APPENDIX B: LAND USE AND TRAFFIC FORECASTING

METHODOLOGY OVERVIEW

Land-use forecasts

These land use forecasts, adopted in June 2014 by the MARC Board of Directors, update and supersede the prior forecasts adopted in 2010. As an update to a prior forecast, no change policy direction was assumed, and no scenarios were developed. However, the forecasts were revised to be consistent with the latest data available, principally from the 2010 Census from the U.S. Department of Commerce and the Quarterly Census of Employment and Wages (QCEW) from the U.S. Department of Labor.

Regional Control Totals using the REMI model

The land use forecasts begin by first establishing regional control totals for expected overall population and employment levels in 2020, 2030 and 2040. As in prior forecasts, the PI+ model from Regional Economic Models, Inc. (REMI) was used to generate these forecasts. The REMI model is a computable general equilibrium model that combines an input-output model with a set of econometric models. It is designed to estimate regional economic growth relative to the U.S., based on how well a region competes with the rest of the U.S. on things like its cost of doing business and its ability to attract people and labor from other parts of the country. REMI continually makes improvements to this complex model consisting of over 2,000 equations solved simultaneously. As a result, it has consistently shown an ability to produce reasonable forecasts since MARC began using it in the 1990s.

In the wake of the Great Recession, and because of a projected slow-down in U.S. labor force growth as the post-WWII baby-boomers retire, the REMI model forecast the region’s employment to grow significantly slower than in the prior forecast over the 2010-2040 period. As a result, projected employment growth was reduced from about 600,000 in the prior forecast to 322,000 in the current update. The region’s employment is projected to grow from 1.0 million in 2010 to 1.3 million in 2040.

Sources: Census Bureau, Bureau of Labor Statistics, MARC
The REMI model was also updated with data from the 2010 Census that showed regional population growing at a rate of about 200,000 persons per decade instead of the 250,000 projected in the prior forecast. As a result, projected population growth over the 30-year forecast period was reduced from about 750,000 in the prior forecast to 597,000 in the current update. The region’s population is then projected to grow from 1.9 million in 2010 to 2.5 million in 2040.

**Assumed Redevelopment Percentage**

The 2010 census also showed that redevelopment occurring some parts of the existing area during the 2000-2010 period was insufficient to offset population losses in its more distressed portions. To make clearer what was meant by “the existing area” and provide a basis for tracking progress in the future, the Technical Forecast Committee defined as the region’s “redevelopment area” those portions that had largely developed by 1990. Calculations based on the change between the 2000 and 2010 Censuses showed this area lost 20,000 people over the decade, an amount equal to 10 percent of the region’s overall population growth during the period. This contradicted the assumption of the prior forecast that existing areas had stopped being a drag on regional population growth during the 2000s. That the redevelopment area’s contribution was still a net negative during the last decade meant the amount of growth expected to be captured there over the next three decades needed to be reduced.

To arrive at how much, the Technical Forecast Committee assumed that local policy, investments and incentives for redevelopment would still result in increasing the capture rate at the same pace as the prior forecast, but acknowledged it was starting from a minus 10 percent instead of zero. This 10 percent reduction in the starting point meant the ending point would have to be reduced by a similar amount to keep the pace of improvement constant. Since the prior forecast resulted in the existing areas capturing a net of 14 percent of the region’s population growth over the 2010-40 period (18 percent redevelopment combined with 4 percent decline), the Committee adjusted this projected capture rate downward, to about 5 percent.

Note that this is the average percentage of population growth captured in the redevelopment area during the 2010-2040 period. Given a starting point below 5 percent (and in fact, negative), to average 5 percent over the entire 30-year period meant the capture rate would need to ramp up to something well above 5 percent by the end of it. Assuming a gradual transition, MARC staff calculated that, given a capture rate of -10 percent between 2000 and 2010, assuming subsequent capture rates of -3 percent between 2010 and 2020, 5 percent between 2020 and 2030, and 17 percent between 2030 and 2040 would achieve the target average of 5 percent over the entire period. The Technical Forecast Committee agreed this would represent a reasonable path of improvement.

**Growth allocation using Paint the Town**

The regional growth totals are then allocated to small, sub-county areas using MARC’s land use change model, Paint the Town. This model was developed in-house by MARC based on an original concept by Criterion, Inc. It uses the metaphor of paint chips, where colors represent different types and densities of land uses, to display the location and type of land use change. The geographic area over which each chip is applied times its assumed density of development converts the land use change into housing units and/or employment. Additional conversion factors specific to each paint chip, such as vacancy rates and persons per household, convert housing units to population.
The small-areas to which the paint chips are applied are land use polygons derived from parcel data provided by the counties in the MARC region. These differ from the actual parcels in that they are based on vector grid cells, 50 feet in developed areas and 500 feet in undeveloped areas, where land use data was converted first to a 50-foot cell size raster and then converted to vector data. Grid cells are then merged if they share certain attributes, including land use type, decade of development, future land use type, availability for development, whether or not they are platted and whether or not they are in an activity center. The result is a parcel-like land use fabric covering the region that contains over 1 million polygons.

MARC translates each county’s land use categories into an overall regional “palette” of paint chips. The result, using a simplified version of this palette, is shown in the following existing land use map.

Source: County Assessors Offices and GIS departments, as compiled and tabulated by MARC
After collecting existing land use, MARC surveys cities and counties to obtain their future land use plans. Typically, these plans are designed to visualize what the jurisdiction will look like once it is fully built-out or, in older areas, when anticipated redevelopment is completed. As such, these plans provide guidance for MARC’s forecast concerning what kinds of development will occur and where, provided there is sufficient demand to make the development economically feasible.

Considerable work is required to make the land use classifications used by the various jurisdictions consistent with the regional land use palette. Some cities and counties are shifting their comprehensive plans to represent development types such as city centers or town squares, rather than traditional classifications. Where consistency with the existing palette was impossible, new land use chips were created in to accommodate them.

This resulted in the following planned land use map, again symbolized using a simplified version of the regional palette.

Source: County Assessors Offices and GIS departments, as compiled and tabulated by MARC.
It is clear from the planned land use map above that local governments intend to convert most of the Planning Area’s vacant and agricultural land to single-family housing at some point in the future. Compared to current land use, the planned land use map represents an increase in developed land acreage of 257 percent. Given that the population in the Kansas City region as a whole is only projected to grow by 31 percent between 2010 and 2040, however, this implies that not all of the land planned for development will, in fact, develop during the 30-year planning horizon.

Which land is most likely to develop is determined by *Paint the Town*’s development probability models, of which there are four: new development (greenfield development within the area expected to be served sanitary sewers), rural development (greenfield development outside of the area served by sanitary sewers), refill development (redevelopment and infill within areas largely developed by 1990), decline (principally in the most distressed areas of the region). The rural development model is new for this update.

These models were calibrated based on how well they predicted the land use change that occurred between 2000 and 2010. Explanatory variables include a variety of measures, such as availability of vacant land, sewer availability, employment density, median household income, proximity to arterials and highways, destination density, age of housing, quality of school districts, percent minority and poverty rate. The land expected to be served by sewers each decade was critical to forecasting the potential extent of suburban development. The data for this was obtained from the local wastewater districts and wastewater departments in the region.

The use of four separate models required dividing the control totals into four types of change each decade of the forecast period. The overall level of decline was set by simply running the decline model and summing the result across all polygons. This negative change then determines the amount of population and employment needing to be allocated to the redevelopment area to offset the decline and achieve the assumed redevelopment percentage. Greenfield development then accounts for the remainder of the projected population and employment change, which needs to be split into new, suburban-style development and rural development. As county governments are anticipating most future development will be served by sanitary sewers, the rural development proportion of greenfield growth was assumed to decline from current levels of about 30 percent of residential growth to about 5 percent in the future.

A new feature in this version of *Paint the Town* now allows the forecast to be constrained to match county as well as regional totals. The Technical Forecast Committee employed this feature to ensure the changes in each county’s share of the region’s overall growth was in line with historical trends.

Running *Paint the Town* yielded the following forecast of land use change, shown below with the full regional land use palette.
Source: MARC
Land use change can then be added to existing land use to produce a map of 2040 forecast land use.

Source: MARC

Land use changes were converted by *Paint the Town* into changes in population, households and employment, then aggregated from 1 million land use polygons to 1,000 Transportation Analysis Zones (TAZs). The Technical Forecast Committee then conducted their review at this level of aggregation and shifted growth within counties to be more consistent with local knowledge. The aggregated and reviewed numbers were then adopted by the MARC Board of Directors, and are depicted in the forecast maps in Chapter 8.
Travel demand model

MARC maintains the regional travel demand model for the bistate, eight-county planning area which includes Johnson, Leavenworth, Miami and Wyandotte counties in Kansas and Cass, Clay, Jackson and Platte counties in Missouri along with a small section of Lafayette County in Missouri.

The main objective of the regional model is to analyze impacts of specific policies and investments that might be undertaken in support of regional goals and objectives adopted by the MARC Board and stated in the plan.

The current MARC model is an enhanced four-step, trip-based model that focuses on daily travel patterns. The modeled area is 3,849 square miles and includes 951 traffic analysis zones (TAZ) and 30 external stations. The model is implemented using EMME transportation modeling software package and contains approximately 30,438 links and 15,204 nodes.

Model structure
Over the last few years, MARC has improved and augmented its traditional four-step model to include:

- An auto availability model with household income and household size sub-models.
- Expanded the range of trip purposes modeled.
- Improved trip distribution procedures to include destination choice formulations.
- Re-estimated mode choice model based on year 2005 onboard transit survey.
- Enhanced time-of-day component to model 24 hour daily slices that can be aggregated to customized time-of-day periods.
- External station model that explicitly models external travel (external-external, external-internal and internal-external) with its own trip generation and distribution procedures.
- Kansas City International Airport as a special generator.

**Trip generation**

A cross-classification model that generates trips by income, household size and auto availability.

**Eight internal trip purposes:**

**Person trips**

- Home-based work.
- Home-based shopping.
- Home-based social/recreation.
- Home based school (K-12).
- Home based college.
- Home-based other.
- Non-home based work.
- Non-home based other.
**Trip distribution**  
Destination choice model run as a set of macros in EMME.

**Mode choice**  
A nested logit model structure, run as an external program compiled in FORTRAN.

**Trip assignment**  
Auto assignment is implemented using a single-class equilibrium traffic-assignment. Modified BPR formulae are used for volume–delay functions.

**Traffic analysis zones and road networks**  
The model is implemented using EMME transportation modeling software and covers the eight-county planning area, and is divided into 951 traffic analysis zones (TAZs).