the operation of the model were developed based on 2000 census information by small area. Data used to develop these equations incorporates decennial census (2000) one hundred percent data items and 2000 census sample data by small area. All projections are mid-year estimates that were derived from a variety of sources.

The remainder of this section will identify and define the travel demand model input variable and statistical geography, identify its base year origin, explain the current projection technique, and identify alternate forecasting techniques, if necessary.

TAZ – Transportation Analysis Zones (Geography)

Origin: U.S. Bureau of the Census statistical geography for census block groups and census blocks. TAZ boundaries cannot breach a jurisdiction boundary. TAZ boundaries generally do not breach Regional Planning District or census tract boundaries except in Howard County. There are currently 1,151 regional transportation analysis zones.

RPD – Regional Planning District (Geography)

Origin: BMC/RPC and local planning offices. RPDs are aggregations of census tracts that were defined in 1960 by RPC and local planning directors and have been updated each decennial census year. A RPD cannot breach a jurisdiction boundary. There are currently 94 Regional Planning Districts.

Total Population (persons in households and group quarters)

Origin:

- Years ending in zero through 2000: U.S. Bureau of the Census April 1 decennial 100% count by level of geography. If not otherwise noted, all 2000 census data is for April 1 of the decennial census year. Note: (Howard County uses the July 1 population count for a decennial census year)

- Current Forecasts: Submitted by local government; if not submitted by local government then BMC develops projections from the local comprehensive plan

update or Master Plan; or previous forecasts are carried forward as approved by local government.

Institutional Group Quarters (persons not in households living under formally supervised care or custody in institutions such as correctional institutions, nursing homes, and juvenile institutions)

Origin:

- Years ending in zero through 2000: U.S. Bureau of the Census decennial data – 100% item by geography, BMC allocates block data to TAZs.

- Current Forecasts: BMC uses total group quarters by jurisdiction projections from the Maryland Department of Planning's statewide cohort survival model and apportions the institutional/non-institutional split based on the census base year estimate. Initial allocations by TAZ are revised based on project level adjustments made by local jurisdictions. This methodology is employed for all jurisdictions except Howard County who altered the 2000 census group quarters data and projects their own group quarters data by TAZ.

Non-Institutional Group Quarters (persons in group quarters other than institutions such as college dormitories, military quarters and group homes)

Origin:

- Years ending in zero through 2000: U.S. Bureau of the Census decennial data – 100% item by geography, BMC allocates block data to TAZs.

- Current Forecasts: BMC uses total group quarters by jurisdiction projections from the Maryland Department of Planning's statewide cohort survival model and apportions the institutional/non-institutional split based on the census base year estimate. Initial allocations by TAZ are revised based on project level adjustments made by local jurisdictions. This methodology is employed for all jurisdictions except Howard County who altered 2000 census group quarters data and projects their own group quarters data by TAZ.

Households (occupied dwelling units)

Origin:

- Years ending in zero through 2000: U.S. Bureau of the Census April 1 decennial 100% count by level of geography except in Howard County which uses a July 1 figure.

- Current Forecasts: Submitted by local government; if not submitted by local government then BMC develops projections from the local comprehensive plan

update or Master Plan; or previous forecasts are carried forward as approved by local government.

Median Household Income (income in 1999 dollars)

Origin:

- Years ending in zero through 2000: U.S. Bureau of the Census Transportation Planning Package (2000, 1990, and 1980).

- Current Forecasts: Apply jurisdiction level five-year growth rate for per-capita income developed by the Maryland Department of Planning, based on U.S. Bureau of Economic Analysis historical data, to initial small area census estimates.

Total Labor Force (civilian and military persons employed and unemployed from age 16+)

Origin:

- Years ending in zero through 2000: U.S. Bureau of the Census Transportation Planning Package (2000, 1990, and 1980).

- Current Forecasts: BMC uses jurisdictional forecasts developed by the Maryland Department of Planning's cohort survival model and updated U.S. Bureau of Labor Statistics labor force participation rate forecasts by region and state. Initial decennial census base year labor force to population ratio is applied to new population forecast and small area projections are scaled to the jurisdiction forecast. This procedure is used for all jurisdictions except Harford County who provides their own small area projections of labor force.

Workers (employed civilian and military persons from age 16+)

Origin:

- Years ending in zero through 2000: U.S. Bureau of the Census Transportation Planning Package (2000, 1990, and 1980).

- Current Forecasts: BMC compiles the most recent unemployment rates by jurisdiction from the Maryland Department of Labor, Licensing and Regulation (DLLR). Intermediate forecast years are adjusted by applying the DLLR jurisdiction unemployment rate for the forecast year to the total labor force forecast to derive a jurisdiction worker control total. For forecast years beyond the DLLR unemployment rate set, apply the latest year DLLR unemployment rate as a constant to all "out years" total labor force projections to derive total workers.

Civilian Household Workers (employed civilian persons living in households and includes a share of college students living in dormitories and regular households) *(Note: This is a new variable developed in 2008 to better fit the updated travel demand model.)*

Origin:

- First developed for year 2000: Begin with year 2000 U.S. Census Bureau's Total Population, Total Population 16 years old or older, Derived Total Labor Force Participation Rate (Total Labor Force divided by Total Population 16+), Group Quarters Population by Type (Institutional and Non-Institutional by category), 2007 U.S. Census Bureau American Community Survey (ACS) Public Use Microdata Sample (5%). *(Note: The Labor Force Section of the U.S. Census Bureau's Population Division informed BMC that there were problems with the 2000 Census Group Quarter tallies for students and it affected the labor force tallies for the 2000 Summary File 3. We were directed to use the current ACS microdata files (2007) to develop our new household labor force estimates.)*

- Current Forecasts: BMC compiles the most recent unemployment rates by jurisdiction from the Maryland Department of Labor, Licensing and Regulation (DLLR). BMC used Maryland Department of Planning projections of Total Labor Force (via Cohort Survival Model), Labor Force Participation Rates and Population 16+ to develop new Population 16+ projections using existing MDP ratios applied to new Round 7-A Total Population forecasts. Applied MDP percent in Labor Force projections to new Round 7-A Population 16+ forecasts to derive new Round 7-A based Total Labor Force forecasts. Subtracted Group Quarters Population by category (all Institutional Group Quarters and Non-Institutional Group Quarters that include military, other non-institutional group quarters, and the share of college students who do not work) from new Total Labor Force forecasts to produce Civilian Household Labor Force forecasts. Apply most recent Maryland DLLR unemployment rate to Civilian Household Labor Force forecasts as a constant to produce Civilian Household Workers.

Employment – Retail and Non-Retail

Origin:

- Base Year: 2000 base year data developed using 2000 Master Establishment File with SIC classifications.

- Current Forecasts: 2005 and beyond data based on 2005 Master Establishment File with NAICS classifications. If no data is submitted by local government then BMC will develop data using the most recent Master Establishment File; information from the latest comprehensive plan update or Master Plan; carry forward data from latest approved forecast set; and/or use data sources that can be approved by the local government.

Employment by industry sector (Retail, Office, Industrial, Other by Standard Industrial Classification Group [SIC]/North American Industrial Classification System [NAICS])

Origin:

- Base Year: 2000 base year estimate developed by BMC by TAZ cross-tabulating the 2000 Master Establishment File employer/employee record data by eighteen SIC groups and four industry sectors to produce proportional distributions by TAZ. BMC applies the shares of industry sector by TAZ to each new employment forecast for retail and non-retail by five-year period.

- Current Forecasts: 2005 and beyond data developed by BMC by TAZ cross-tabulating the 2005 Master Establishment File employer/employee record data by fourteen NAICS groups and four industry sectors to produce proportional distributions by TAZ within each jurisdiction (See Appendix B). BMC applies the shares of industry sector by TAZ to each new employment forecast for retail and non-retail by five-year period. These shares by industry sector remain constant throughout the projection period.

School Enrollment

Origin:

- Base year is for most recent set of enrollment statistics compiled by BMC. The BMC compiles current enrollments and enrollment projections for public and private schools from Maryland State Department of Education and the Maryland Department of Planning by school name and address (for all schools within the modeling area – including Frederick, Montgomery and Prince Georges Counties). These records are then *geocoded* (assigned a latitude/longitude coordinate based on their location along with other geographic identifiers) to TAZs. BMC compiles current enrollment from the District of Columbia Public Schools by school name and address and geocodes these records to external TAZs.

- Current Forecasts: BMC compiles jurisdiction level projections of public school enrollment for a 10 year planning horizon from the Maryland Department of Planning. Historical public and private school enrollment data is obtained from the Maryland State Department of Education and the Maryland Department of Planning. BMC staff scales existing school enrollment distributions by TAZ within jurisdiction to the enrollment control for the time period except where actual school level long-range projections exist (Montgomery County). Projections of school enrollment beyond the jurisdiction controls horizon become a constant for later forecast years.

DEMOGRAPHIC DATA DEVELOPMENT TECHNIQUES

There are many steps involved in deriving and updating small area socioeconomic forecasts. The variables listed above are not exhaustive and each round of forecast development generates its own special cases that must be handled based on the availability and breadth of data that is available at that time.

DATA GENERATION/DEVELOPMENT STEPS:

Step 1: DEVELOP JURISDICTION CONTROLS FOR ALL MODEL INPUTS

Extract base year estimates of Total Population, Group Quarters Population (Institutional and Non-Institutional), Household Population, Persons Per Household, Households, Total Labor Force, Total Workers, Labor Force Participation Rate, and Median Household Income from U.S. Census Bureau information or private data source.

Generate projected jurisdiction-level households by:

- Using the controls developed by local jurisdictions, or
- Using projected households developed by Maryland Department of Planning (MDP), or
- Using projected households developed by a private data source (e.g. Woods and Poole or Claritas).

Generate projected jurisdiction-level household population by:

- Derive by the product of jurisdiction submitted households size and jurisdiction submitted household counts, or
- Using jurisdiction level household population forecasts developed via the MDP Cohort Survival model, or
- Deriving household population projections from Woods and Poole forecasts of the number of households and household size or using another private data set.

Generate projected jurisdiction-level group quarters population:

- Derive jurisdiction projection by subtracting jurisdiction submitted household population or derived household population from jurisdiction submitted total population control, or
- Directly using MDP group quarters projections developed via the Cohort Survival model, or
- Deriving projections from a private data source (e.g. Woods and Poole or Claritas) by subtracting the product of persons per household and number of households from the total population projections.

Generate projected persons per household by dividing the household population by the number of households.

Generate projected total population by:

- Directly using controls developed by local jurisdictions, or
- Directly using controls developed by MDP, or
- Directly using controls developed by private data source (e.g. Woods and Poole or Claritas), or
- Derive total population by adding (derived or submitted) household population projection and (derived or submitted) group quarters projection.

Generate projected total labor force by:

- Directly using controls developed by local jurisdictions, or
- Directly using controls developed by MDP via the Cohort Survival model, or
- Directly using controls developed private data source, or
- Derive projected labor force by multiplying the total population projection by the base year labor force to total population ratio.

Generate projected total workers by using the following steps:

- Compile most recent unemployment rates by jurisdiction from the Maryland Department of Labor, Licensing and Regulation to determine the base year
- Hold latest unemployment rate by jurisdiction beyond the base year as a constant throughout the planning horizon unless it appears to be an anomaly
- Reduce total labor force projections by the unemployment rate.

Generate projected civilian household workers by using the following steps:

- Compile most recent unemployment rates by jurisdiction from the Maryland Department of Labor, Licensing and Regulation to determine the base year
- Compile MDP forecasts of Total Population, Population 16+, Institutional and Non-Institution Group Quarters, and Labor Force Participation Rates
- Subdivide Group Quarters Population forecasts by Institutional and Non-Institutional categories
- Apply projected Labor Force Participation Rates to new Population 16+ (based on original MDP ratio applied to new Total Population Controls which yields new Population 16+)
- Subtract selected Group Quarters Population categories from new Total Labor Force figures derived in the above step
- Hold latest unemployment rate by jurisdiction beyond the base year as a constant and apply throughout the planning horizon

to the Civilian Household Labor Force forecasts derived in the above step unless it appears to be an anomaly
- Reduce Civilian Household Labor Force projections by the unemployment rate.

Generate projected median household income by:
- Applying MDP per capita five year income growth rate to each previous median household income figure beginning with the base year estimate, or
- Applying Woods and Poole (or other private source) five year mean household income growth rate to each previous median household income figure beginning with the base year estimate.

Generate projected total, retail and non-retail employment by:
- Directly using controls developed by the local jurisdiction, or
- Directly using controls developed by MDP (modified BEA forecasts), or
- Directly using controls developed by a private data source (e.g. Woods and Poole).

Controls for Industrial, Office, and Other employment are scaled to the Non-Retail employment controls developed in the preceding step.

Step 2: <u>ALLOCATION TECHNIQUES FOR SMALL AREA DATA</u>

Generate small area household projections by:
- Directly using TAZ data submitted by local jurisdictions, or
- Allocating census tract data from private data sources to TAZ level and scale to jurisdiction household controls, or
- Applying household growth rates from a previous forecast by time period to base year household estimates and scale to jurisdiction household controls, or
- Using previous forecast set compute the TAZ share of overall jurisdiction household growth by time period. Apply these shares to current jurisdiction household growth to create new household counts by TAZ. Scale results to the jurisdiction household control, if necessary.

Generate small area institutional and non-institutional group quarters projections by:
- Directly using TAZ data submitted by local jurisdictions, or
- Maintaining base year institutional and non-institutional group quarters population from census data as a constant for the forecast period, or

- Using base year (2000) data develop institutional and non-institutional group quarters split by TAZ. Sum institutional and non-institutional group quarters by TAZ to get total group quarters. Aggregate TAZ group quarters for all TAZs in the jurisdiction. Scale these TAZ totals to the MDP jurisdiction control for group quarters for the time period. Apply institutional and non-institutional split to new group quarters estimate.

Generate small area total population projections by:

- Directly using TAZ data submitted by local jurisdictions, or
- Multiplying previous period persons per household by new forecast year households to derive household population. Add new household population to new group quarters estimate for the forecast year and scale all values to the jurisdiction population control. Compute new persons per household for the current forecast year, or
- Using previous forecast set and compute TAZ share of overall jurisdiction population growth by time period. Apply these shares to current jurisdiction population growth to create new population estimates by TAZ. Scale results to the jurisdiction population control, if necessary.

Generate small area total labor force projections by:

- Directly using TAZ data submitted by local jurisdictions, or
- Computing labor force to total population ratio by TZ for base year (2000). Apply labor force to population ratio to new total population estimate for current forecast year. Scale results to jurisdiction total labor force control for the forecast year using MDP jurisdiction forecasts.

Generate small area total workers projections by:

- Directly using TAZ data submitted by local jurisdictions, or
- Reducing each TAZ labor force estimate within a jurisdiction by the jurisdiction employment rate for the forecast year.

Generate small area civilian household worker projections by:

- Directly using TAZ data submitted by local jurisdictions, or
- Compute 2000 Total Labor Force to Total Population Ratio and hold as constant for future years (adjust individual TAZ ratios were necessary)
- Derive Population 16+ by controlling Total Population to Jurisdiction Population 16+ Controls

- Reduce Population 16+ by Group Quarters Institutional and Non-Institutional Military and Other Non-Institutional and the share of college students who do not work
- Apply individual TAZ Total Labor Force to Total Population ratios to Reduced Population 16+ to derive Total Civilian Household Labor Force forecasts
- Apply jurisdictional unemployment rate to Civilian Household Labor Force estimates to derive Civilian Household Workers (subtract derived unemployed from Civilian Household Labor Force)

Generate small area median household income projections by:

- Directly using TAZ data submitted by local jurisdictions, or
- Applying MDP per capita five year income growth rate to each previous median household income figure beginning with the base year estimate by TAZ, or
- Applying Woods and Poole (or other private source) five year mean household income growth rate to each previous median household income figure beginning with the base year estimate by TAZ.

Special Case Procedures

In the event of a "zero-start" (no population and/or households for base year, but a small area develops later in the forecast period) situation for future year forecasts, use either the value or distribution of an adjacent TAZ that has or is expected to exhibit similar socio-economic characteristics (same as U.S. Census Bureau's substitution or "hot deck" method) or use the countywide "weighted average or median" or the actual countywide value. Determine which method is the best fit.

Triggers for zero-start situations:

In order to create additional socio-economic variables for a "zero-start", either population or households must be present.

- If the new variable is total population without any accompanying households, then the entire population is group quarters. Changes should be made to institutional and non-institutional group quarters, total labor force, workers, and school enrollment. Since the population is entirely group quarters there are no households and no accompanying median household income.

- If the new variable is households, then a household size figure must be derived using a similar TAZ, or using an adjacent TAZ, or using the jurisdiction-level household size as an interim measure. Derive the total population based on the product of the interim household size and the new household figure. Derive institutional and non-institutional group quarters, if appropriate and adjust the

household size figure accordingly. Derive total labor force, workers, median household income, and school enrollment.

- To derive new institutional and non-institutional group quarters splits once a new group quarters figure has been determined, apply an adjacent TAZ split, or apply a similar TAZ split, or use the jurisdiction-level split. If the characteristics of the new population are known specifically then create the split based on local project knowledge.

- To derive new total labor force, apply labor force to population ratio from an adjacent TAZ, or apply labor force to population ratio from a similar TAZ, or apply jurisdiction-level labor force participation rate developed by MDP to new total population figure. If the expected labor force participation rate is significantly different than adjacent TAZs or the jurisdiction-level MDP labor force participation rate, then use the labor force participation rate that is based on local project knowledge.

- To derive new civilian Household workers, follow steps outlined for this activity listed earlier in this document. If the expected unemployment rate is significantly different than the jurisdiction-level unemployment rate, then use the unemployment rate that is based on local project knowledge.

- To derive a new median household income, use income figure from an adjacent TAZ, or use income figure from a similar TAZ, or use jurisdiction-level median household income figure. If the expected median household income is significantly different than adjacent TAZs or the jurisdiction, then use median household income based on local project knowledge.

- To derive new student enrollment, use specific project information.

Before finalizing these interim values, each interim TAZ distribution should be scaled to the jurisdiction level control for the variable.

Conduct internal consistency checks across variables to make certain that they make sense (e.g. there cannot be a median household income if there are no households; no labor force figure without accompanying population; labor force cannot exceed population; and group quarters cannot exceed total population).

Special processing of Baltimore County Employment

A conversion of employment data must be conducted for retail and non-retail employment for Baltimore County for the years 2005-2030 forecast preparation following the Round 7 Cooperative Forecasts. The SIC to NAICS conversion that occurred following Round 7 had a profound effect on retail employment estimates in the Baltimore region generally, but a severe effect on Baltimore County data. Since all employment attraction equations in

the BMC Travel Demand Model are based on a 2000 SIC employment tallies by TAZ, it was necessary to convert all post-2000 forecasts for NAICS-based retail and non-retail employment back into the SIC-based employment equivalent in order to develop consistent Travel Demand Model outputs.

To facilitate this conversion, the BMC staff used the 2005 Master Establishment File (MEF) records which contain both SIC and NAICS codes for each employer record. A SIC/NAICS table was developed that assigned those records which were identified as being in the service sector by the NAICS code back into the proper SIC-based retail category. The SIC/NAICS table was tallied and the retail proportion of the service industry that should be moved to retail was calculated by TAZ. These shares were developed based on the 2005 MEF and were applied to each retail and non-retail employment projection year (2005 – 2035) to generate SIC-based retail and non-retail employment splits.

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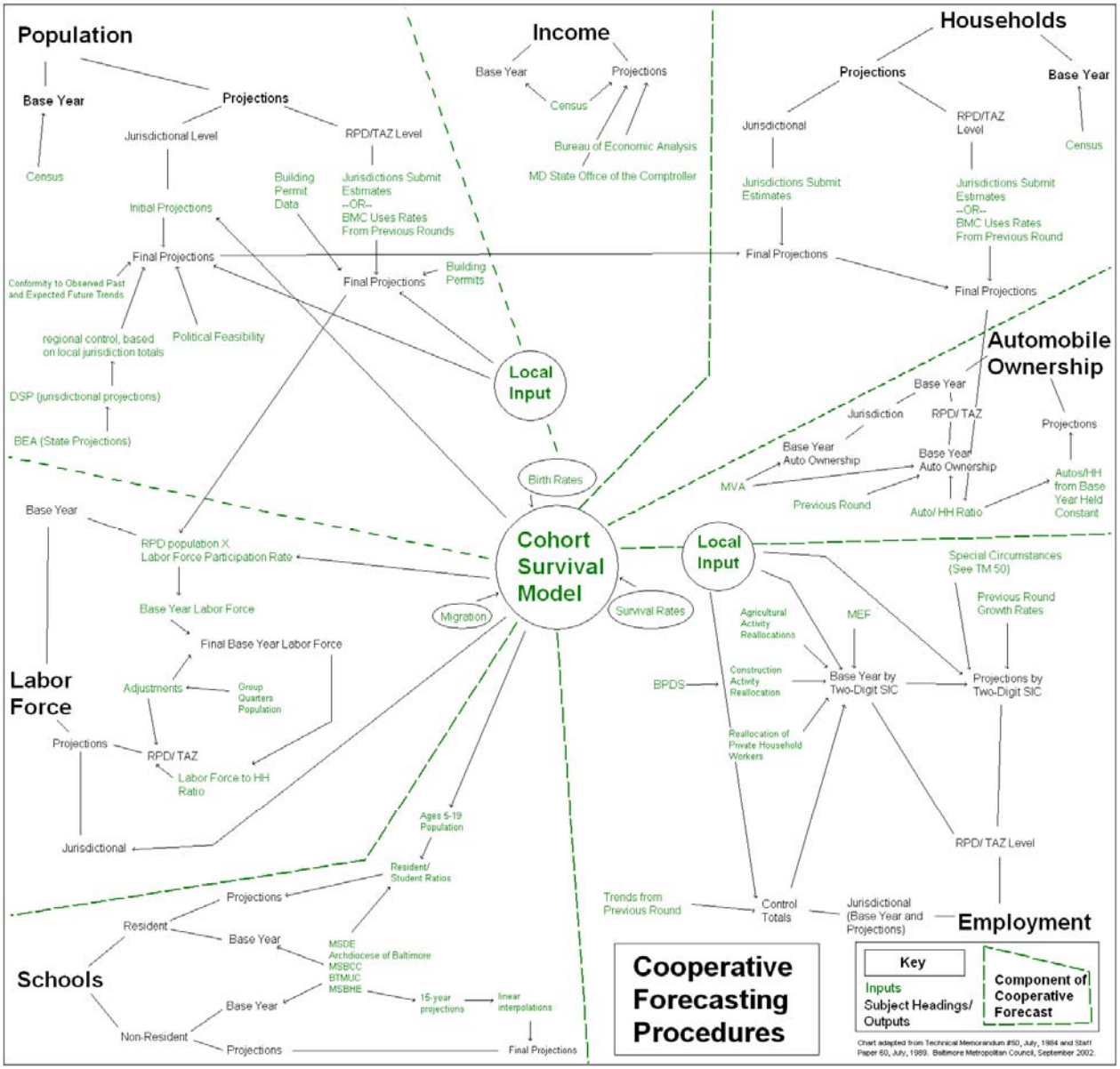
APPENDIX A
Cooperative Forecasting Group Flow Chart


Population
Base Year
Census
Projections
Jurisdictional Level
RPD/TAZ Level
Initial Projections
Building Permit Data
Jurisdictions Submit Estimates
--OR--
BMC Uses Rates From Previous Rounds
Final Projections
Conformity to Observed Past and Expected Future Trends
regional control, based on local jurisdiction totals
Political Feasibility
DSP (jurisdictional projections)
BEA (State Projections)
Final Projections
Building Permits
Income
Base Year
Projections
Census
Bureau of Economic Analysis
MD State Office of the Comptroller
Households
Projections
Base Year
Jurisdictional
RPD/TAZ Level
Census
Jurisdictions Submit Estimates
Jurisdictions Submit Estimates
--OR--
BMC Uses Rates From Previous Round
Final Projections
Final Projections
Local Input
Automobile Ownership
Base Year
Jurisdiction
RPD/ TAZ
Projections
Base Year Auto Ownership
MVA
Base Year Auto Ownership
Previous Round
Auto/ HH Ratio
Autos/HH from Base Year Held Constant
Birth Rates
Base Year
RPD population X Labor Force Participation Rate
Base Year Labor Force
Final Base Year Labor Force
Cohort Survival Model
Migration
Survival Rates
Local Input
Special Circumstances (See TM 50)
Previous Round Growth Rates
Agricultural Activity Reallocations
MEF
BPDS
Construction Activity Reallocation
Base Year by Two-Digit SIC
Projections by Two-Digit SIC
Reallocation of Private Household Workers
Labor Force
Adjustments
Group Quarters Population
Projections
RPD/ TAZ
Labor Force to HH Ratio
Jurisdictional
Ages 5-19 Population
Resident/ Student Ratios
RPD/ TAZ Level
Trends from Previous Round
Control Totals
Jurisdictional (Base Year and Projections)
Employment
Projections
Resident
Base Year
MSDE
Archdiocese of Baltimore
MSBCC
BTMUC
MSBHE
Schools
Base Year
15-year projections
linear interpolations
Non-Resident
Projections
Final Projections
Cooperative Forecasting Procedures
Key
Inputs
Subject Headings/ Outputs
Component of Cooperative Forecast
Chart adapted from Technical Memorandum #50, July, 1984 and Staff Paper 60, July, 1989. Baltimore Metropolitan Council, September 2002.

APPENDIX B
NAICS Sectors by Occupation

Baltimore City

ID	NAICS Industrial Sector	OFF	IND	OTH
1	Agriculture, forestry, fishing and hunting and mining	0.298701	0.500000	0.201299
2	Construction	0.351044	0.559646	0.089310
3	Manufacturing	0.365600	0.523052	0.111348
4	Wholesale trade	0.410254	0.352260	0.237486
5	Retail trade	0.609561	0.138224	0.252215
6	Transportation and warehousing and utilities	0.453986	0.183698	0.362316
7	Information	0.636206	0.055117	0.308676
8	Finance, insurance, real estate and rental and leasing	0.899003	0.027640	0.073357
9	Professional, scientific, management, administrative, and waste management services	0.727065	0.052929	0.220007
10	Educational, health and social services	0.365154	0.015010	0.619836
11	Arts, entertainment, recreation, accommodation and food services	0.340051	0.028125	0.631824
12	Other services (except public administration)	0.483286	0.079207	0.437508
13	Public administration	0.698438	0.025163	0.276400
14	Armed forces	0.406077	0.048343	0.545580

Anne Arundel County

ID	NAICS Industrial Sector	OFF	IND	OTH
1	Agriculture, forestry, fishing and hunting and mining	0.206266	0.681462	0.112272
2	Construction	0.401518	0.531719	0.066763
3	Manufacturing	0.598700	0.303367	0.097933
4	Wholesale trade	0.472675	0.368526	0.158798
5	Retail trade	0.628919	0.138538	0.232542
6	Transportation and warehousing and utilities	0.440066	0.112958	0.446976
7	Information	0.709211	0.025935	0.264854
8	Finance, insurance, real estate and rental and leasing	0.905784	0.024715	0.069500
9	Professional, scientific, management, administrative, and waste management services	0.765342	0.038140	0.196518
10	Educational, health and social services	0.275495	0.020171	0.704334
11	Arts, entertainment, recreation, accommodation and food services	0.296718	0.018586	0.684696
12	Other services (except public administration)	0.370405	0.100256	0.529339
13	Public administration	0.745094	0.020768	0.234138
14	Armed forces	0.391742	0.018186	0.590072

Baltimore County

ID	NAICS Industrial Sector	OFF	IND	OTH
1	Agriculture, forestry, fishing and hunting and mining	0.258126	0.560229	0.181644
2	Construction	0.362492	0.549891	0.087618
3	Manufacturing	0.485961	0.406514	0.107525
4	Wholesale trade	0.493650	0.347890	0.158460
5	Retail trade	0.626356	0.115699	0.257944
6	Transportation and warehousing and utilities	0.466147	0.161233	0.372620
7	Information	0.731308	0.025111	0.243581
8	Finance, insurance, real estate and rental and leasing	0.933824	0.011062	0.055114
9	Professional, scientific, management, administrative, and waste management services	0.731259	0.043027	0.225714
10	Educational, health and social services	0.312493	0.011997	0.675509
11	Arts, entertainment, recreation, accommodation and food services	0.278138	0.013117	0.708745

12	Other services (except public administration)	0.434542	0.082228	0.483230
13	Public administration	0.726505	0.026226	0.247269
14	Armed forces	0.416708	0.018592	0.564700

Carroll County

ID	NAICS Industrial Sector	OFF	IND	OTH
1	Agriculture, forestry, fishing and hunting and mining	0.203236	0.751264	0.045501
2	Construction	0.355253	0.535768	0.108979
3	Manufacturing	0.393368	0.507330	0.099302
4	Wholesale trade	0.402283	0.400269	0.197448
5	Retail trade	0.620429	0.127255	0.252316
6	Transportation and warehousing and utilities	0.348749	0.153904	0.497346
7	Information	0.533806	0.161941	0.304253
8	Finance, insurance, real estate and rental and leasing	0.943750	0.007917	0.048333
9	Professional, scientific, management, administrative, and waste management services	0.593675	0.071084	0.335241
10	Educational, health and social services	0.240417	0.010924	0.748659
11	Arts, entertainment, recreation, accommodation and food services	0.275067	0.007775	0.717158
12	Other services (except public administration)	0.295206	0.088289	0.616505
13	Public administration	0.602761	0.048569	0.348671
14	Armed forces	0.416708	0.018592	0.564700

Harford County

ID	NAICS Industrial Sector	OFF	IND	OTH
1	Agriculture, forestry, fishing and hunting and mining	0.239864	0.661261	0.098875
2	Construction	0.354860	0.528830	0.116310
3	Manufacturing	0.391680	0.511146	0.097174
4	Wholesale trade	0.401500	0.349783	0.248717
5	Retail trade	0.632866	0.157509	0.209626
6	Transportation and warehousing and utilities	0.377387	0.200776	0.421838
7	Information	0.487547	0.018868	0.493585
8	Finance, insurance, real estate and rental and leasing	0.929980	0.021943	0.048077
9	Professional, scientific, management, administrative, and waste management services	0.753095	0.044599	0.202306
10	Educational, health and social services	0.261416	0.010411	0.728173
11	Arts, entertainment, recreation, accommodation and food services	0.206879	0.014132	0.778989
12	Other services (except public administration)	0.367684	0.091858	0.540458
13	Public administration	0.724922	0.059510	0.215568
14	Armed forces	0.457501	0.017684	0.524815

Howard County

ID	NAICS Industrial Sector	OFF	IND	OTH
1	Agriculture, forestry, fishing and hunting and mining	0.154696	0.762431	0.082873
2	Construction	0.442946	0.468381	0.088673
3	Manufacturing	0.558266	0.354234	0.087500
4	Wholesale trade	0.478043	0.351787	0.170171
5	Retail trade	0.624572	0.119544	0.255884
6	Transportation and warehousing and utilities	0.382251	0.171429	0.446320
7	Information	0.724738	0.038370	0.236892
8	Finance, insurance, real estate and rental and leasing	0.929122	0.008279	0.062599
9	Professional, scientific, management, administrative, and waste management services	0.780799	0.032568	0.186633

10	Educational, health and social services	0.337402	0.010809	0.651789
11	Arts, entertainment, recreation, accommodation and food services	0.311637	0.027916	0.660447
12	Other services (except public administration)	0.401236	0.081906	0.516858
13	Public administration	0.610477	0.035005	0.354518
14	Armed forces	0.416708	0.018592	0.564700