2050 Metropolitan Transportation Plan
for the Rockford Region

RPC | REGION 1 PLANNING COUNCIL

Technical Memorandum #3

Modeling Framework

Adopted:
July 31, 2020

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for the Rockford Region

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This document has been prepared by the Region 1 Planning Council in collaboration with its member agencies, partnership organizations, and local stakeholders.

This report was prepared in cooperation with the following:

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration
Illinois Department of Transportation

The contents, views, policies, and conclusions expressed in this report are not necessarily those of the above agencies.

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Part 1:
Introduction

The Region 1 Planning Council (RPC) has worked closely with Eco Resource Management Systems, Inc. (eRMSi), PTV Group, and KOA Corporation, to develop a computer-based transportation planning model, referred to as a travel demand model (TDM), for the Rockford Metropolitan Planning Area (MPA). The RPC also performs transportation modeling for the State Line Area Transportation Study (SLATS) which encompasses the portion of the Beloit MPA in northern Illinois and south-central Wisconsin. Additionally, the TDM covers the entirety of Ogle County, where the western portion is within the Blackhawk Hills Regional Council (BHRC). This allows for coordinated planning activities between the RPC, SLATS, and the BHRC to conduct transportation planning activities and research. The model is an update to the previous model development that was completed in 2015. The most recent update includes a change in travel demand model software, an expansion of the area being modeled to encompass all of Ogle County, the addition of a building rating distribution component, updates in socioeconomic data variables, the public transit route system and ridership, the addition of new roadways and geometric changes to the system, and an extension of the travel forecast year horizon from 2030 to 2040. The TDM is updated and recalibrated every five years to incorporate the newest available information at that time.

Background

This report describes enhancements to the model that augment its capabilities in addressing a wide range of transportation planning activities. The TDM was used to support the development and implementation of the MPO Metropolitan Transportation Plan (MTP), previously referred to as the Long Range Transportation Plan (LRTP). During the development of the 2050 MTP the TDM was used to model the impacts of forecasted land use changes, increased use of roadways, and future infrastructure projects by comparing baseline data to modeled and forecasted variables. The TDM also assists in the development and evaluation of future transportation improvement projects, as well as forecasted traffic volumes for roadways within the model.

The TDM is a representation of the Rockford MPA's major transportation facilities and the travel patterns of those using these facilities. This computer-based transportation model is used to analyze street and intersection congestion and forecast the need for future roadway improvements based on a set of criteria. The model contains inventories of the existing roadway facilities, housing data and geographic disbursement, major attractors and generators, such as shopping centers, schools, universities, and employment, down to the Traffic Analysis Zone (TAZ) level of geography.

The specific focus of this report is to describe the transportation modeling procedures that have been used to produce representative travel flows for the base year of 2015 and 2040 forecasted year and how this information was utilized in the update of the 2050 MTP. The model was mainly used to forecast the impact of changes in growth patterns and changes to the transportation system. These different tests are called alternative scenarios. This can include changes in number of housing units, employment centers, travel behavior patterns, or roadway improvements.

Model Area

Over several updates that have occurred since the early 1990's, the modeling area was expanded to cover the entire two-county area of Boone and Winnebago Counties, plus the adjacent State Line Area Transportation Study (SLATS), the MPO for Beloit, Wisconsin. Most recently, the RPC model area has expanded to include Ogle County in Illinois.

The RPC model area is shown in Figure 1-1.

Traffic Analysis Zones (TAZ)

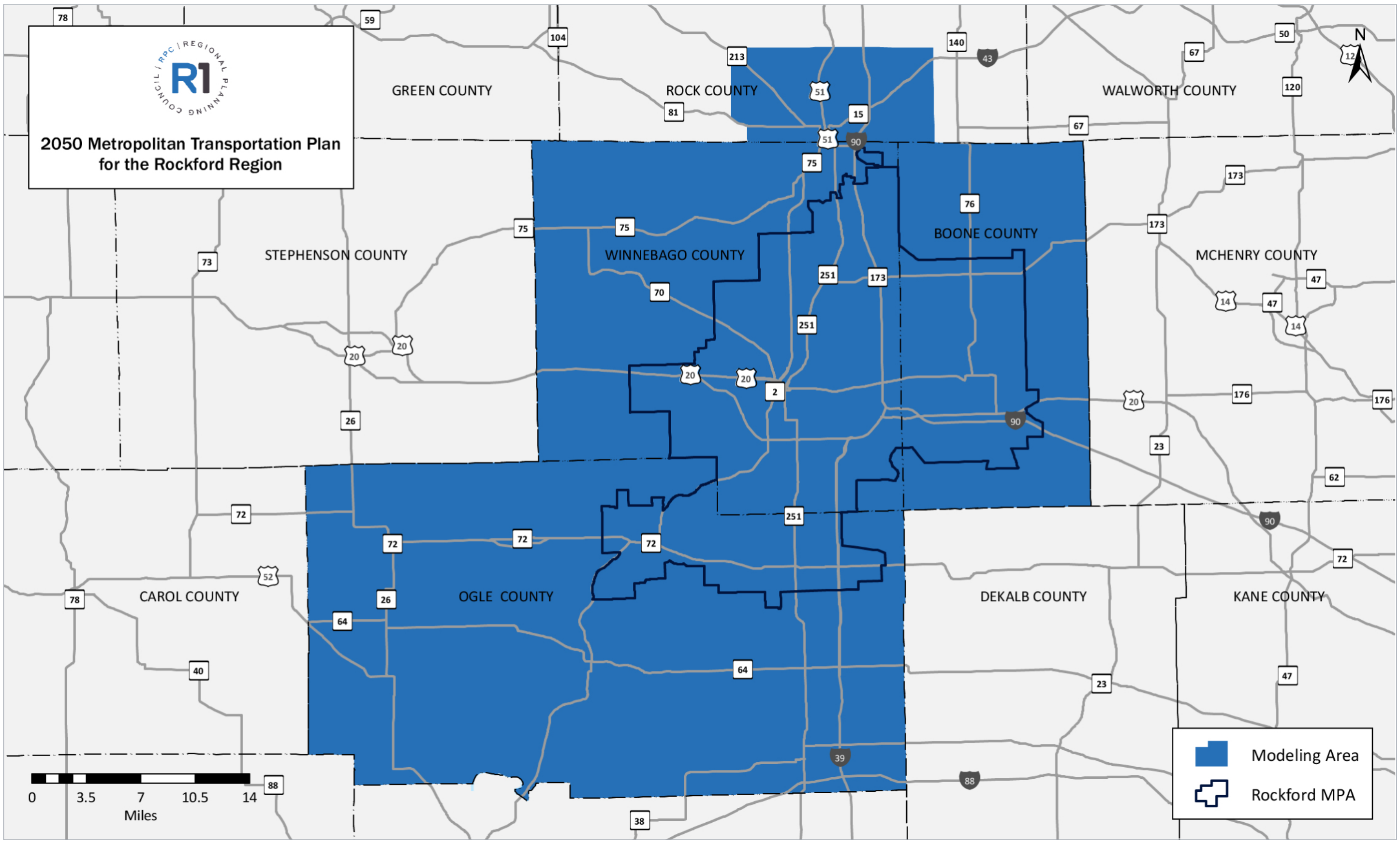
Special areas delineated by state or local transportation officials in order to tabulate traffic-related data, especially commuting statistics and usually consists of one or more census blocks, block groups, or census tracts.

Source: U.S. Census Bureau

MPO's Travel Demand Model

The TDM described in this document has been developed by a team of professional transportation planners, engineers, and modelers with specific experience in the PTV Visum software. The model developers certify that the Region 1 Planning Council Travel Demand Model has been developed within accepted statistical standards. The existing year network can be considered calibrated and validated for the base year and may be used for forecasting traffic and development growth patterns.

Figure 1-1. Travel Demand Modeling Area



Data sources: Region 1 Planning Council

Travel Demand Modeling Process

The TDM follows the traditional four-step modeling process of trip generation, trip distribution, mode choice, and trip assignment. This process first estimates person trips, then converts them to vehicle trips and transit trips. The model then distributes these trips throughout the network using the attractors and generators within the model. The model uses the morning (AM) time period to distribute different trip purposes for mode choice, and will then assign daily vehicle trips. Procedures were developed to also assign AM and PM peak hour travel.

The TDM uses numerous mathematical equations to analyze large amounts of information stored in multiple databases. Demographic and land use forecasts are a major source of data input for the model. Forecasted dwelling units, population, and employment are tied to future land use to determine how future trips and traffic volumes will be distributed in the model. The model area is divided into traffic analysis zones (TAZs). There are currently 647 TAZs within the RPC model area. The more densely populated an area is, the smaller the TAZ will be.

Trip Generation

Trip generation is a prediction of the number of person trips that are generated by and attracted to each TAZ. Within the model, residential land uses are expected to "produce" trips, and the non-residential land uses are considered to "attract" trips. Variables used to forecast trip production include the number of households, household size, number of automobiles owned, and income. As the number of households, automobiles, and income increase, so does the trip production rate. For non-residential land uses (e.g. industrial, commercial, office, education, or accommodation/food service), these are typically impacted by the size of the land use, the type of industry, and by the number of employees. Each type of household and type of employment will have different trip rates used to generate the number of trips.

Trip Distribution

Trip distribution connects the zones that "produce" with the zones that "attract" trips. The trip distribution part of the model is determined by "attractiveness" between the zones. Most of the trips produced in a given zone will be attracted to a surrounding or nearby zone; some will be attracted to moderately distant zones,

Peak Hour Travel

The part of the day during which traffic is occurs at the highest rate per hour, and in which traffic congestion on roads and crowding on public transport is at its highest. The term often refers specifically to private automobile transportation and is generally reported in a 1-hour time frame, as the peak hour of travel. There is generally an AM and PM peak hour of travel for a larger roadway.

Source: Federal Hoighway Adminstration and a small number will be attracted to very distant locations.

Mode Choice

Mode choice is the third step in the four-step modeling process. This is the step where the time and cost of travel by each travel mode is compared. This comparison is used to determine the number of trips taken by vehicle and by public transportation. Rockford Mass Transit District (RMTD) routes were coded as a separate component of the transportation network.

Trip Assignment

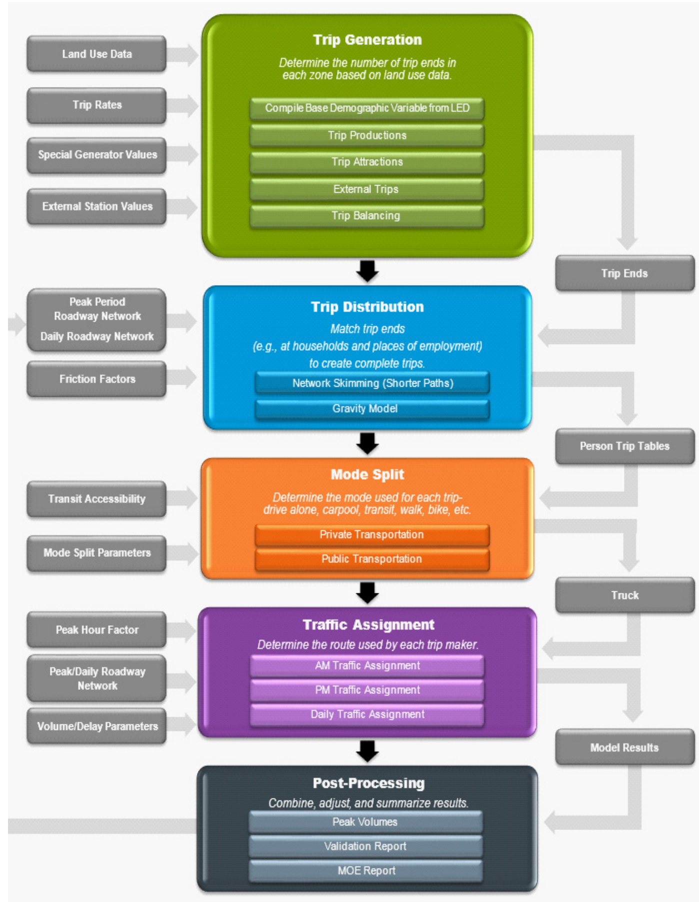
Trip assignment allocates generated trips to specific roadway and transit routes and determines the resulting highway volumes and route ridership. The assignment techniques are based on the general assumption that people will attempt to minimize their travel times when traveling to destinations. Equations are also used to adjust the impact of traffic congestion on travel speed and travel time. The trips are assigned based on the least time and distance involved in the trip, as normal human behavior would dictate.

In addition to the above trips that begin and end inside the model area; there are external trips from outside the area that are also analyzed. There are three types of external trips: external-external, external-internal and internal-external. External-external trips pass through the study area without stopping. Internal-external trips originate in the study area and travel outside the study area. External-internal trips originate outside the study area and travel to the study area. The number of external trips is derived from traffic counts and from use of cell phone and GPS tracking information purchased to aid in the calibration of the model.

Commercial/freight vehicle travel is included in the model. Commercial vehicles are those other than passenger cars or light trucks. The trip generation and distribution for truck trips is performed separately. These trips are then added to the total volume of traffic that is assigned to the network.

As part of the calibration process, the numerous mathematical equations in the transportation model were adjusted until the model outputs replicated existing travel patterns and performance statistics within nationally accepted target ranges. Following the calibration process, future year 2040 socio-economic data was then developed for each TAZ and external station. The model then produced year 2040 traffic and transit ridership projections.

Figure 1-2. Travel Demand Modeling Process



Data sources: Federal Highway Administration

Part 2:

Travel Demand Model Development

This section describes the modeling software used, the development of the transportation network, the process used to collect the base year socioeconomic data, and the parameters used to calibrate the TDM to replicate base year traffic conditions. Each of these steps are further described in the following sections.

Software

Visum is a Windows-based multimodal transportation modeling application. It includes features such as a graphical user interface, allowing information to be transferred to a geographic information system (GIS) for additional analysis. PTV develops and distributes the Visum software and describes the product as one that provides a comprehensive software system for travel demand modeling and network data management. Designed for multimodal analysis, Visum can integrate relevant modes of transportation into one consistent network model. The commands that Visum uses to complete the modeling steps to analyze the network is called the Procedure Sequence. By turning on/off certain sequences you are ultimately engaging different equations and procedures to run analysis and provide output data for the network. There are hundreds of combinations of procedure sequences available to the user that all create different model output variables.

Transportation Network

The initial input to the travel demand modeling process is a geographical representation of the region's roadway network comprised of nodes and links. A link is a directional description of connection between beginning and ending node points, or a roadway. Each link contains attribute data that defines the operation of that link. A node is simply the location where two or more links come together to form the network. These are mostly intersections. However, nodes are also used when roadways characteristics change between intersections, at RR crossings, or for distributing the Average Daily Traffic (ADT) from one zone to the next.

Links Attributes

Each street in the model is represented by a link or a group of links. Each link contains attribute data that defines the operation of that link. A link is a directional description of connection between beginning and ending node points.

Link Type

The link types are shown as link attributes and are used to define link capacities and to set the volume-delay functions used in the highway assignment process. The functional classification was reviewed and modified in some cases to reflect roadway facility types.

Number of Lanes

The number of lanes was added into the link file attribute by direction for each link in the network.

Link Capacity

Link capacity is entered in terms of vehicles per hour (VPH) for each link, directionally. Due to the number of links contained in the model, it wasn't possible to complete individual capacity analyses on each link to calculate specific capacities. The model uses a global link capacity system based on functional classifications and facility types and guidelines outlined in the 2010 Highway Capacity Manual. These capacity values reflect standard industry practice.

Base Speed

Base or free-flow link speeds are entered in Visum in miles per hour. Speeds have a direct influence on the computation of travel times during model runs. As part of this update, the base speeds were given a rigorous review. Field observation indicated that the previous network base speeds needed updating. To do so, Google Maps Street View was used to identify current posted speeds. These speeds were then used in the program to depict the free-flow conditions on roadways. During the model update process, a plot of coded speeds was reviewed for consistency with posted speeds.

Two-Way Left Turn Lanes

The presence of a two-way left turn lane (TWLTL) is used to represent additional capacity. This is coded for each direction of a two-way link.

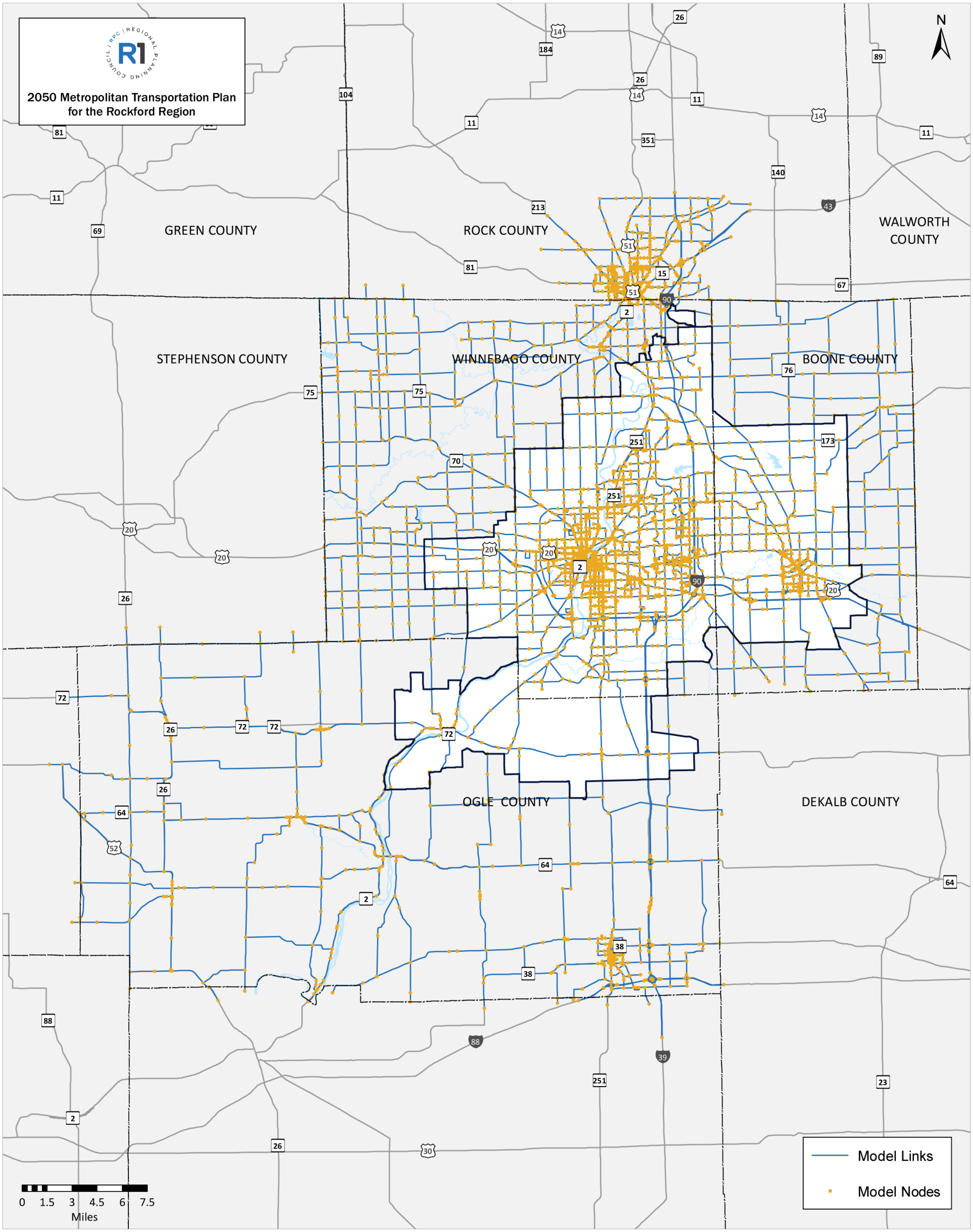
Node Attributes

The beginning and end points of each link are called nodes. A node can be an intersection or an intermediate point between intersections. In Visum, all nodes are coded with data, which defines the operating characteristics of that node. Nodes are classified according to intersection control type and roadway functional classification.

Node Type

The node classifications were coded in the model dependent upon the intersection control. Delay equations are defined by node type. The node types include toll plazas and railroad crossings in addition to intersections of various types and control devices/configurations.

Figure 2-1. Travel Demand Modeling Link/Nodes Network



Data sources: Region 1 Planning Council

Node Capacity

Capacities at all nodes are used in Visum to compute delays based upon traffic congestion at the intersections. This methodology was used to calculate preliminary node capacities at each node.

Node capacities for the model were also used to simulate the effect that a green time-to-cycle length (G/C) ratio has at an intersection. For modeling purposes, it was assumed that when like roadway classes meet, the G/C ratio is fairly even, and as the roadway meets lesser class roadways, the green time, or G/C ratio, increases on the major facility.

Turns and Turn Penalties

At some locations on a network it may not be possible to execute a certain turn movement; there can be a capacity constraint, due to the drivers' perceptions of potential safety concerns. Within the model, turn penalties were used to penalize left turns through the network. An additional delay of three seconds per vehicle was assigned at left turn movements along with all signalized and two-way stop controlled intersections. These additional delays improved model operation to eliminate any excessive “stair-stepping” movements. For tolls, the actual toll cost was imputed into a link field. Cost was part of the link impedance function to calculate link impedance. This is another form of delay used in the modeling process.

Socioeconomic Data

A second input to the travel demand modeling process is to develop a system of smaller geographic areas that cover the entire model area and to populate these small areas with key socio-economic data. These small areas are called Transportation Analysis Zones (TAZs). The socio-economic data is compiled for the types of households and types of employment within each TAZ. Other additional information on unique trip generators are also added.

TAZ Structure

The TAZs used in this model update are consistent with those used in the previous model. Additional TAZs have been defined for the newly added areas in the model. The TAZs used in the model are comprised of census blocks and are often a subset of census tracts. TAZs are of two types: internal and external. Internal zones were those zones within the model area and external zones are placed along roadways entering and leaving the model area. There are 647 internal TAZs and 56 external stations (total of 703 TAZs) in the model. Zone numbering for the model was done in accordance with the type of zone. The TAZs are shown in Figure 2-2.

Territories

Territories are used to define areas within the larger model area. The intent of the territories is to summarize the link data in areas which are much larger in size, thus creating a summary of the model data.

Travel Demand

Travel demand analysis is based on the concept that travel is a derived demand of the people and activities in a given region. Zonal demographic data, such as population, households, and income, is considered the demand for transportation. Economic characteristics, such as jobs by industry, are linked with supply.

The travel demand modeling process is enhanced when employment can be stratified into specific sectors, as each sector has different trip generation characteristics. The TDM uses employment categories based on North American Industry Classification System (NAICS) codes. Use of Visum and its integration with REMI requires verifying an accurate inventory of base conditions for each TAZ.

Household information was obtained from the U.S. Census Bureau. For the employment data, the RPC, in an agreement between IDOT and the Illinois Department of Employment Security (IDES), had access to the Quarterly Census of Employment and Wages (QCEW) data, which provided the number of employees by NAICS code to the exact street addresses.

External Data

Trips generated by external zones fall into two categories. Traffic that travels from external zone to external zone, or through the network, is called a through trip. These movements are designated as X-X trips in Visum, which stands for external to external travel. The primary characteristic of these trips is that they travel through the network but do not stop or start within an internal zone.

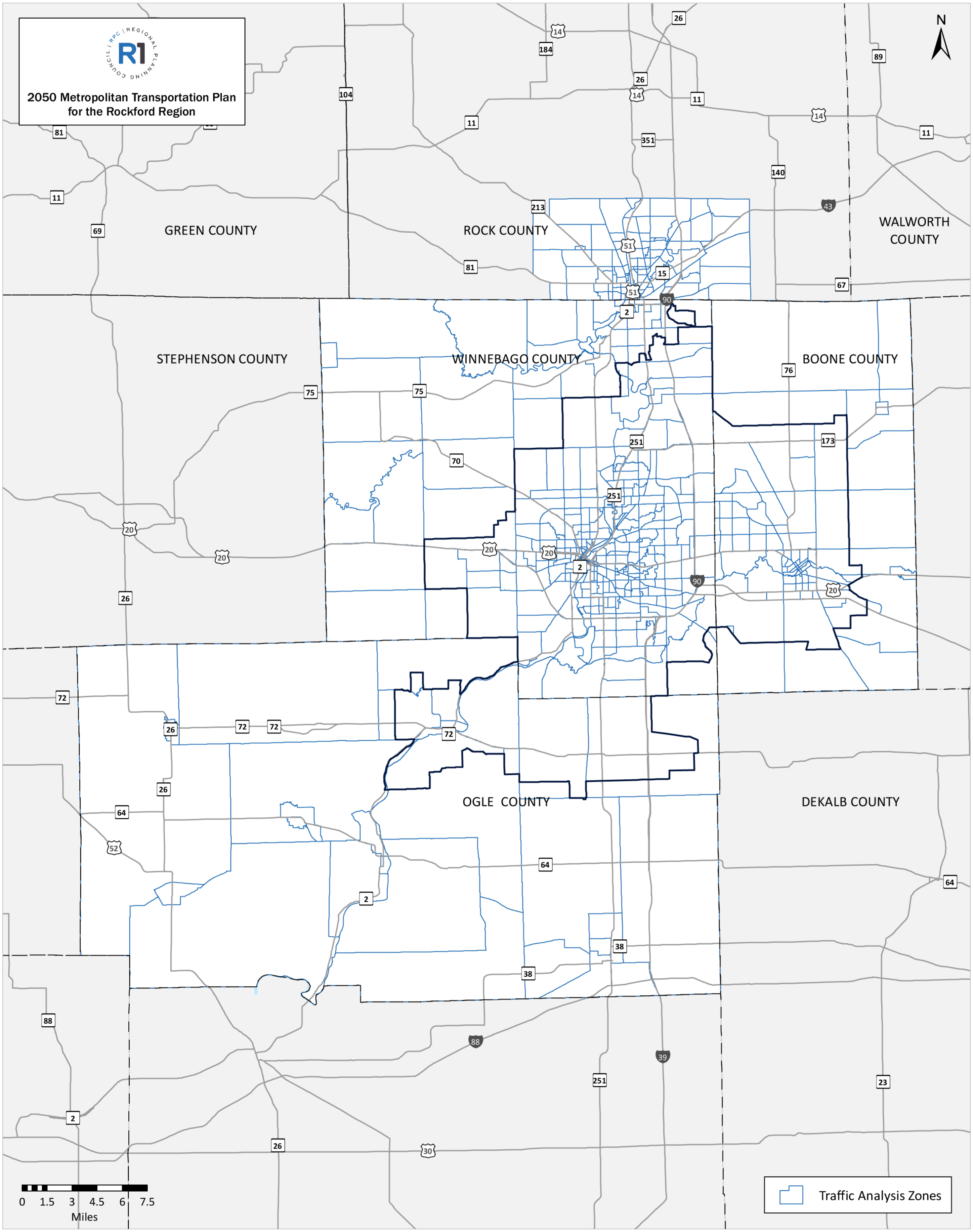
The second trip type generated by an external zone is the one that begins at an internal zone and ends in an external zone, or vice versa. These trips are often designated as internal to external (I-X) and external to internal (X-I) trips.

Trip Generation

Trip generation is the first formal step of the four-step travel demand modeling process. The number of trips generated by each zone is calculated by applying trip generation rates to zonal socioeconomic data. This procedure, called trip generation, is a compilation of several mathematical formulas that determine the number of trips produced and attracted to each model zone.

When a trip generation model (such as the one used in Visum) is applied to origins and destinations, different trip purposes exhibit different travel characteristics. For example, the characteristics of a home-to-work trip are different from a home-to-shopping trip. Therefore, it is important that the model generate different trip productions (origins) and attractions (destinations) for different trip purposes so that different travel characteristics can be accounted for in the gravity model.

Figure 2-2. Transportation Analysis Zone Geographies



Data sources: Region 1 Planning Council

Trip Productions

The model generates trip productions for four different purposes. Trip productions are calculated for the five REMI household codes, group quarters, hotels and the 21 NAICS code groupings. Person trip rates were developed for both urban and rural areas as well as the three counties and SLATS area.

Note that for all home-based trips, the home end is considered the production end and the non-home end is considered the attraction end, regardless of the direction of the trip.[1]

The trip production rates employed in the model are then compared with the vehicle trip rates in the Institute of Transportation Engineer's (ITE) Trip Generation Manual. The vehicle occupancy rate used to convert the person trip rate to the vehicle trip rate was based on the National Cooperative Highway Research Program's (NCHRP) Report 716 "Travel Demand Forecasting: Parameters and Techniques" and previous model experience working with the Rockford TDM.

Trip Attractions

Trip attractions are generally places of employment. Attractions are estimated based on the trip-generation characteristics of the land uses within the TAZs and (like productions) are broken out by trip purpose. The trip attraction rates used in the model were primarily derived from the rates provided in ITE's Trip Generation Manual and from other travel demand models for similar sized urban areas that the consultants have worked on. Because the model is a "closed system," productions and attractions for each trip purpose must be balanced when external trips are included. Due to differential growth, future forecasts do not always ensure that the same balance will be achieved.

Trip Distribution

Trip distribution is the process of allocating the generated trips between various zones within the network. The product of the distribution is a trip table that lists the number of trips between the model's zones. The model applies the Visum software's "gravity" model to distribute the peak hour and daily trips between TAZs. The travel forecasting gravity model is built on Isaac Newton's Law of Universal Gravitation that, all else being equal, the attraction between two masses will be proportional to the size of the masses and inversely proportional to the distance between the masses. In a travel forecasting model, the number of trips in a TAZ (for a trip purpose) is used to reflect the size of the mass, and a combination of travel time and distance is used to represent the distance factor in the gravity model.

The trip distribution model contains parameters that adjust the relationship between travel time and distance based on trip purpose. The RPC model uses a utility function method to calculate travel time impedance matrices. The impedance is averaged with each feedback loop to take into account congested travel paths as well as terminal time to and from each zone. During the model calibration it was found that travelers tended to stay within their local area or county for home and work, so an additional impedance matrix was created to better model this behavior.

1 In/Out percentages are used to obtain the correct directionality in the peak-hour modeling process.

Types of Trip Productions

Home-Based Work (HBW): Trips that have one trip-end at home and one trip-end at work.

Home-Based Other (HBO): All other home-based trips.

Non-Home-Based (NHB): Trips that do not begin or end at home.

Truck (Truck): Trips that were made by trucks.

Mode Choice

Mode choice is the step in the demand modeling process where demand by segment is apportioned to a method of travel. In the base model, demand is divided between the private transport system (automobiles) and public transport (bus service).

Transit Network

Transit network development in Visum requires the following essential components:

- Transit stops;
- Transit line route course;
- Transit line time profiles for line haul time; and
- Transit line headways.

The definition of transit lines and stops in the transit network were derived from the data provided by the Rockford Mass Transit District (RMTD). Currently new data is being collected on both ridership and routes as this information will be updated with the newly calibrated TDM in 2020.

The line frequencies or transit service runs were provided by RMTD. This data was then converted into appropriate headways assuming a service period from 6am to 7pm (13hrs) by PTV staff.

Demand Development

The demand development for the transit model was carried out in two stages. In the first stage, a multinomial logit model was explored and evaluated. In the second stage, a methodology was developed to refine the logit model outputs. The most common method for evaluation of mode split is the multinomial logit model. According to this model, a utility term is calculated for each of the modes competing for a share. The utility term commonly consists of variables such as travel time, travel cost, various dummy variables, and a mode bias constant. The coefficients for each of these terms is typically estimated by using data available in a travel survey conducted through the agency on a sample of residents in the area. In the absence of an available travel survey, the coefficients from a 'similar' region or area are typically adopted for the calculation of the mode choice. In order to adjust the mode split to some observed data, the mode choice constants are then adjusted to match target mode shares.

The model choice step also includes the conversion of person trips to vehicle trips for the private transport system (cars). Average vehicle occupancy (AVO) was used for person-to-vehicle conversions. . Factors based upon the average occupancy were applied after the mode split procedure to further develop the vehicle matrices.

Highway Assignment

Highway assignment is a process in which the trips distributed in the trip distribution stage are assigned to the highway network based on a set of established criteria. Highway assignment involves distributing the trips going from one zone to another zone onto the various paths available to travel between those zones. The mode of those trips can be by car, truck, transit, or by walking.

In the assignment portion of the TDM run, the distributed trips from the trip table are allocated to the shortest travel paths between each zone. Link and node congestion is modeled in an assignment using link and node volume delay functions.

Visum provides several traffic assignment methods. The Equilibrium Lohse method was used for model traffic assignment. The Equilibrium Lohse procedure was developed by Professor Lohse and is a widely used method that has been proven and is trusted. This procedure models the learning process of road users using the network. Starting with an "all or nothing assignment," drivers consecutively include information gained during their last journey for the next route search. Several shorter routes are searched for in an iterative process whereby the impedance is deduced from the impedance of the current volume and the previously estimated impedance. The assignment process is completed when the maximum number of iterations of 100 is reached or the impedance on each link reaches equilibrium.

Travel impedance is calculated for each travel path using travel time and delay obtained from the network, travel length from the network, and toll impedance.

The travel times from the network are based upon a base travel time and then estimates of delay that increase as the traffic volume increases. This is captured using volume-delay functions for each roadway classification and each node classification.

Transit Assignment

Transit assignment maps the public transit trip demand onto the transit network. The logit model was used to develop the initial transit trip table and assignment. Transit demand was then refined using an Origin-Destination (O-D) estimation method. This method adjusted the transit demand matrix, so that the assignment results more closely match the observed ridership (O-D demand, passenger trips unlinked or number of boarding/alighting passengers).

The following count data was used for estimation of demand:

- Passenger trips unlinked per line;
- Passenger miles per line;
- Boarding/alighting passengers at stop areas; and
- Skim data distribution, e.g. journey distance distribution.

Once the line ridership from the assignment of the adjusted trip table matched reasonably with the observed line ridership, the matrix was adopted as the final daily transit trip matrix

Part 3:

Model Calibration

After all of the data has been collected, coded, and entered into Visum, the calibration process can be initiated. In this phase of the project, the data and the model rules are refined so that the model closely simulates existing travel patterns and volumes. Model calibration and validation is an iterative process of adjusting various model parameters to best replicate known traffic volumes, transit ridership, and travel patterns. Calibration is performed by conducting a series of simulation runs, evaluating the results, and adjusting parameters. The calibration is considered complete when the results of the simulation runs are statistically similar to the traffic count volumes and other measures of travel behavior. The series of calibration simulation runs involves review of the assumptions used to construct the model. In the distribution portion of the simulation, the exponents to the distance function of the gravity model are examined. During the assignment portion of the simulation, the assumptions for link speeds, capacities, and delay parameters are studied. Between each run, different parameters are evaluated and necessary adjustments are made to the "rules" so that the desired results (i.e., calibration) are reached. Before any adjustments to the model parameters were made, they were justified either through the collected travel pattern data or through the judgment of eRMSi/PTV/KOA and their experience with transportation planning models and travel conditions throughout the model area.

Two documents that play a central role in the calibration and validation steps are:

- NCHRP 716, Travel Demand Forecasting: Parameters and Techniques (2012), and
- Travel Model Validation and Reasonableness Checking Manual 2nd Ed. (2010)

Several tests were applied to make sure that the 2015 model was calibrated and valid:

- Percent Assignment Error;
- Root Mean Square Error (RMSE);
- Coefficient of Determination (R2);
- Screen Line Analysis; and
- Vehicle Miles of Travel Comparison.

Percent Assignment Error

The assigned 2015 daily traffic volumes were compared with the counted daily traffic volumes for individual links. The report Travel Model Validation and Reasonableness Checking Manual, 2nd Ed., presents the error limits used for various models. This analysis employs the values recommended by the Federal Highway Administration (FHWA) in their 1990 report, Calibration and Adjustment of System Planning Models. The computed percent error is compared to the suggested error limits. The percent error of the traffic assignment for the network as a whole was 1.3 percent, and the errors for the individual functional classifications were within acceptable tolerances.

Root Mean Square Error

Another measure of the model's ability to assign traffic volumes is the percent root mean square error (RMSE). The RMSE measures the deviation between the assigned traffic volumes and the counted traffic volumes; the calculation is shown in Figure 3-1.

The percent RMSE indicates a degree of deviation between the assigned and counted traffic volumes. Currently, there are no national standards for model verifications of RMSE. NCHRP 365 includes the recommendation that RMSE be below 35 percent. The RPC model is within this limit at 33 percent RMSE.

Table 3-1. Percent Assignment Error, 2015 Daily

Functional Class	Computed	Suggested Range
Interstate/Freeway	1.6%	7%
Principal Arterial	-2.5%	10%
Minor Arterial	0.1%	15%
Collectors	14.4%	25%
Total	**1.3%**	-

Source: Region 1 Planning Council; Federal Highway Adminstration

Figure 3-1. Root Mean Square Error

$$\%\ \text{RMSE} = 100 \text{ x } \frac{\sqrt{\dfrac{\sum(\text{Assignment Errors})^2}{\text{Number of Links}}}}{\text{Average Count}}$$

Source: Region 1 Planning Council

Table 3-2. RMSE by Count Range

Count Range	Precent RMSE	Acceptable RMSE Range
< 5,000	50%	45-55%
5,000 – 10,000	20%	35-45%
10,000 – 20,000	15%	27-35%
20,000+	0%	< 20%

Source: Region 1 Planning Council

Coefficient of Determination

Coefficient of Determination (R^2) is another tool to measure the overall model accuracy. The R^2 or "goodness of fit" statistic shows how well the regression line represents the assignment data. In statistics, R^2 is a number that indicates the proportion of the variance in the dependent variable that is predictable from the independent variable.

For travel models, the industry has typically sought to achieve a R^2 of 0.88 or higher. A value of 1.00 is perfect, but even if traffic counts were compared against themselves, the daily variation would not allow for a regression coefficient of 1.00.

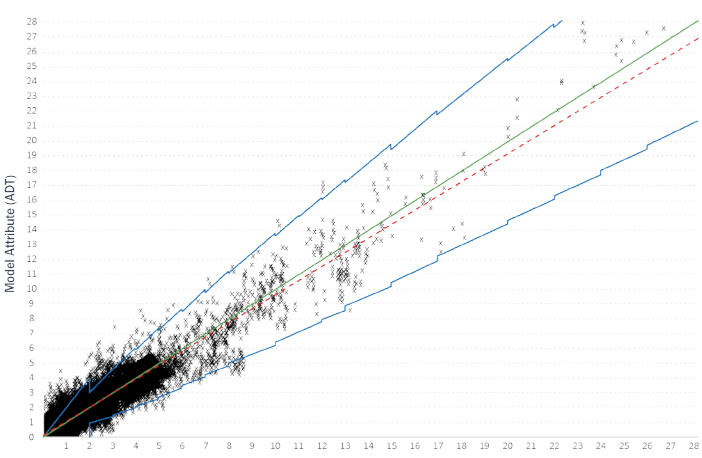
The calibrated model has an R^2 value of 0.93 which illustrates a good fit between the model output and the available counts and is shown in Figure 3-2.

Screen Line Analysis

A screenline or cutline is an imaginary line crossing all (screenline) or a portion (cutline) of the model area and intersecting a number of network links. Typically, these lines divide the model area into logical regions or cut across major travel routes. The process compares the sum of daily traffic count volumes across a screenline with the sum of assigned daily traffic volumes across the same screenline. The average of ratios over all the screenlines can also be used to measure the overall accuracy of the model.

There were five screenlines with GEH values over 5.0. Three of the GEH values were very close to 5.0; two are in the central area of Belvidere and one is on the western edge of Beloit. The two screenlines with the larger variance are located in western Ogle County, shown in Figures 3-3 and 3-4. These screenlines are located in the part of the model that has larger zones and a less defined network, resulting in additional trips being placed on the network that is there. These larger GEH values will be improved with the next model update in part by reducing the size of the TAZs in there areas.

Table 3-2. Comparison of Modeled Volumes With Observed Volumes



Source: Region 1 Planning Council

Vehicle Miles of Travel Comparison

The observed Vehicle Miles of Travel (VMT) was compared with the modeled VMT by facility type. The observed VMT was computed by multiplying traffic counts by length of segment. Modeled VMT was computed by multiplying assigned volumes by length of segment. The share of VMT by facility type was also compared and the model was found to represent observed conditions. The results are shown in Table 3-3.

Table 3-3. Modeled and Observed Vehicle Miles of Travel

	Modeled VMT	Observed VMT	Difference	Model Percent of VMT	Observed Percent of VMT
Interstate	2,667,815	2,589,808	3.0%	30.3%	31.0%
Principal Arterial	2,392,724	2,402,029	-0.4%	27.2%	28.8%
Monor Arterial	2,289,199	2,166,335	20.8%	16.4%	14.3%
Collectors	1,444,941	1,195,850	5.7%	26.0%	25.9%
Total	**8,794,679**	**8,354,022**	**5.3%**	**100.0%**	**100.0%**

Source: Region 1 Planning Council; Federal Highway Adminstration

Figure 3-3. Location of Screenlines- North Portion of Model

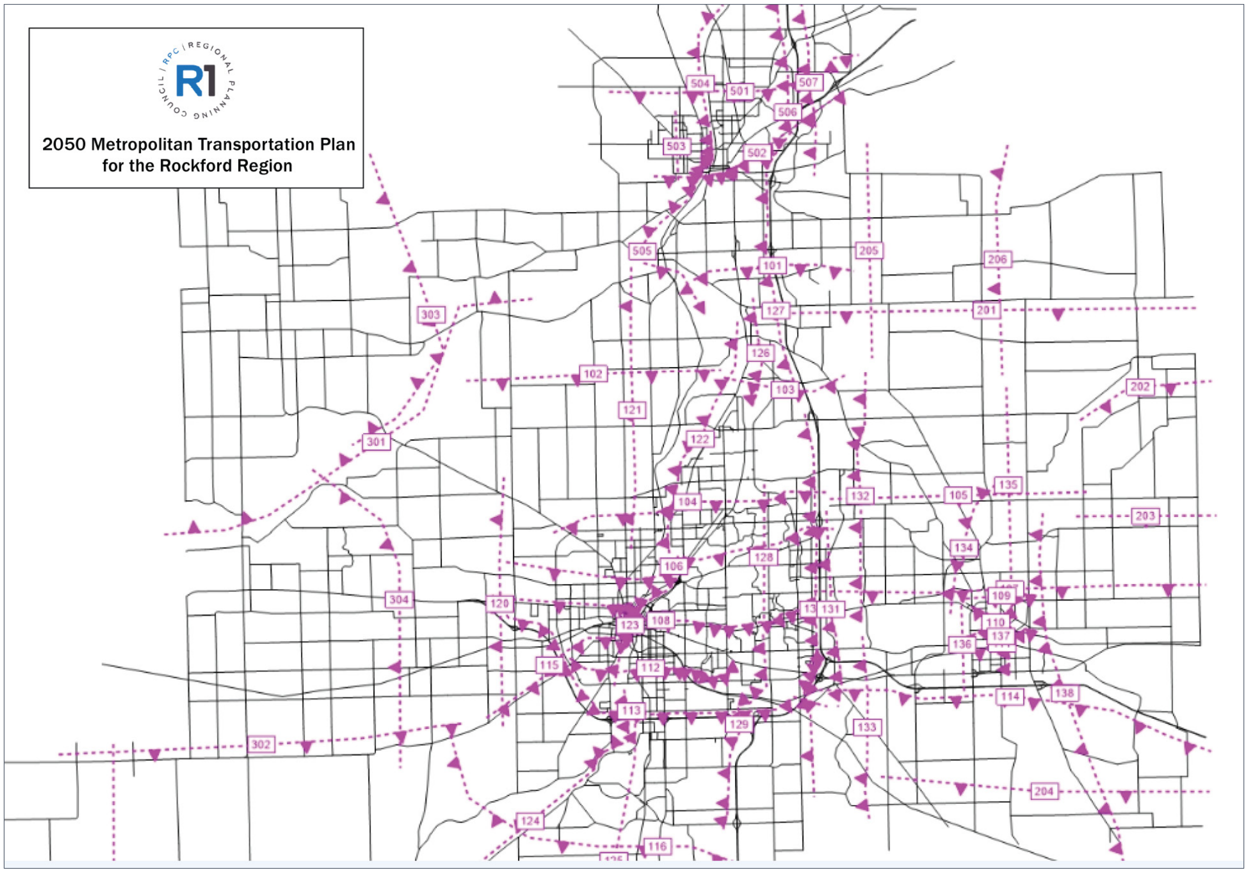
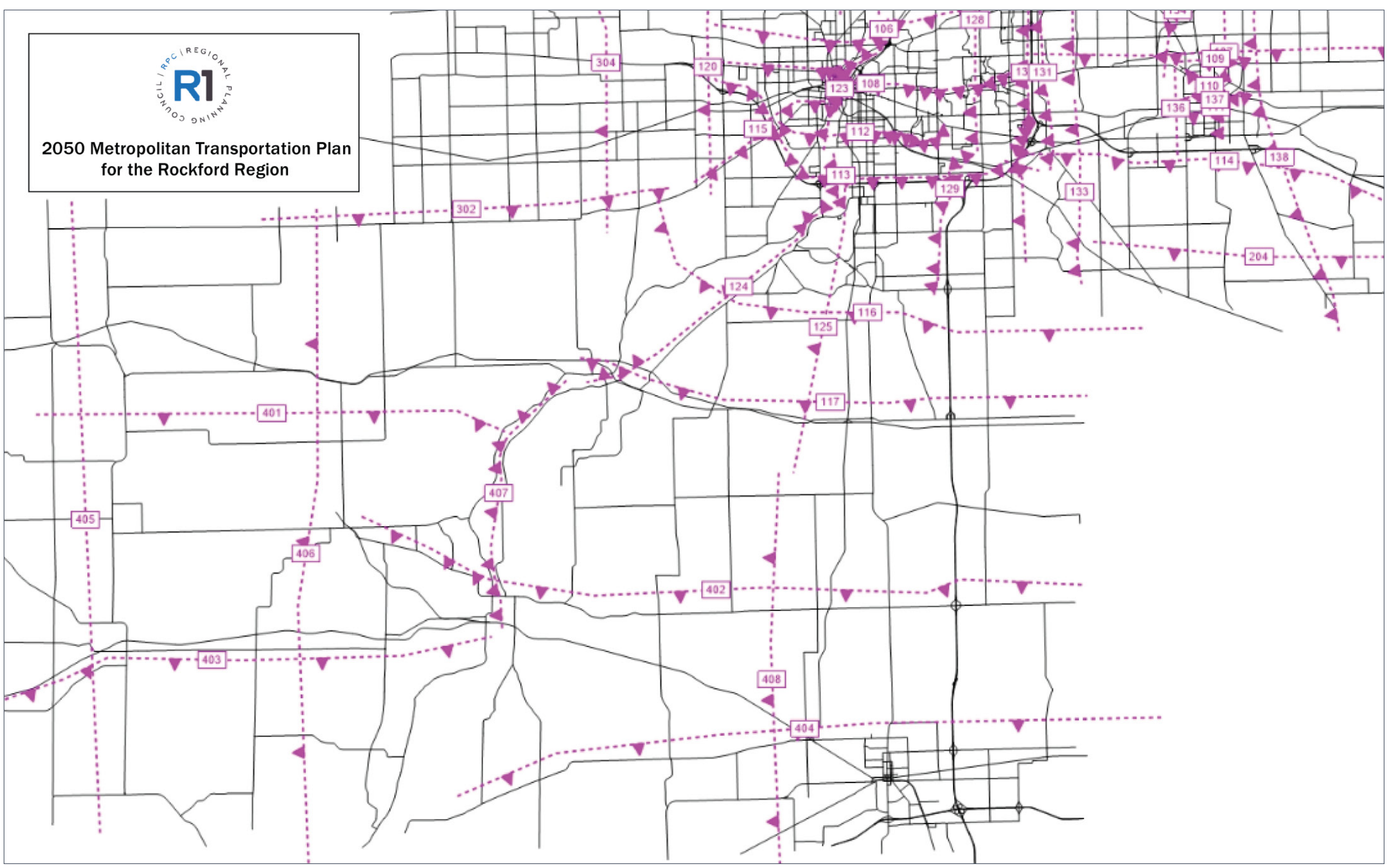


Figure 3-4. Location of Screenlines- South Portion of Model



Data sources: Region 1 Planning Council

Part 4:

Future Year Forecasts

This section describes the process used to develop future socio-economic forecasts that were used as inputs to develop the year 2040 traffic forecasts. The results of the initial 2040 traffic assignments are described below.

Regional Socioeconomic Forecasts

Regional and county level population and employment projections were prepared using the REMI software program TranSight. TranSight's main principle is that the transportation networks are the channels to economic improvements, growth, and overall net benefits to the region. Future differences in Visum travel impedance data was then converted into economic variables that TranSight uses to generate changes in employment, income, population, and economic migration patterns. Based upon the baseline location of employment at the TAZ level, changes in employment by NAICS sectors can then be translated as part of the future impacts phase based upon land use/transport system changes being made. There are feedback loops established between these programs that reflect the effects on employment, income, population and other economic variables which depend upon the scenario details.

Population and economic projections for the region are shown in Table 4-1 and Table 4-2.

Socioeconomic Forecasts by Zone

The REMI program Metro-PI provides a tool for economic and demographic forecasting at the Traffic Analysis Zone (TAZ) level. Metro-PI is used as the tool to develop TAZ level forecasts of employment, population and households. Using existing households, NAICS sector employment data and other local land use characteristics allocated at the TAZ geography, the Metro-PI program utilizes macroeconomic trends from REMI's PI model to ensure consistency with the regional and county level forecasts. Metro PI was still being refined at the time that the zonal forecasts were needed. To account for that, additional review and refinement were completed along with the Metro PI forecasts. As this software is refined, it may be used exclusively in subsequent updates.

Table 4-1. Projected Population Trends, 2050

Population	2015	2050	Absolute Growth (2015 - 2050)	Percent Growth (2015-2050)
Boone	53,767	56,364	2,597	4.8%
Ogle	51,785	52,891	1,106	2.1%
Winnebago	288,237	308,415	20,178	7.0%
3-County Total	**393,788**	**417,670**	**23,881**	**6.1%**
Age Group	**2015**	**2050**	**Absolute Growth (2015 - 2050)**	**Percent Growth (2015-2050)**
Under 18	93,232	82,917	-10,315	-11.1%
18 to 24	33,912	28,008	-5,904	-17.4%
25 to 34	46,278	47,298	1,020	2.2%
35 to 44	48,211	52,755	4,544	9.4%
45 to 54	55,558	56,647	1,089	2.0%
55 to 64	53,287	50,428	-2,858	-5.4%
65 +	63,310	99,616	36,306	57.3%
Race & Ethnicity	**2015**	**2050**	**Absolute Growth (2015 - 2050)**	**Percent Growth (2015-2050)**
White, Non-Hispanic	288,270	250,999	-37,271	-12.9%
Black, Non-Hispanic	37,592	44,181	6,589	17.5%
Other, Non-Hispanic	16,459	32,417	15,958	97.0%
Hispanic	51,467	90,074	38,606	75.0%

Data sources: Region 1 Planning Council
Note: Projections are based upon the Preferred Scenario.

Socio-economic forecast data was projected to 2040 using employment and dwelling unit data, as well as adopted land use plans of local and county jurisdictions. The economic forecasting firm REMI provided initial forecasts using building/development ratings by TAZ that creates a measure of attractiveness for new development. The development attractiveness is determined by access to urban infrastructure, such as utilities, as well as the amount of available buildable property by land use category. The ratings were used to estimate the supply of land while demand equations were used to determine where future population and employment growth would take place. The building ratings for the region are shown in Figure 4-1. Using the county-level forecast, local area labor force, household, and population was forecasted based on the local employment, initial residential location, and building ratings.

For the building rating system for residential land use activity, residential dwelling units were stratified into five different tiers to better reflect the different trip rates that occur in different land use environments. Values were assigned to apportion growth to each tier for each residential and employment type.

Level 1: Zones that currently have and/or will have full urban services and other infrastructure available to them to target future prime growth for each county based upon adopted land use plans. Examples would be:

- Property along the north-side of IL 173 between I-90, IL-251, and Swanson Road;
- Northeast Rockford and Loves Park, near East State Street, I-90, Harlem Rd, and the Winnebago/Boone County line)
- Sub-areas targeted for economic development, such as the zones around the airport, the Fiat Chrysler plant, and the Rochelle Business and Technology Park.

Level 2: Zones that have and/or will have access to other urban services that will encourage growth for each county based upon adopted land use plans.

Level 3: Transition zones that will have a mix of urban and rural services and lower residential density patterns for each county based upon adopted land use plans. Also, existing urban zones that are fully developed and will likely to continue to function this way.

Level 4: Countryside/suburban zones that have no or little access to urban services; therefore, not to foster growth. Also, existing urban zones that have little or no capacity to foster growth for each county based upon adopted land use plans.

Level 5: Agricultural and environmentally/ecologically sensitive zones that are not targeted and/or planned for growth for each county based upon adopted land use plans. Examples would be:

- Rock Cut State Park;
- Sinnissippi Park / Scandinavian Cemetery; and
- Agriculture zones in the rural area of each county.

Forecasts for population, employment, household size, and household median income were developed at the TAZ level for the three counties in the Rockford MPO and for the SLATS MPA.

Table 4-2. Projected Employment Growth by County, 2050

Population	2015	2050	Absolute Growth (2015 - 2050)	Percent Growth (2015-2050)
Boone	23,694	26,116	2,422	10.2%
Ogle	23,564	25,705	2,141	9.1%
Winnebago	166,343	190,774	24,431	14.7%
3-County Total	**213,601**	**242,595**	**28,994**	**13.6%**

Data sources: Region 1 Planning Council
Note: Projections are based upon the Preferred Scenario.

The forecasts were created on a decade basis out to 2040 using 2015 as the base year of the analysis.

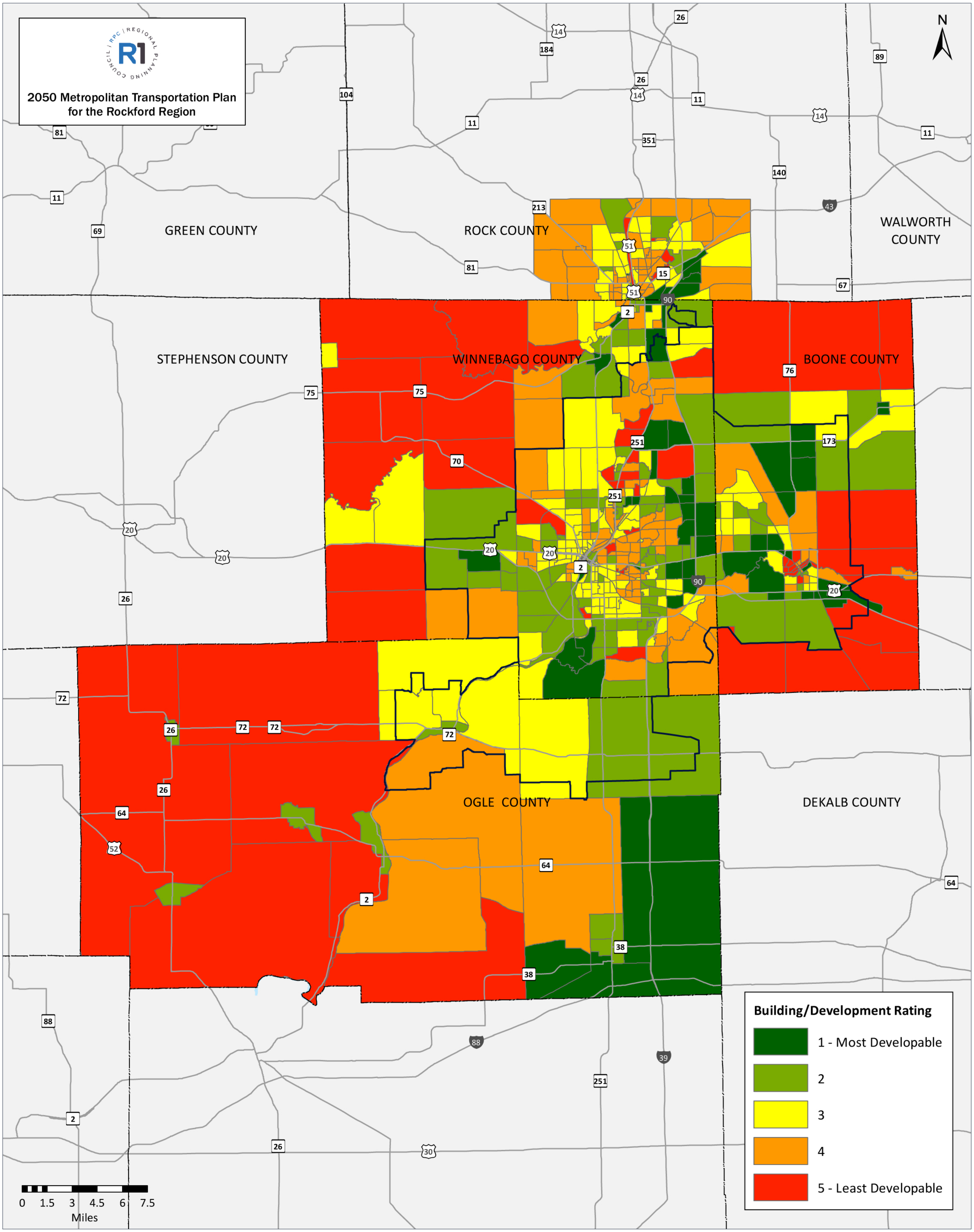
Network Scenario Assumptions

The existing network was modified by adding the capacity projects from the RPC and SLATS FY 2016- FY2019 Transportation Improvement Programs (TIP). These TIP projects have programmed funding and are defined as committed representing the set of future projects fully expected to be constructed. These projects were added to the existing network resulting in the Existing and Committed (E+C) network. A second future year network was created by adding the projects included in the fiscally constrained RPC and SLATS Long Range Transportation Plans to the E+C network to create the 2040 Existing, Committed, and Planned (E+C+P) network. The "planned" projects are those that are expected to be constructed if funding commitment for construction or is anticipated in the future.

Traffic Forecasts

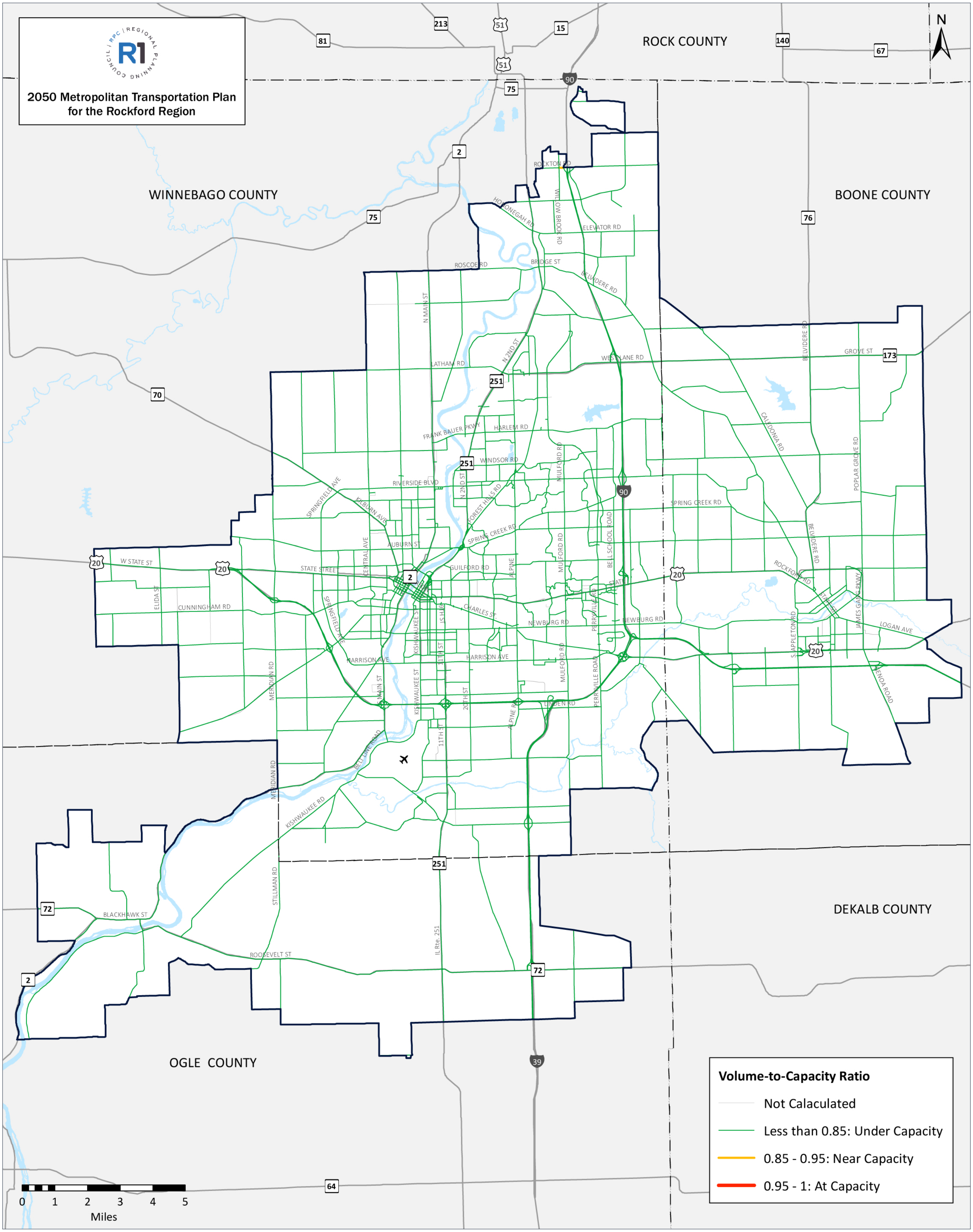
The two future year network assignments were developed with the input of the year 2040 socio-economic data and the development of the future year roadway networks. Link level of service provides a measurement of the level of congestion and travel speed on links. Level of service is computed by dividing the volume of traffic by the capacity of the link. Ratios close to or above 1.0 would reflect higher congestion and slower speeds. Ratios closer to 0.6 or lower would represent lower congestion and higher speeds. The current and future link level of services are shown in Figures 4-2 and 4-3 for the 2015 Base Year and 2040 Existing, Committed, and Planned (E+C+P) network, respectively.

Figure 4-1. Building/Development Ratings



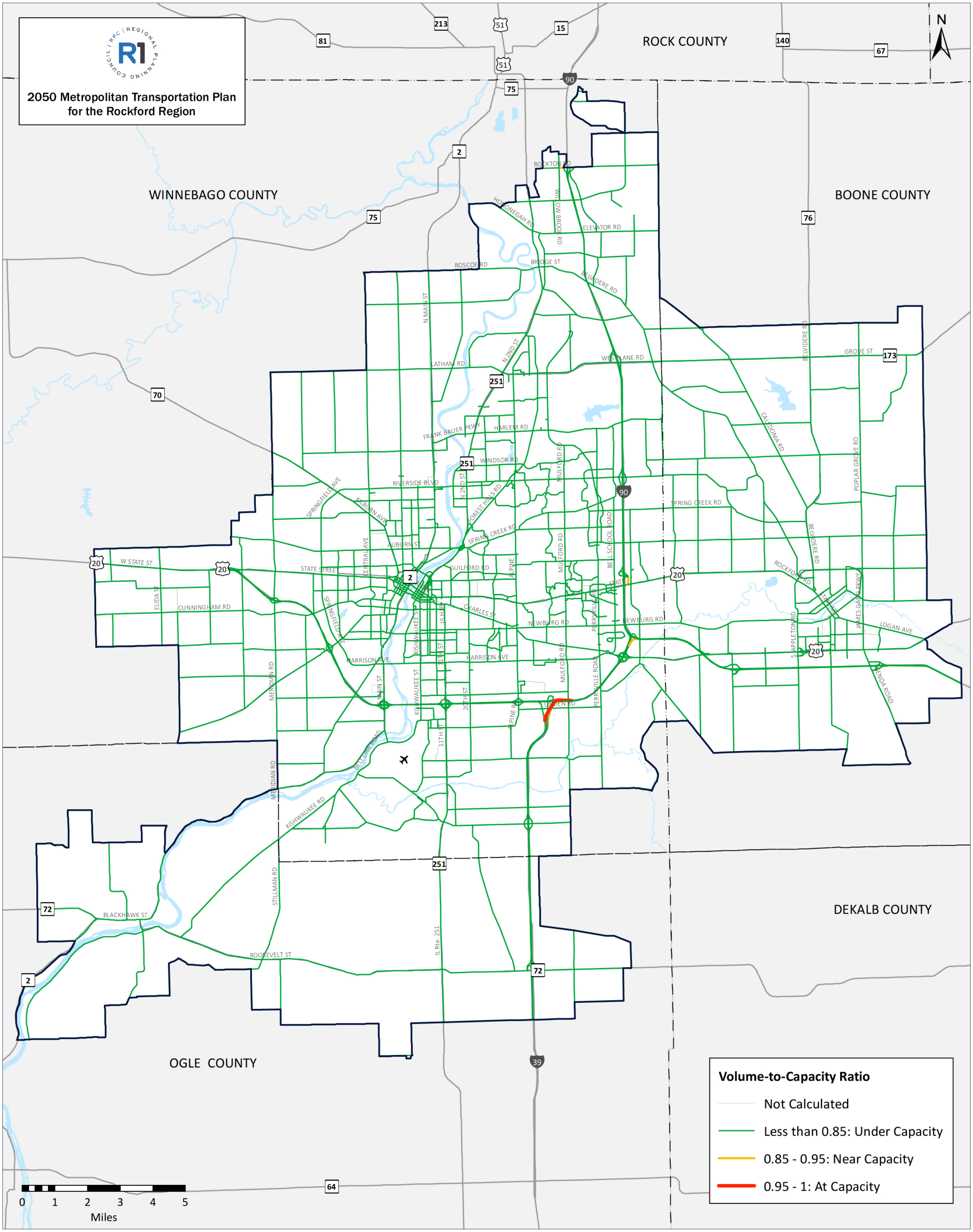
Data sources: Region 1 Planning Council

Figure 4-2. Roadway V/C Ratios, 2015



Data sources: Region 1 Planning Council

Figure 4-3. Projected Roadway V/C Ratios, 2040



Data sources: Region 1 Planning Council

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Additional Resources

2050 Metropolitan Transportation Plan for the Rockford Region
http://r1planning.org/mtp

2050 MTP Technical Memorandum #1: Public Engagement Process
http://r1planning.org/mtp

2050 MTP Technical Memorandum #2: Scenario Planning Process
http://r1planning.org/mtp

2050 MTP Technical Memorandum #4: Financial Analysis and Funding Resources
http://r1planning.org/mtp

2050 MTP Technical Memorandum #5: Project Evaluation Process
http://r1planning.org/mtp

2050 MTP Technical Memorandum #6: Detailed Project List
http://r1planning.org/mtp

Region 1 Planning Council Website
http://r1planning.org/

2050 Metropolitan Transportation Plan Webpage
http://r1planning.org/mtp

Transportation for Tomorrow (2040): A Long Range Plan for the Rockford Region
http://r1planning.org/fundamentals

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