CMAP

GO TO 2040
UPDATE APPENDIX

Major Capital Projects

October 2014

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Introduction

A key element of the GO TO 2040 comprehensive regional plan update is to establish a priority list of major transportation projects to fit within the plan's expected "fiscal constraint," meaning that the costs of the selected projects can be covered through the existing or reasonably expected revenue sources documented in the GO TO 2040 update appendix on the financial plan for transportation. As CMAP defines them, major capital projects are large projects with a significant effect on the capacity of the region's transportation system, including extensions or additional lanes on the interstate system, new expressways, major new expressway-to-expressway interchanges, or similar changes to the public transit system. These must be identified in GO TO 2040 to be eligible to receive federal transportation funds or obtain certain federal approvals. This document details the projects and provides background on the process CMAP employed to evaluate them for inclusion under fiscal constraint in the GO TO 2040 plan update.

The GO TO 2040 financial plan includes budgets for maintaining the system, modernizing the system (including both state of good repair projects and system enhancements), and finally for capacity expansion (the major capital projects). While they are not itemized as part of the fiscally constrained major capital projects, numerous other projects that fall below the major capital threshold continue to be priorities for GO TO 2040. These include bus rapid transit and arterial rapid transit projects, elements of the CREATE program, and others. These projects are included, but not specifically listed, in the system enhancements budget of the financial plan.

In order to be included in the plan, major capital projects are also evaluated for air quality conformity. As part of the region's overall transportation system, these projects must not contribute to violations of federal air quality standards or delay achievement of the standards. When these conditions are met, the plan is considered to be in air quality conformity. A separate GO TO 2040 update appendix demonstrates air quality conformity for the GO TO 2040 plan update and will be available at www.cmap.illinois.gov/about/2040/update. Lastly, projects are also assessed for their effects on environmental justice. The environmental justice measure assesses the potential impacts that the fiscally constrained projects will have on minority and disadvantaged population groups in the CMAP region to demonstrate that transportation investments are shared among socioeconomic groups.

Throughout the major capital project evaluation process, the Transportation Committee and other working committees were closely involved through staff memos, presentations, and discussions. This document is composed of material previously presented to these committees.

Major Capital Projects

The list of priority major capital projects includes the same set of projects under fiscal constraint as the original plan, minus three projects already completed, plus two projects amended into the plan in 2013. Thus, the update continues the same priorities of GO TO 2040, although details have changed in some cases, including costs, financing, and project scope. The financial plan for the GO TO 2040 update indicates that the $12.33 billion in funding will be available to construct these projects within the planning period. Nevertheless, rapid progress has been made on some projects and less on others, and several projects have near-term funding shortfalls. These and other implementation challenges are discussed as appropriate.

Expressway Additions: Express Toll Lanes

A major focus of GO TO 2040 is directing investment to improve the heavily used transportation infrastructure that serves existing communities in the region. Strategically adding capacity to existing expressways in the region is a key part of this approach. The expressway additions identified for fiscal constraint in the GO TO 2040 update address capacity limitations and reliability on some of the most congested facilities in the region. At the same time, these projects also rehabilitate older infrastructure and tackle major safety and operational problems.

Once built, new capacity needs to be managed to prevent the loss of performance to congestion over time. The most effective way of managing highway capacity is to implement congestion pricing, so that the price to use the facility changes with demand. This allows traffic to flow freely even in peak periods and improves travel time reliability by giving operators a mechanism to respond to changes in travel demand. Except on very short or isolated segments, GO TO 2040's policy is to construct added lanes as express toll lanes.

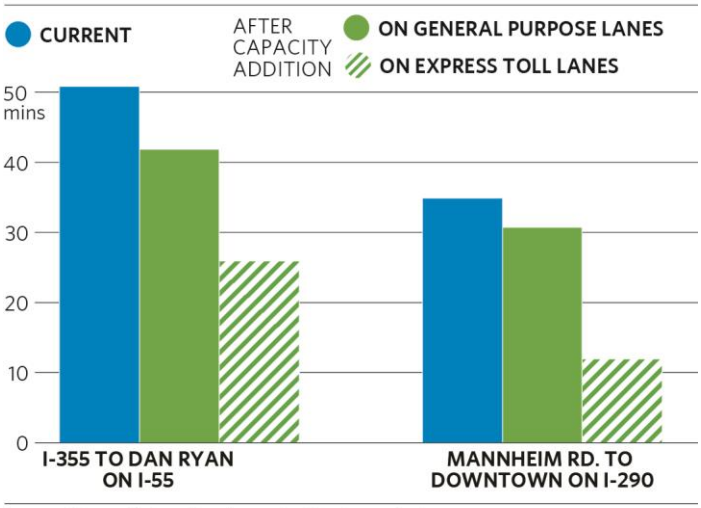
I-55 Stevenson Express Toll Lanes

The southbound Stevenson Expressway from I-355 to the Dan Ryan Expressway ranks among the ten most congested expressway segments in the region. The reconstruction of the Stevenson in the 1990s left much of the expressway with wide inside shoulders with mostly full-depth pavement that can withstand regular use. Thus, there is a major opportunity to convert this shoulder cost-effectively to an express toll lane, which would cut travel times (see Figure 1), improve reliability, and benefit transit services already using the corridor. The project would provide one express toll lane in each direction on I-55 between I-355 and the I-90/94. Per unit cost, the I-55 Express Toll Lanes project has the highest economic impact and second highest congestion reduction of any of the projects CMAP studied.

Funded by CMAP's Congestion Mitigation and Air Quality Improvement (CMAQ) program, Pace has for several years operated a successful program running express buses on the shoulder, but buses must merge with regular traffic at several narrow points and travel at limited speeds when on the shoulder. The express toll lane is envisioned to upgrade this service,

allowing continuous travel in a lane with minimal congestion from I-355 to the Dan Ryan. The Stevenson is also a freight-rich corridor with access to intermodal facilities. For safety and operational reasons, multi-unit trucks would not be able to use the express toll lanes, though any new capacity on the expressway will improve travel times and reliability for all users, including trucks.

Figure 1. Travel time savings on a typical trip on the Stevenson and Eisenhower express toll lanes (AM peak)



Source: Chicago Metropolitan Agency for Planning analysis.

The blue bars represent current travel times on a typical morning commute for a 23-mile trip on I-55 and an 11-mile trip on I-290. The green bars indicate travel times with the construction of express toll lanes. CMAP estimated the tolls for these two trips to be roughly $2.75 and $3.50, respectively. This assumes the toll is set to keep traffic at 55 mph.

The Illinois Department of Transportation (IDOT) has begun Phase I Engineering for the project but has not allocated specific funding for further engineering and construction. CMAP's work on **congestion pricing** suggests that pricing could reduce the constrained cost of the new lane by nearly 20 percent, making it critical to implement pricing to help fund the project. Perhaps the most significant challenge with this project is the lower priority that IDOT has placed on it relative to its other projects.

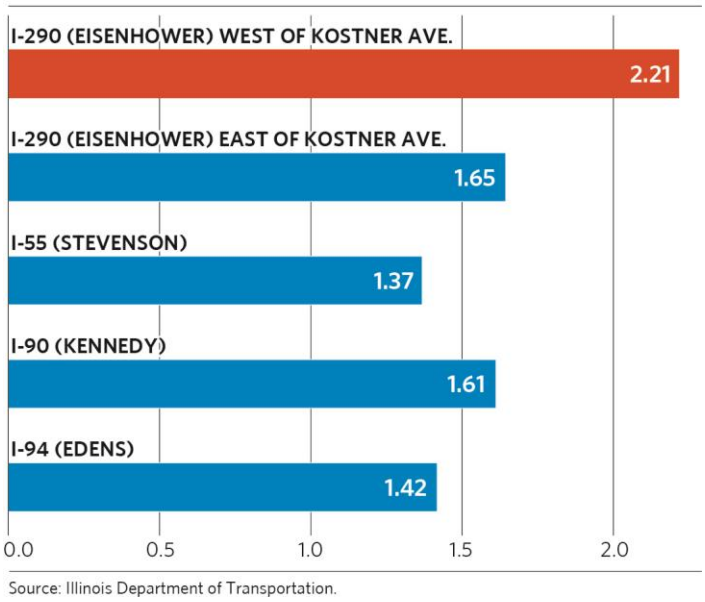
I-290 Eisenhower Express Toll Lanes

The Eisenhower Expressway was one of the earliest expressways constructed in the Chicago region and has been the vanguard for a number of innovations, including the first use of ramp metering and the construction of rapid transit in the expressway median. The Eisenhower Expressway is generally in the top five most congested expressway segments in the region. It also suffers from major geometric deficiencies, including narrow shoulders, short weaving distances between ramps, and especially the left-hand exits at Austin and Harlem Avenues. Moreover, it has what is probably the most severe bottleneck in the region, where the number of lanes drops from four to three west of Central Avenue. As a result of these problems, the western portion of the expressway has a significantly higher crash rate than comparable expressways in the region (see Figure 2).

Adding an express toll lane to the Eisenhower from Mannheim Road to Racine Avenue will significantly improve speeds and travel time reliability on the facility. Reconstruction and

modernization of the facility will help improve safety. IDOT is currently in Phase I Engineering for this project and has narrowed its study to four alternatives, all of which involve adding a lane to the Eisenhower. However, the Department has not allocated specific funding in the near term for further engineering and construction. CMAP's work on congestion pricing suggests that pricing could reduce the constrained cost of the new lane by about a quarter, making pricing a key part of funding the project.

Figure 2. Crash rates on select Chicago-area expressways, per million vehicles per mile



While this project has significant engineering challenges relating to the availability of right-of-way and railroad coordination, perhaps its biggest obstacle is the potential for community impacts. The expressway is in a dense urban corridor. One important mitigation approach is the improvement of the pedestrian and transit station environment along the Blue Line, which the Chicago Transit Authority (CTA) has been considering in its Blue Line Forest Park Branch Feasibility/Vision Study.

Expressway Additions: Interchanges and Improvements

The projects in this category either reconstruct and modernize older highway infrastructure or correct major deficiencies. While they provide some additional capacity, this is modest relative to the contribution that these projects make to achieving the overall goal of maintaining and improving the existing highway system. CMAP treats interchanges between expressways as major capital projects.

Circle Interchange

The Circle Interchange project will reconstruct and modernize an interchange that has not had a major rehabilitation since it was first built more than a half-century ago. While it is mostly a reconstruction project, new capacity will be added in the form of an additional lane on the east-north and north-west ramps, as well as three new flyovers. A new through-lane will also be added on I-90/94, correcting a deficiency that forces drivers to make lane changes when entering the interchange. The new ramp configurations and added lanes are expected to significantly reduce crashes for all users. The Circle Interchange is the busiest interchange in in the region, and is typically among the most congested interchanges in the country. For several years the Federal Highway Administration (FHWA) has identified the Circle Interchange as the **worst freight bottleneck in the U.S.** Rehabilitation of the interchange will support the region's competitive position in freight, manufacturing, and other industries.

FHWA issued a Finding of No Significant Impact for the project in late 2013, allowing it to proceed to construction. Since the project is in a dense, urban area with older buildings, noise walls will be needed in certain areas, as well as special attention to the potential for structural damage to adjacent buildings during construction. Particular attention is expected to be given to improving the pedestrian environment around the interchange and at the Chicago Transit Authority's (CTA) Halsted/UIC Blue Line station.

I-294/I-57 Interchange

The crossing of I-294 and I-57 is the only place in the region, and one of very few locations in the country, where two interstates cross but do not have an interchange. The Tri-State Tollway links the region's suburban communities in an arc from the south suburbs to Lake County, providing access to O'Hare International Airport and several commercial and industrial centers, as well as intermodal freight terminals. The I-294/I-57 interchange project will provide a full connection of these two interstates for improved accessibility to and from the south suburbs and for improved north-south regional travel. The Tollway included this project in its Move Illinois capital program. Construction of Phase 1, which is anticipated to provide the largest congestion reduction benefits, will be complete in 2014. It involves construction of new ramps to connect northbound I-57 to northbound I-294 and southbound I-294 to southbound I-57, as well as an entrance and exit ramp from I-294 to 147th Street. Phase Two is planned for completion in 2024 and will provide the remaining interchange connections.

I-190 Access and Capacity Improvements

The I-190 Access Improvements project consists of reconfiguring arterial access to I-190 and O'Hare International Airport to improve mobility and reduce collisions, as well as ultimately reconstructing and adding capacity to mainline I-190. Project planning is advancing; several elements have already been funded through IDOT, Chicago Department of Transportation (CDOT), and the Chicago Department of Aviation, using Passenger Facility Charge funds. O'Hare International Airport and its surrounding freight and manufacturing development are a significant economic engine for the region. But, the area experiences significant congestion and

unreliable travel times. The I-190 project will improve access to the O'Hare area and reduce congestion in a high-traffic corridor.

Jane Addams Tollway (I-90)

As part of the Move Illinois program, the Illinois Tollway is reconstructing the Jane Addams Tollway from Rockford to I-294, given that most of the roadway is more than a half-century old. A new lane will also be added in each direction to accommodate current and future traffic. The Addams experiences congestion within the Chicago region, although not to the same degree as the Stevenson and Eisenhower. As part of the project, the Tollway is making major strides in modernizing the Addams by including active traffic management technology that warns drivers of upcoming congestion and closes lanes well ahead of a stalled vehicle or wreck (Figure 3). This technology would also permit the use of variable speed limits (speed harmonization), which has been shown to reduce crashes and increase roadway capacity by stabilizing traffic flow.

While the Tollway has studied the use of congestion pricing on the new lane, it has elected not to implement the policy on the Addams when the reconstruction and widening is complete in 2016. The ITS infrastructure will be in place to support a future decision to use congestion pricing, but converting to congestion pricing later may present a challenge for public acceptance. The Tollway is also working closely with Pace to operate a bus-on-shoulder program along the Addams, which is partly funded by CMAP through the CMAQ program.

Figure 3. Example of active traffic management from Washington State



Source: Washington State Department of Transportation.

Transit Improvements

Projects that rehabilitate transit lines to improve asset condition and that add service to accommodate greater ridership are major elements of GO TO 2040's focus on maintaining and modernizing existing infrastructure. These projects add capacity by making improvements to track, platforms, and stations for the purpose of increasing the number of riders that can move through the system. Some of these investments are part of the CREATE program or involve operational improvements that make the freight and passenger rail system work more efficiently. This enhances the region's economic competitiveness.

The transit improvement projects included in GO TO 2040 support existing communities and also create new opportunities for transit-supportive development. Considerable planning has been completed both for the stations and broader communities around these investments, although plans are not yet in place for all stations included as part of the major capital projects. Completing and implementing these plans is a priority. The plans should seek to foster livable communities and support the region's substantial investment in new and proposed transit infrastructure by promoting land use patterns that allow transit access.

CTA North Red/Purple Line Modernization

This project envisions a modernization of the 100-year old "El" lines serving the north side of Chicago and near north suburban communities. The Red and Purple Line modernization will provide significant reinvestment in existing communities and upgrade the CTA's most heavily used rail line. Dilapidated viaducts and crumbling infrastructure will be replaced or improved, building a new elevated structure and providing a quieter, more livable environment. The improved facility is also expected to experience significantly lower operating and maintenance costs once it is brought to a state of good repair. A Brown Line flyover at Clark Junction, which would decrease travel time for riders by allowing Brown Line trains to cross above the Red and Purple Line tracks, is also being considered for the project.

The CTA is analyzing traditional and innovative funding options. The project recently received authorization to apply for funding under the new Core Capacity Program of the Federal Transit Administration's New Starts transit funding program. The Core Capacity Program allows existing systems to apply for New Starts funds if they expand capacity by at least 10 percent in transit corridors that are currently at or above capacity. The project also has the potential to use innovative funding methods like value capture or obtain innovative financing through the federal Transportation Infrastructure Finance and Innovation Act (TIFIA) program, which provides low-cost loans to transportation projects. CMAP's financial plan assumes value capture will provide approximately five percent of the project's total cost.

West Loop Transportation Center Phase I Improvements

The West Loop Transportation Center is envisioned as a new transportation hub that would reconfigure Chicago Union Station and ultimately lead to greatly improved connections between rapid transit, bus, commuter rail, and intercity rail services, supporting the GO TO 2040 goal of seamless coordination between transit modes. The **Union Station Stage 1 Master Plan** determined that work on the project should take place in two key phases: Phase 1 improvements to existing facilities east of and within Union Station, and Phase 2 development of a new underground transitway in the West Loop.

In the GO TO 2040 plan update, only Phase 1 is included in the fiscally constrained project list. Phase 1 will increase capacity within the existing footprint of Chicago Union Station by creating new platforms and tracks and by repurposing currently inactive tracks and platforms formerly

used for mail handling. It will also expand the passenger-carrying capacity of existing platforms used by commuter trains, reconfiguring the station's internal spaces to increase passenger capacity. Finally, the project will create the capability to through-route some intercity trains.

Metra Rock Island Improvements

Metra's improvements to the Rock Island District (RID) Line will enhance coordination between freight traffic and Metra trains as well as allow for eventual connection of the SouthWest Service (SWS) with LaSalle Street Station. This connection and other improvements will improve rail freight movement through the region, reduce congestion, and improve access at Union Station. Improvements include adding a third track to the nine-mile double-track portion (between Gresham Junction and a point north of 16th Street Junction) of the RID Line. The upgrade also includes the CREATE P1 Project, new bi-directional signals, centralized traffic control to integrate with existing RID operations, several new or rehabilitated bridges over city streets, and an expanded and modernized 47th Street Yard. CREATE Project P1 is a rail flyover expected to eliminate conflict between 78 Metra Rock Island trains and approximately 60 freight and Amtrak trains that presently cross at grade through the Englewood interlocking each day. This portion of the RID project is fully funded and under construction.

Metra SouthWest Service Improvements

The SouthWest Service Improvements project will reduce congestion at Union Station and improve freight movements within and through the region. As part of the CREATE 75th Street Corridor Improvement Project, it will address the most congested rail chokepoint in the Chicago Terminal District. As part of this project, the SouthWest Service will be rerouted to terminate at LaSalle Street station, relieving congested operations at Union Station. The improvements also include constructing a two-mile segment beginning west of Belt Junction to carry trains over the parallel Norfolk Southern service along 74th Street to the Rock Island District Line tracks to provide improved reliability with fewer operating conflicts.

Metra UP North Improvements

The UP North Improvements will improve the operating capacity and reliability of the line between Ogilvie Transportation Center and Kenosha through installation of additional crossovers and track improvements. A new outlying coach yard will allow for more efficient servicing of equipment and accommodate expansion of service. Additional upgrades to existing stations will accommodate an expected increase in passengers in both the traditional commute and reverse commute direction. A new station at Peterson and Ridge Avenues is also planned, and improvements to the existing Hubbard Woods Station are expected to expand transportation options for these communities.

Metra UP West Improvements

The UP West Improvements will provide track, signal, safety, and infrastructure improvements to increase passenger service and coordinate with freight traffic. Specifically, a third track will

be added to an existing double-track portion of the line east of Elmhurst. Among the alternatives under evaluation to address congestion at the A-2 Crossing, where the Milwaukee District and North Central Service lines cross the UP West near Western Avenue, are moving the crossing to a new location one mile east and constructing a flyover near the current crossing. These improvements will enable the UP West to better serve as an alternative to the BNSF line and also to operate more effectively in coordination with freight rail movements. In combination, these improvements would allow for an increase in service from 59 to 80 trains per day, nearly doubling estimated passenger miles traveled on the line. Part of the project involves upgrades to signal systems, crossovers, pedestrian safety improvements, and new triple track. Most of the pedestrian diversion construction was completed in summer 2011, and construction of signals and crossovers is currently proceeding.

New Projects and Extensions

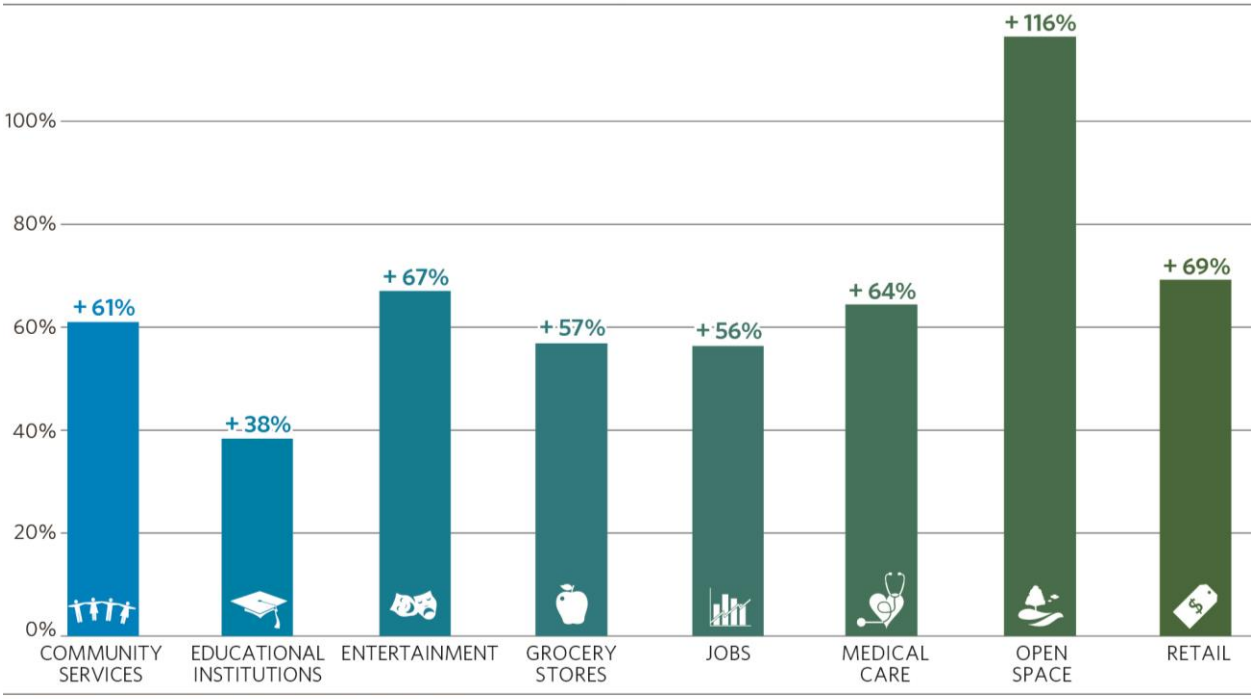
The focus of GO TO 2040 is first on maintaining and modernizing the existing system, then strategically adding capacity to existing facilities, and only then building entirely new projects. GO TO 2040 includes a small number of critically important new projects, discussed below.

CTA Red Line South Extension

The CTA Red Line currently terminates at the 95th Street/Dan Ryan station, which through the 1990s and most of the 2000s was the busiest CTA station outside of downtown Chicago because of its numerous connecting bus lines. South of 95th Street, residents struggle with long commute times and multiple transit transfers required to reach work, school, medical appointments, and services. By extending the Red Line south to 130th Street, the area it serves would see improved access to jobs and services, reduced travel times by streamlining CTA and Pace bus-to-rail connections, and enhanced livability and economic impact in distressed neighborhoods.

The Red Line south extension would be approximately 5.3 miles in length and add new stations at 103rd Street, 111th Street, and Michigan Avenue (115th) before terminating at 130th Street. The investment would cut transit travel time from 130th Street to the Chicago Loop by 21 minutes or 34 percent. It would also dramatically increase access to a variety of services and amenities for residents of the greater Roseland area to be served by the project (Figure 4). This access would offer residents significantly more employment opportunities and contribute to an improved quality of life. Furthermore, because of its proximity to an interchange with the Bishop Ford Expressway, the large (2,300-space) park-and-ride lot to be constructed at the 130th Street station will provide new commute options for southern Cook County as well.

Figure 4. Increase in number of services and amenities that can be accessed within 60 minutes with the Red Line Extension

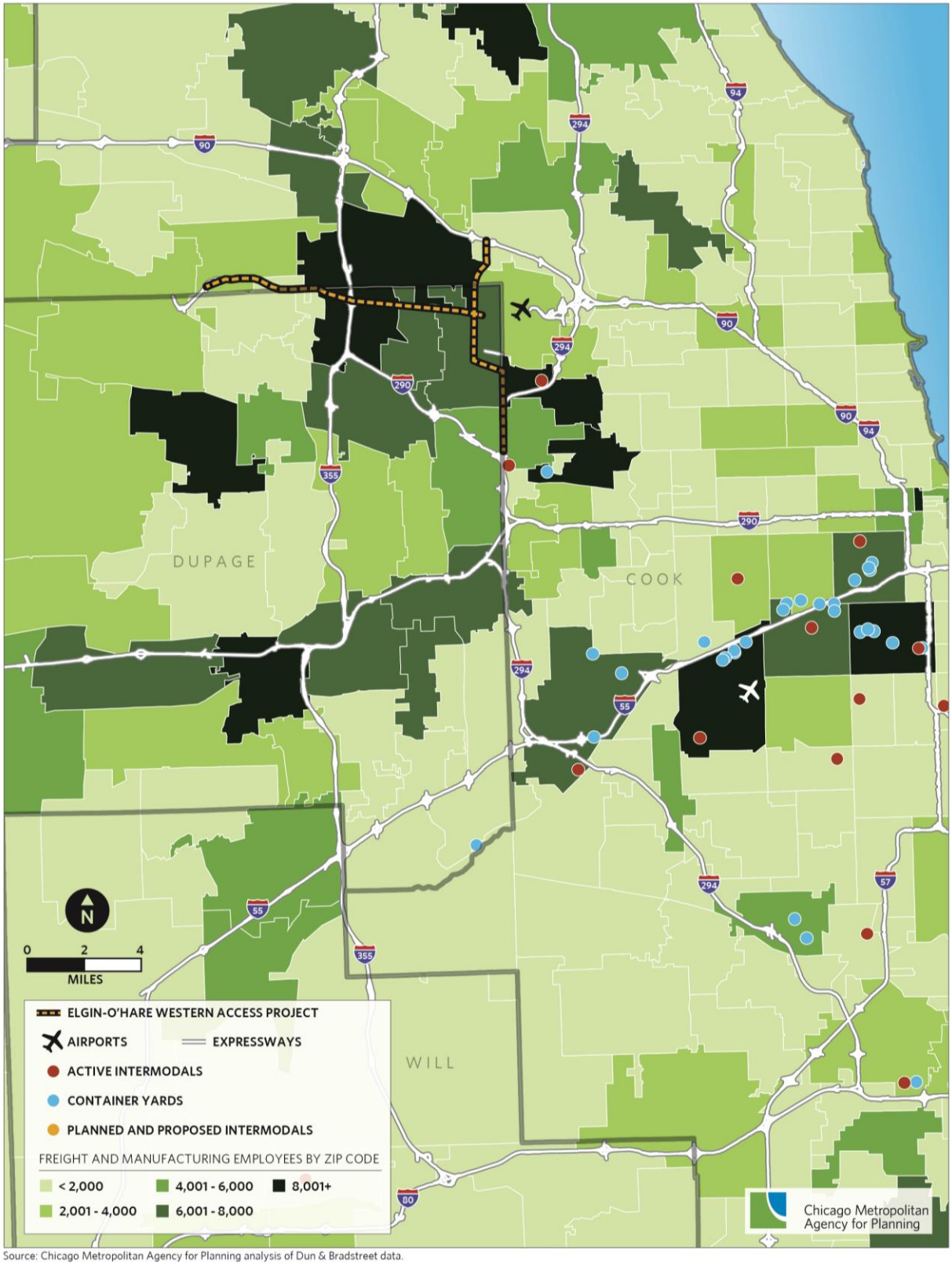


Source: Chicago Metropolitan Agency for Planning analysis, 2012.

While there is a large stock of affordable housing in the greater Roseland area, residents experience longer and more expensive commutes than the rest of the region. In particular, Roseland commuters drive to work alone at a rate 10 percentage points higher than the City of Chicago as a whole and spend a higher proportion of their income on transportation costs. By making transit use more viable, the Red Line Extension will improve overall affordability in the area it serves. Furthermore, the Red Line Extension has the potential to spur revitalization of the area around the planned d stations.

Perhaps the biggest challenge for the Red Line Extension is the specific allocation of funding to this project relative to other investments. Current CTA efforts are focused on reconstruction of the existing system, and this is appropriate given GO TO 2040's emphasis on modernization. However, the project has significant local support and substantial planning efforts have been undertaken by stakeholders in the community to lay the local groundwork for the facility.

Figure 5. The EOWA and CMAP region freight and manufacturing employment



Source: Chicago Metropolitan Agency for Planning analysis of Dun & Bradstreet data.

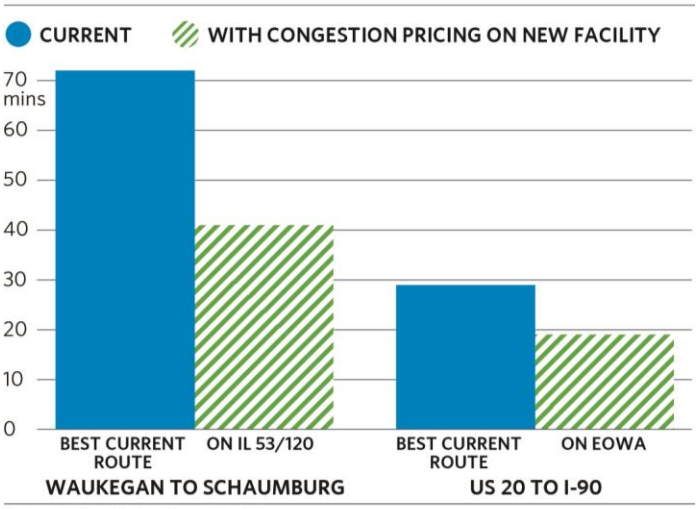
Elgin O'Hare Western Access

While the area around O'Hare International Airport owes its economic vitality to its unique convergence of air, road, and rail infrastructure, the same assets have also led to significant congestion problems for truck and passenger traffic. The Elgin O'Hare Western Access (EOWA) project will provide a new, limited-access facility to reduce congestion and improve access to the airport. The project includes three main components: reconstructing and widening the existing Elgin O'Hare Expressway, extending the expressway east to O'Hare International Airport, and adding an expressway around the western side of O'Hare from I-90 to I-294 (the western bypass). All three components will be tolled. The first two components are expected to be complete in 2018, while the western bypass is planned for 2025. Federal approval for the EOWA was given on January 24, 2013, and construction is now underway.

The EOWA provides critical support to the most significant cluster of freight and manufacturing employment in the region (Figure 5). It would also eventually provide access to the planned western terminal of O'Hare. In addition, the EOWA provides meaningful travel time savings (Figure 6) and yields the highest increase in access to jobs by automobile of any of the projects considered.

While the project does reserve right-of-way for future transit improvements, there are no specific commitments to providing this service. Planning for and implementing enhanced transit service that improves access to this regional employment center will be critical over the long term. Pace is currently developing the Cook DuPage Area Rapid Transit Investment Plan, which would identify investment priorities for rapid transit service, a refined network of near- and long-term transit corridors, and the establishment of an action plan to implement arterial rapid transit (ART). Transit service within the Elgin O'Hare Expressway is a component of this plan. Pace is expected to complete the plan in 2015.

Figure 6. Travel time savings on an example trip using IL53/120 and EOWA (AM peak)



Note: EOWB = Elgin O'Hare West Access.
Source: Chicago Metropolitan Agency for Planning analysis.

IL 53/120 Tollway

As development in central Lake County in recent decades has led to severe arterial traffic congestion, several attempts have been made to plan and build a north-south route through central Lake County. Those efforts were stalled by strong concerns over negative community and environmental impacts as well as funding challenges. In the past two years, the project has made significant progress via the Tollway's **53/120 Blue Ribbon Advisory Council** (BRAC), which developed consensus among communities, environmental groups, and other key stakeholders to build a "21st Century modern boulevard" in the corridor. **Principles from the BRAC process** are guiding the continued 53/120 work, and they call for "innovative design solutions for a safe, integrated, multi-modal corridor." In line with BRAC recommendations, the project is envisioned as a limited-access, four-lane, 45-mph tolled facility that uses congestion pricing to help manage demand. It would utilize a context-sensitive design that protects Lake County's communities and environmental assets. The project would extend the existing, limited-access IL Route 53 from its terminus at Lake-Cook Road to join IL Route 120 to the north. Additionally, the project would include an extension of the limited-access portion of IL Route 120. This project would offer significant travel time savings over travel on the arterial network (Figure 6).

Beyond the BRAC's effort, work is still needed to finalize the roadway design, plan for supportive land use, and develop a funding plan. As part of its **Illinois 53/120 Feasibility Analysis**, the Tollway has convened a Finance Committee comprised of local officials and stakeholders to develop a financing strategy for the facility. The Committee will evaluate both traditional and innovative revenue sources for the facility, including congestion pricing and value capture. The expectation is that toll revenue from the facility will be used to help fund its construction.

Of all the capital projects considered in the GO TO 2040 update, the IL 53/120 Tollway would have the highest congestion reduction benefits for both automobile and freight traffic. It would also have the largest economic impacts of any project. Although the environmental impacts from a conventional road design would also be high, work by the BRAC and furthered by CMAP in the corridor land use plan strongly suggests that the road can be designed to protect environmental assets and local community character. Planning for supportive land use will be critical to meet the mobility and livability goals of the project. In March 2014, CMAP, Lake County, and the Tollway initiated development of the **Illinois Route 53/120 Corridor Land Use Plan**. This multi-year effort will engage relevant municipalities, the environmental and economic development communities, and other stakeholders in a facilitated, open process to create a plan for land use, open space, local transportation, and economic development within a two-mile buffer of the IL 53/120 project right of way.

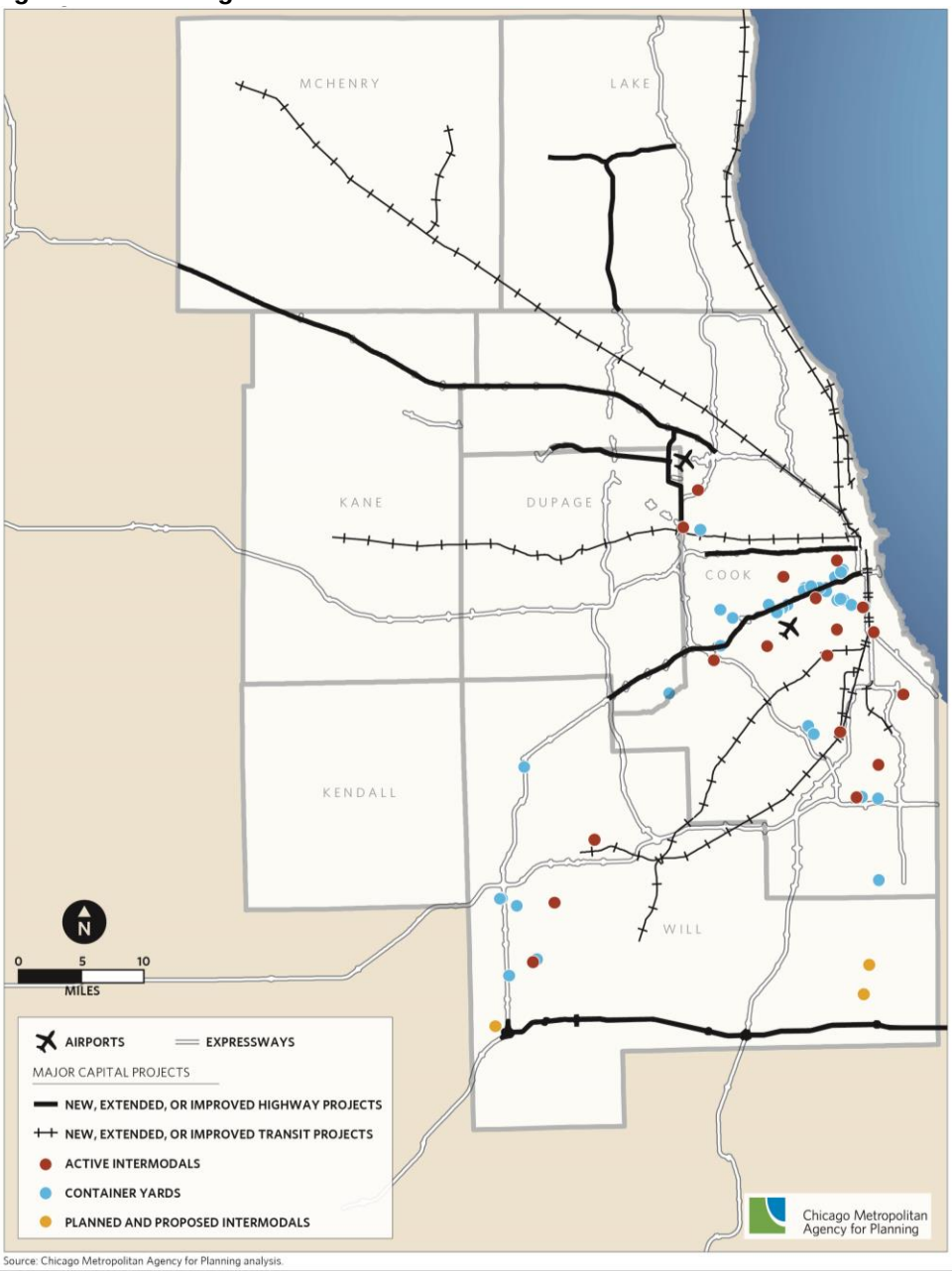
Illiana Expressway

Metropolitan Chicago maintains a significant competitive advantage over other freight hubs in intermodal operations, which facilitate the transfer of goods between truck and rail freight. Well-chosen investments in transportation infrastructure will be critical to maintain that

competitive position over the long term. The Illiana Expressway is designed to support the region's growing **freight cluster**.

The 47-mile, four-lane Illiana Expressway is envisioned as a bypass of I-80 for long-distance truck freight, as well as an alternative for heavy truck travel that is currently utilizing local roadways in Will County. Over the last decade, three new intermodal facilities have been developed in the western portion of Will County, and several additional intermodal facilities are proposed (Figure 7). This growing concentration of intermodal activity in Will County has driven an increase in truck traffic on local roads that are not configured for heavy truck use. In fact, modeling suggests that about 50 percent of the traffic on the facility would be heavy trucks.

Figure 7. CMAP region intermodal and container facilities



Source: Chicago Metropolitan Agency for Planning analysis.

The Illiana is on an accelerated timetable. The **Tier 2 Environmental Impact Statement** for the project is nearing completion, with the expectation of beginning construction in 2015 and opening to traffic in 2018. IDOT is pursuing use of a public-private partnership (P3) for the Illiana Expressway. GO TO 2040 supports the use of P3s as an innovative and efficient public finance tool, and also states that these arrangements must be handled with a high degree of transparency and care. IDOT has indicated that it intends to pursue an **availability payment P3 model** for the Illiana Expressway, an approach that may transfer risk in achieving projected toll revenues to the public sector.

A significant implementation challenge for the project is planning for growth that meets the tenets of GO TO 2040. The alignment for the Illiana is well to the south of the urbanized area. GO TO 2040 supports reinvesting in existing communities, pursuing opportunities for more compact, walkable, and mixed-use development, protecting the environment and preserving open space, and providing a range of housing options. A large volume of input was received during the public comment period of the plan update process regarding the Illiana Expressway from stakeholders who called for protecting regional environmental assets, particularly Midewin Tallgrass Prairie, and maintaining a compact regional growth strategy. Local planning to meet the goals of GO TO 2040 should be seen as a key part of the overall project.

Metra UP Northwest Improvements and Extension

Two improvements are planned on the UP Northwest line: infrastructure upgrades and a 1.6 mile extension to Johnsburg from McHenry. Infrastructure upgrades include improvements to the existing signal system and additional crossovers and other track improvements to increase operating capacity and reliability. Two additional stations will be added to the line at Prairie Grove on the McHenry branch and Ridgefield on the Woodstock branch. In addition, new yards are planned for the Woodstock and Johnsburg areas. These combined improvements, the extension, and new stations are estimated to considerably increase passenger miles traveled on the line. This project serves a substantial population of 2.8 million residents within 5 miles, and 1.6 million jobs. The full line travels through a major employment corridor in the Northwest suburbs, and the extension would increase access to jobs there and in downtown Chicago. Planning for transit-supportive development at new stations and for feeder bus service will increase access along the line.

Project Cost Estimates

This section presents the estimated cost of all the major capital projects considered and documents the methodology used. Federal rules on fiscal constraint require costs to be in year-of-expenditure dollars (YOE$) and to include both capital and operations and maintenance (O&M) costs. Thus, estimates are needed of both types of costs as well as the years in which these expenditures are expected to take place. CMAP staff worked with implementers to update project information including scope, costs, phasing plans, and the portion of the project that would involve the addition of new capacity.

Capital Costs

Capital costs were provided directly by the project sponsor. When provided in current year (or earlier) dollars, costs were escalated to YOE$ by assuming 3 percent annual cost inflation, the same as the assumption used in the GO TO 2040 financial plan for capital maintenance expenditures. Project phasing was taken into account when that information was available. When the sponsor provided costs in YOE$ but used a different cost escalation factor, costs were deflated to the base year and then escalated at 3 percent. In some cases, project sponsors did not provide a year within the time horizon of the plan. For those projects, the construction year is left blank and no YOE$ costs are calculated.

In CMAP's financial plan, the constrained cost of major capital projects is only the amount needed to build and operate new capacity. However, many major capital projects include elements of reconstruction as well as capacity addition. For example, add-lanes projects frequently include reconstruction of the existing facility along with addition of the new lane. The proportion of capital costs required for new capacity and reconstruction was provided directly by the project sponsor.

Operating Costs

Operating costs were generally estimated from information provided by sponsors. For highway projects, operating costs were estimated by applying unit costs (per year per lane-mile) to the amount of new capacity, then inflating the cost each year by 3 percent. The unit cost estimate for non-tolled highways was derived from costs for FY09 – FY13 operations on the interstate system provided by IDOT District 1. The estimate for Tollway projects was derived from information provided by the Tollway on operating costs for the Elgin-O'Hare Western Access project. The estimate for the Illiana was taken from back-up material for the Illiana Expressway project study.

Except when directly provided by the sponsor, annual operating costs for transit projects were assumed to be 1 percent of the initial construction cost. In these cases, half of the transit operating cost was assumed to be covered through farebox recovery and therefore would reduce the cost of the project required to be fiscally constrained. Again, operating costs were

inflated by 3 percent each year. These are the same assumptions previously used for transit projects in the major capital element of the GO TO 2040 plan.

Role of Project-Specific Revenues

Unless they have already been counted in the financial plan forecasts, any revenues specifically generated by a project help offset the constrained cost of the project. Accounting for project revenues is somewhat complex, but the following points can be made for specific projects.

- The Illiana Expressway is assumed to be tolled and to utilize a public-private partnership. **CMAP's earlier analysis of the project** found that, under a "moderate" financing scenario (neither optimistic nor pessimistic), a $710 million public contribution would be required to help fund the Illiana. It was assumed that this amount would have to be provided by 2040. After accounting for financing costs, then, project revenue is estimated to offset 53% of the Illiana Expressway's capital and ongoing operations costs.

- The revenues of Tollway projects funded under Move Illinois are included in the financial plan forecast, with the exception of the Elgin-O'Hare Western Access (EOWA) project. CMAP staff used back-up material provided by the Tollway to estimate the portion of EOWA project costs recovered by tolls from that facility. Additional revenues from congestion pricing were not assumed in the estimate, congestion pricing could offset an additional 9 percent of the constrained cost over and above flat tolling.

- Construction of the extension of IL 53 and IL 120 bypass (the Central Lake County Corridor) is not included in the Move Illinois program. Cost estimates were provided by Tollway staff and revenue estimates were derived from the 2012 Blue Ribbon Advisory Committee recommendations. They include tolling the new capacity as well as tolling existing Route 53, indexing tolls to inflation, congestion pricing, and value capture.

- The I-55 and I-290 managed lanes projects were assumed to have variable tolling with rates set to keep traffic moving at the speed limit. Both the capital and operating costs of priced managed lanes will be higher than on a newly added general purpose lane, mainly because electronic toll collection (ETC) systems will be needed. However, the revenue generated by these lanes would reduce the constrained cost by 24 percent on I-290 and 19 percent on I-55 in comparison to a non-priced managed lane alternative.

- The Red/Purple Line Modernization project was assumed to have a small portion (5 percent) of its overall costs covered through the use of value capture, estimated as the blended potential of either a special service area or a mechanism similar to a tax increment finance district.

Managed Lanes Methodology

Revenue for I-55 and I-290 was estimated from a previous **CMAP study of congestion pricing**. The costs of building and operating the electronic toll collection (ETC) systems were estimated from backup material for the 2010 study by the Tollway and the Metropolitan Planning Council. To estimate the total project capital cost, the costs related to ETC (detection equipment, gantries, etc.) were added onto the capital costs provided by the implementers. Additional costs related to lane separation were assumed negligible (striping only). Operating costs for ETC were taken from a survey of other managed lanes projects in the backup material. To account for financing costs, construction was assumed to be financed through bonds with a 20-year term, 6 percent interest, and a debt coverage ratio of 2.0. Revenue was assumed to grow at 1 percent while costs grow at 3 percent.

Results

The full list of fiscally constrained projects and their costs is in Table 1, while the unconstrained projects are in Table 2. The second-to-last column in bold type indicates the new capacity costs considered for fiscal constraint, while the last column describes the reconstruction costs associated with that new capacity. Constrained projects come to $12.33 billion for new capacity with an additional $8.53 billion in associated reconstruction costs. No YOE$ costs are provided for projects outside the planning horizon (indicated by a '–' in the third column).

Table 1. Costs of fiscally constrained major capital projects

Project	Project information				Costs for new capacity in YOE$b					Associated reconstruction costs, YOE$b
	Sponsor	Year	Capital cost, 2014$	Percent of cost for new capacity	Capital cost, YOE$b	Operating costs to 2040, YOE$b	Total project cost, YOE$b	Cost offset by new project-specific revenue	**Constrained cost, YOE$b**	
Elgin O'Hare Western Access*	Tollway	2020	2.15	99%	2.52	0.20	2.72	52%	**1.11**	0.03
I-90 Reconstruction and Widening	Tollway	2016	1.27	17%	0.23	0.07	0.30	0%	**0.30**	1.11
Illinois 53/120 Tollway	Tollway	2020	2.10	88%	2.78	0.08	2.87	30%	**1.63**	0.32
I-294/I-57 Interchange Addition	Tollway	2024	0.35	75%	0.35	0.01	0.36	0%	**0.36**	0.12
I-55 Express Toll Lanes	IDOT	2020	0.40	80%	0.38	0.03	0.41	19%	**0.33**	0.10
I-290 Express Toll Lanes	IDOT	2020	1.60	20%	0.38	0.01	0.39	24%	**0.30**	1.53
Illiana Expressway	IDOT	2016	1.00	100%	1.06	0.46	1.52	53%	**0.71**	-
I-190 Access Improvements	IDOT	2020	0.38	20%	0.09	0.00	0.09	0%	**0.09**	0.36
Circle Interchange Reconstruction	IDOT	2015	0.41	20%	0.08	0.00	0.09	0%	**0.09**	0.34
Red Line Extension (South)	CTA	2020	1.70	82%	1.66	0.23	1.90	0%	**1.90**	0.37
Red/Purple Line Modernization	CTA	2020	4.20	64%	3.21	(0.06)	3.15	5%	**2.99**	1.81
UP Northwest Extension	Metra	2020	0.58	50%	0.35	0.19	0.54	0%	**0.54**	0.35
SouthWest Service Improvements	Metra	2020	1.03	25%	0.31	0.16	0.47	0%	**0.47**	0.92
UP North Improvements	Metra	2020	0.45	25%	0.13	0.07	0.21	0%	**0.21**	0.40
UP West Improvements	Metra	2020	0.52	25%	0.16	0.08	0.24	0%	**0.24**	0.47
Rock Island Improvements	Metra	2020	0.05	25%	0.02	0.01	0.02	0%	**0.02**	0.05
West Loop Transportation Ctr: Phase 1**	CDOT	2020	0.84	75%	0.75	0.30	1.05	0%	**1.05**	0.25
Total for constrained projects									**12.33**	8.53

* Operating costs for the Elgin O'Hare Western Access project are already included in the financial plan expenditure forecasts, so they are not counted as part of the constrained cost here. ** In GO TO 2040, the West Loop Transportation Center was considered one project. As a result of the Union Station Master Plan, it was broken into two projects.

Table 2. Costs of unconstrained major capital projects

Project	Project information				Costs for new capacity in YOE$b					Associated reconstruction costs, YOE$b
	Sponsor	Year	Capital cost, 2014$	Percent of cost for new capacity	Capital cost, YOE$b	Operating costs to 2040, YOE$b	Total project cost, YOE$b	Cost offset by new project-specific revenue	**Cost considered for fiscal constraint, YOE$b**	
Elgin O'Hare Exwy Far West Extension	Tollway	-	0.24	100%	-	-	-	-	-	-
Elgin O'Hare Exwy West Extension	Tollway	-	0.20	100%	-	-	-	-	-	-
I-294 Central Tri-State Mobility Imprvmt	Tollway	2025	1.04	25%	0.36	0.05	0.41	0%	**0.41**	1.08
I-55 Add Lanes - I-80 to Coal City Rd.	IDOT	-	0.84	20%	-	-	-	-	-	-
I-57 Add Lanes	IDOT	2030	0.90	80%	1.15	0.01	1.16	0%	**1.16**	0.29
I-80 Managed Lanes - Ridge Road to US	IDOT	2020	0.75	20%	0.18	0.12	0.30	0%	**0.30**	0.72
I-80 Managed Lanes - US 30 to I-294	IDOT	-	0.45	80%	-	-	-	-	-	-
I-80 to I-55 Connector	IDOT	-	0.10	100%	-	-	-	-	-	-
IL 394	IDOT	-	0.60	40%	-	-	-	-	-	-
West Loop Transportation Ctr: Phase 2**	CDOT	-	2.09	100%	-	-	-	-	-	-
Blue Line West Extension	CTA	-	2.57	75%	-	-	-	-	-	-
Brown Line Extension	CTA	-	4.14	75%	-	-	-	-	-	-
Circle Line South (Phase II)	CTA	-	1.00	75%	-	-	-	-	-	-
Circle Line North (Phase III)	CTA	-	2.24	75%	-	-	-	-	-	-
Orange Line Extension	CTA	-	0.50	75%	-	-	-	-	-	-
Yellow Line Enhancements and Extension	CTA	-	0.29	75%	-	-	-	-	-	-
Express Airport Train Service	CTA	-	1.80	50%	-	-	-	-	-	-
BNSF Extension	Kendall	-	0.84	100%	-	-	-	-	-	-
BNSF Improvements	Metra	-	0.45	25%	-	-	-	-	-	-
Heritage Corridor Improvements	Metra	-	0.20	25%	-	-	-	-	-	-
Metra Electric Improvements	Metra	-	0.45	25%	-	-	-	-	-	-
Metra Electric Extension	Metra	-	0.29	50%	-	-	-	-	-	-
Milwaukee District North Extension	Metra	-	0.64	75%	-	-	-	-	-	-
Milwaukee District West Extension	Metra	-	0.42	75%	-	-	-	-	-	-
Milwaukee District West Improvements	Metra	-	0.45	25%	-	-	-	-	-	-
North Central Service Improvements	Metra	-	0.33	50%	-	-	-	-	-	-
Rock Island Extension	Metra	-	0.32	100%	-	-	-	-	-	-
SouthEast Service	Metra	-	0.83	75%	-	-	-	-	-	-
SouthWest Extension	Metra	-	0.33	50%	-	-	-	-	-	-
STAR Line	Metra	-	3.00	100%	-	-	-	-	-	-
Central Area Transitway	CDOT	2020	0.36	75%	0.33	0.13	0.46	0%	**0.46**	0.11
Mid-City Transitway	CDOT	-	1.60	100%	-	-	-	-	-	-

Project Evaluation

GO TO 2040 strongly encourages transportation implementers to select projects based on their performance. For the major capital element of the GO TO 2040 update, CMAP evaluated the benefits of proposed capital projects to help prioritize them for inclusion within the plan's fiscal constraint. The primary tool used to evaluate the major capital projects was CMAP's regional travel demand model, supplemented with spreadsheet analyses and commercial economic impact software.

Build and No Build Scenarios

Travel conditions in 2040 were compared with the project (build scenario) and without the project (no-build scenario). All currently constrained projects were included in a single GO TO 2040 network as the build scenario. For each constrained project, an individual no-build scenario was constructed that excluded only the project in question. For unconstrained projects, the GO TO 2040 network was considered the no-build scenario, and each unconstrained project then had an individual build scenario constructed that included the project in question. The change between no-build and build measures was calculated accordingly by using the difference between the appropriate scenarios. The characteristics of individual projects were coded into the model based on information supplied by the project sponsors.

Evaluation Measures

The following summary describes evaluation measures and the methods used to calculate them. While the modeled area extends outside of CMAP's service area, the evaluation measures are calculated only for the area within the CMAP region.

- **Long-term economic development** – Measured by gross regional product in 2040, which is the total business output in the region less the value of inputs, reported in millions of dollars. This measures long-term gains from a more efficient transportation system rather than short-term gains from economic activity associated with facility construction.

  This measure relies on a combination of information generated by the travel demand model and TREDIS, software used to estimate economic impacts. A TREDIS input file is created from the travel demand model results for each build and no build scenario, and each file is input to TREDIS using a web-based interface which generates the estimate of gross regional product. Changes caused by the project are based on the difference between build and no-build scenarios, with changes in accessibility, delay, overall travel, etc. converted to economic impacts by county.

- **Congestion** – Measured by daily vehicle-hours traveled in congested conditions ("congested VHT"), both in the region as a whole and in a five-mile corridor around the

facility. It includes all network traffic which occurs inside the CMAP area, even if it originates or is destined to areas outside the CMAP area.

Congested highway links were identified with a volume/capacity ratio exceeding 0.9 and located within the CMAP area. On these links, vehicle equivalents were converted to vehicles, and the total volume was multiplied by the congested travel time. This calculation includes all vehicles, both autos and trucks. The process was applied to each of the eight daily time period assignment results, and summed. The change between build and no-build was calculated by simple subtraction of one total from the other.

For the corridor congested VHT, only links within the five mile buffer of the project were considered. These links were identified through a GIS exercise for both build and no-build conditions. The total for the corridor includes traffic on the new project. For the heavy truck regional and corridor congested VHT, the calculations were carried out in the same way, but only heavy truck vehicles were multiplied by link travel time.

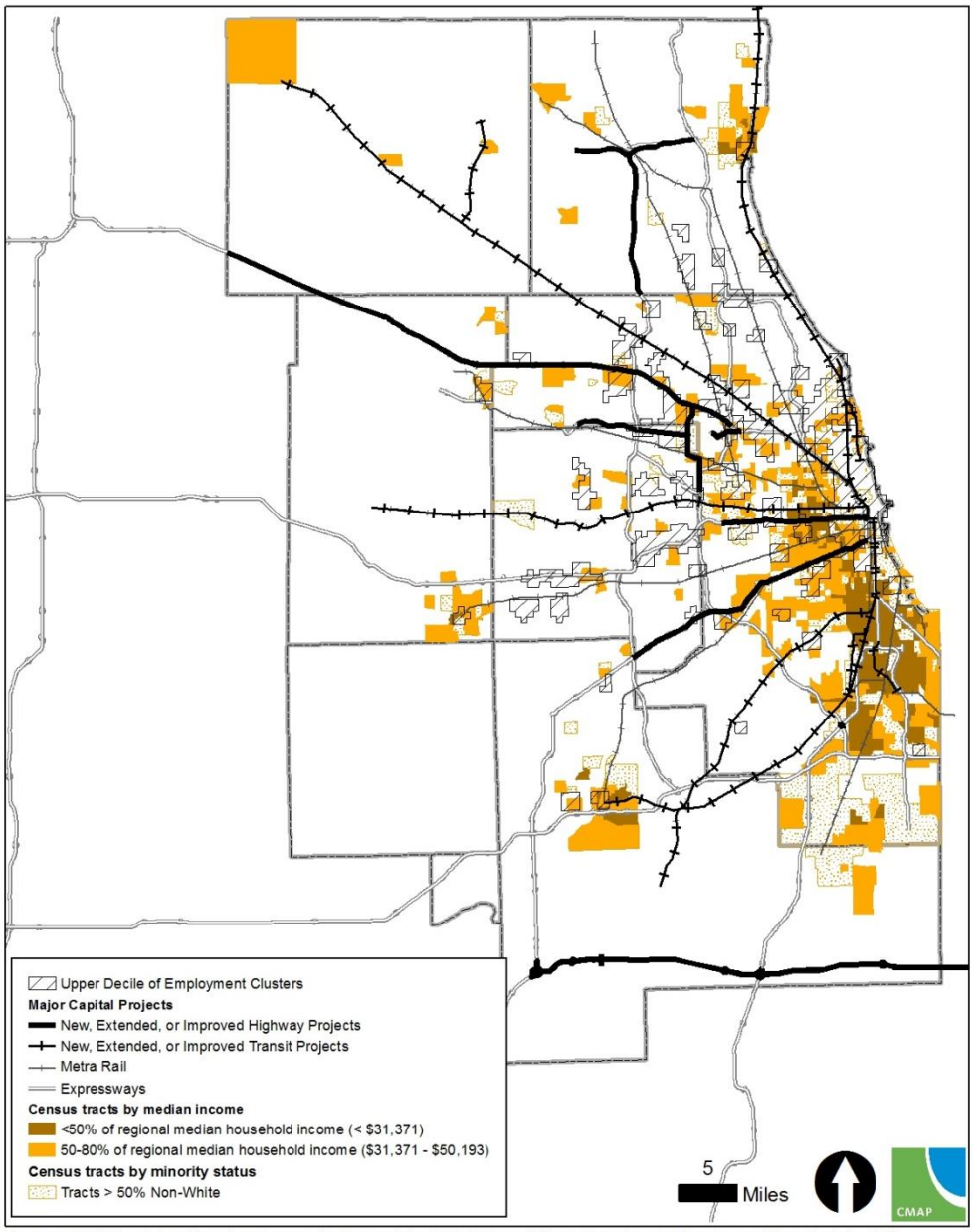
- **Work trip travel time** – Change in the average commute time in the region, in minutes, by auto or transit. For transit projects, all home-based work transit person trips originating in the CMAP area were multiplied by the total origin to destination transit travel time, on a zonal interchange by interchange basis. The transit travel time included in-vehicle time, walk transfer time, and waiting time. The product of trips and time was summed, and divided by the total number of home based work transit person trips. For this measure the destination end of the trip could be outside the CMAP area. For highway projects, the same procedure was used, with all home-based work auto person trips originating in the CMAP area multiplied by the A.M. peak congested highway time.

- **Jobs-housing access** – Measured as the number of jobs that can be reached by auto within 45 minutes or by transit within 75 minutes. For the transit calculation, a table based on the A.M. peak transit travel time was created, where the transit travel time was 75 minutes or less and the origin was within the CMAP area. The transit travel time included in-vehicle time, walk transfer time, and waiting time. The table was then multiplied by the destination employment vector and summed over the origins. The result is an origin vector whose contents are the total number of accessible jobs for each origin within the CMAP area. This data was summed into a scalar, for the total number of accessible jobs, and divided by the number of zones within the CMAP area for the average number of accessible jobs per zone.

  For the auto calculation, a table based on the A.M. peak auto travel time was created, where the travel time was 45 minutes or less and the origin was within the CMAP area. The table was then multiplied by the destination employment vector and summed over origins. The result is a vector with the number of jobs accessible for each origin. This vector was summed for the total number of accessible jobs, and then divided by the number of zones within the CMAP area.

- **Environmental justice** -- Environmental justice impacts were evaluated to demonstrate that the benefits of transportation investments are shared broadly in the CMAP region. This analysis was only conducted for projects included under fiscal constraint. It was evaluated by examining the jobs-housing access measure for census tracts where median income is less than the regional median income or where more than half of the population is minority to ensure that access to jobs by auto or transit is improving for disadvantaged communities as a result of the project. A map of these areas is shown in Figure 8 below.

Figure 8. Employment clusters, low-income areas, and minority status in the CMAP region



Sources: CMAP Analysis of American Community Survey data, 2008-2012, and Illinois Department of Employment Security data, 2012

- **Mode share** – Measured as net new daily transit trips, where transit projects are evaluated for their ability to induce transit trips and highway projects are evaluated for their potential negative effect on transit use. The home based work, home based non-work and non-home based transit person trip tables were summed for all origins within the CMAP area. The destination end of the trip could be outside the CMAP area.

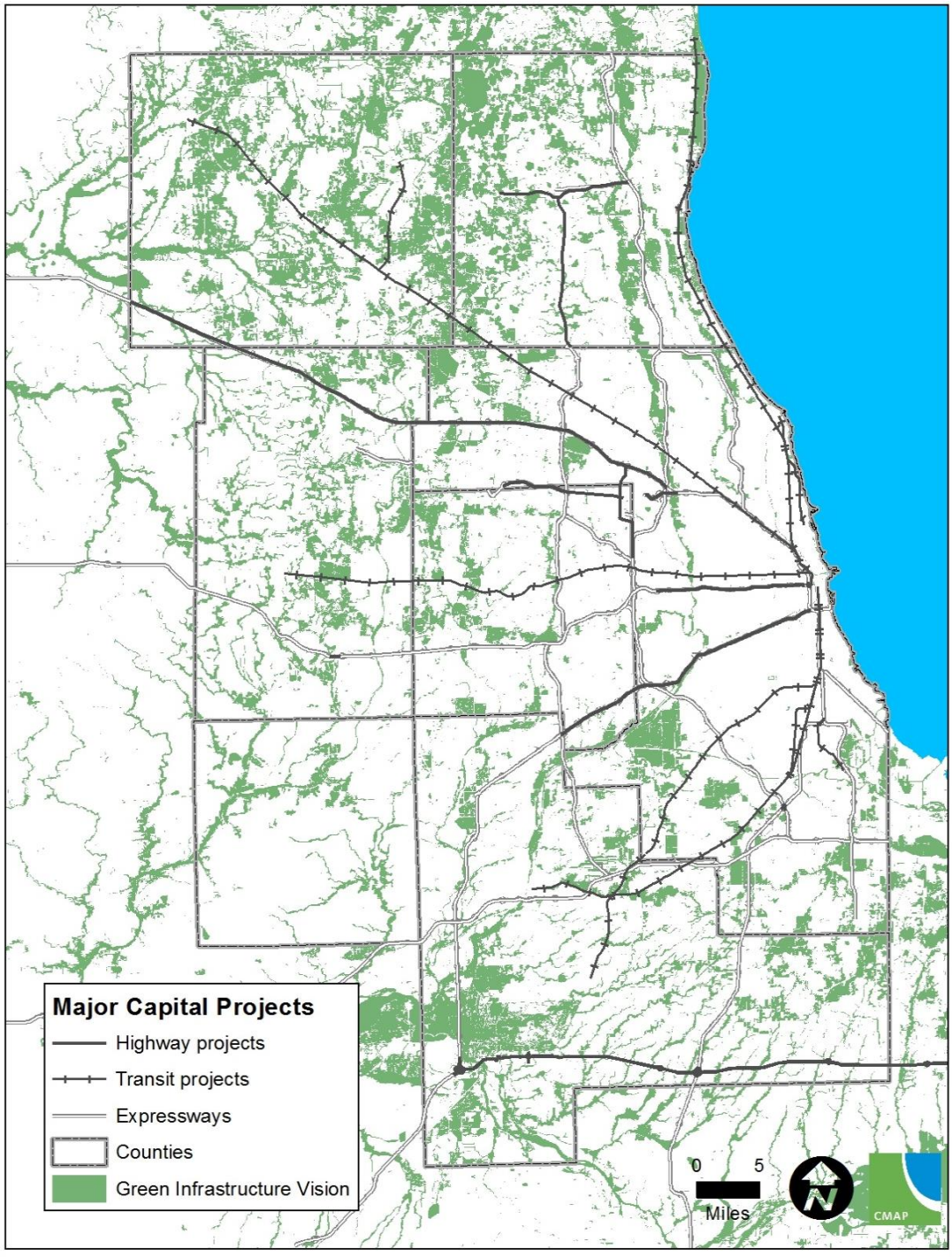
- **Air quality** – Measured as the change in carbon dioxide equivalent emitted by the transportation system in the region, in tons per year. The emissions of pollutants CMAP calculates under the Clean Air Act's transportation conformity requirements are ozone precursors and fine particulate matter. Emissions of these pollutants generally track with carbon dioxide emissions and for simplicity were not reported. The change in emissions of carbon dioxide equivalents was calculated using the MOVES model for each build and no-build scenario. The inputs were the standard processed model results used for the air quality conformity analysis, as described in the **Travel Model Documentation**. The procedure considers all traffic on links within the nonattainment area, whether or not the traffic originates within the region.

- **Natural resource preservation** – Two measures were used to try to capture impacts on natural resources: the creation of impervious surface and potential damage to regional green infrastructure. A well-accepted proxy measure for degradation of water resources, impervious surface is created directly by a facility as well as by encouraging spinoff development in undeveloped areas. Potential impact on terrestrial resources was measured by the number of households expected to locate in areas identified as ecologically important in the **Chicago Wilderness Green Infrastructure Vision** (Figure 9).

  Potential impact on the GIV is calculated by summing the number of households locating in an area as a result of the improved accessibility associated with the proposed project. The change in households was calculated as follows. For each project, the difference in composite transit and auto commute travel costs between build and no-build was calculated for each zone-to-zone trip interchange. The logsum of these costs was then calculated, which serves as the measure of accessibility. The probability of household change was based on the change in cost logsums. For the constrained projects, the original GO TO 2040 household forecast was the build forecast. Therefore, the probability of change calculation process resulted in a reduction factor to be applied to GO TO 2040 households where accessibility was reduced by removing the project to represent the no-build condition. The difference between build and no-build households was included in a GIS file for comparison with the green infrastructure areas. For unconstrained projects, the GO TO 2040 household forecast file was considered to be the no-build condition. The accessibility was increased by adding the project to represent the build condition. This resulted in a probability of increase in households which was applied to the GO TO 2040 number. The difference between build and no build households was included in a GIS file for comparison with the green infrastructure areas.

Impervious surface creation estimated from a subzone-level statistical relationship between imperviousness in the 2006 National Land Cover Dataset and the density of households and jobs. This statistical relationship was applied to the change in households and jobs in 2040 resulting from the project's accessibility improvement, as just described.

Figure 9. Chicago Wilderness Green Infrastructure Vision



Source: Chicago Metropolitan Agency for Planning.

- **Infill and reinvestment** – Measured by the percent of trips using the facility that originate within current municipal boundaries, which indicates the extent to which existing communities benefit from a project. For highway projects, a traffic assignment with select link analysis was used for each of the traffic assignment periods. The number of trips coming from trip generation zones within municipalities was calculated along with the total number of trips. For transit projects, a select segment transit assignment was undertaken. Transit is not capacity constrained, so a single daily transit assignment can be used. Each itinerary segment which was considered part of the project was flagged and any trips that used the segment during the transit assignment were collected into a daily transit matrix. Finally, the number of trip origins coming from within municipal boundaries and the total number of trips was calculated.

- **Facility condition –** For improvements or additions to existing facilities, reconstruction and modernization is a typical part of the project. Thus, existing facility condition is a relevant metric for prioritization. For highway projects, conditions were measured by the Condition Rating Survey (IDOT roads only). Higher values indicate better condition with a maximum of nine. Facility condition was not examined for transit or Tollway projects due to data availability issues.

Summary of Evaluation Results

Tables 3 and 4 below report the evaluation results as the change in the measure, i.e., the build scenario minus the no-build scenario. The baseline value for 2040 is provided at the bottom of the tables for comparison. Because the projects are small relative to overall travel in the region in 2040, modeling in some cases shows insignificant results. In those cases, the results are reported as '---'. It is important to emphasize that the evaluation is a planning-level comparison rather than the more detailed modeling required for project studies.

Roadway extensions typically have relatively large effects on regional mobility and accessibility. For instance, the Central Lake County Corridor reduces system congestion more than any other project, while the Elgin O'Hare Western Access project makes significantly more jobs available within a 45-minute drive. Several of the roadway extensions have fairly large economic benefits as well, much of which is driven by improved access to customers and suppliers for businesses. On the other hand, these roadway extension projects have higher costs and higher negative impacts as well. The Illiana Expressway is projected to create nearly 2,000 acres of impervious surface and induce the location of about 500 new households in important areas identified in the Green Infrastructure Vision, while the Central Lake County Corridor would create 2,200 acres of impervious surface and potentially induce 1,800 households to locate within the regional green infrastructure network (although the **Illinois Route 53/120 Corridor Land Use Plan** that CMAP is developing in conjunction with Lake County is expressly meant to lower such potential impacts). Overall environmental impacts are lower with the Elgin O'Hare Western Access because it is in an already-developed area.

Greenhouse gas emissions (GHG) from roadway extensions are variable. By reducing congestion, highway projects also reduce GHG emissions, since emission rates generally decrease as speeds increase. On the other hand, an overall increase in driving brought about by the project can offset this effect. The balance of these two competing factors is reflected in the handful of highway projects that show significant changes in GHG emissions. Lastly, highway extensions by themselves tend to affect transit ridership negatively. Many of the capital projects have transit elements (typically express bus or bus rapid transit) under consideration for them, but no specific information was available for modeling. Inclusion of transit elements in highway projects is expected to offset negative impacts on overall transit ridership. In one case transit ridership increases with highway construction; this is likely because the project increases accessibility to transit stations by car.

Like highway extensions, transit extensions typically have relatively large effects as well. For example, several of the transit extensions are able to put tens of thousands of additional jobs within reach in a reasonable commute time. They also have lower impacts on natural resources in their corridors, although a few do tend to increase development pressure on areas identified in the Green Infrastructure Vision. In general, transit extensions to areas that are poorly served by transit currently tend to show greater net increases in ridership while transit projects in transit-rich areas partly take their riders from existing services. Thus, a commuter rail extension to an outlying area may show a relatively high increase in overall ridership while a rapid transit project shows lower net ridership gains even though it has higher usage. Transit improvements typically have large reconstruction elements associated with them, but new capacity and service enhancement can combine to provide significant benefits. For instance, several of the transit improvement projects make 10,000 - 20,000 more jobs accessible.

With some exceptions, additions to existing highways typically have more modest effects than construction of new facilities. The I-90 managed lane project performs well because of its length and the congestion in the corridor, as does the Central Tristate Mobility Improvements project. Both reduce overall hours traveled in congested conditions with a large portion of the benefit to freight haulers. In general, additions to existing highways would be expected to support infill/reinvestment goals better, but it should be noted that several of the add-lanes projects have relatively low benefit to existing communities because they are on the outer portions of expressways. The add-lanes projects tend to have lower environmental impacts than the highway extension projects.

Two expressway-to-expressway interchanges were modeled. Although it adds some new capacity, the Circle Interchange is mostly a rehabilitation project. While the weighted average condition rating score puts it in good condition, portions of it are in much worse condition. While it was not modeled, the project is expected to reduce the number of crashes through the interchange as well. The interchange at I-294/I-57 is a new project at the only location where two interstates cross but do not interchange. Neither project shows a significant regional congestion reduction benefit and is expected to slightly worsen congestion in the surrounding corridor.

Lastly, job access to environmental justice areas improves as a result of GO TO 2040. The major capital projects increase by 61,000 the number of jobs accessible to disadvantaged census tracts within 45 minutes via car. The number of jobs accessible within 75 minutes via transit increases by 42,600.

Table 3. Evaluation results for highway projects: 2040 build minus no-build

Project	Fiscal constrain t status	Gross regional product ($ millions annually)	Regional congested VHT (daily)	Corridor congested VHT (daily)	Work trip travel time by auto (minutes)	Transit trips (daily)	Number of jobs accessible within 45 minutes by car	Carbon dioxide emissions (tons/year)	Number of households located in Green Infrastructure Vision areas	New impervious surface in project corridor (acres)	Percent of trip origins within current municipal borders	Heavy truck regional congested VHT	Heavy truck corridor congested VHT	Current Condition Rating Survey	Percent change in job accessibility in environmental justice areas
Elgin O'Hare Western Access	C	$598	-10,031	-3,433	-0.14	-882	21,688	38,476	---	---	96	555	452	7.4	1.6
I-90 Add Lanes	C	$93	-21,048	-13,699	-0.12	-1,366	8,129	88,422	---	732	90	-1,138	-883	---	0.4
IL 53/120 Tollway	C	$1,203	-64,406	-39,788	-0.37	-4,633	8,296	---	1,779	2,203	87	-5,811	-2,625	---	0.5
I-294/I-57 Interchange Addition	C	$95	---	936	---	-1,011	---	---	---	---	75	---	141	---	0.6
I-55 Express Toll Lane	C	$371	-8,347	-3,342	---	-2,531	4,966	---	---	---	94	---	---	7.8	0.5
I-290 Express Toll Lane	C	$272	-4,498	-1,566	---	---	5,491	-48,693	---	---	98	---	-111	8.6	0.5
Illiana Expressway	C	$425	-4,441	-1,471	---	---	3,849	99,528	478	1,948	42	-997	-78	---	0.4
I-190 Access Improvements	C	---	-6,808	-981	---	-1,116	---	---	---	---	89	---	---	4.5	0.0
Circle Interchange	C	$295	-7,247	1,108	---	-1,073	3,484	---	---	---	97	---	164	7.6	0.6
Elgin O'Hare Exwy Far West Ext.	U	---	---	-1,482	---	---	---	---	---	---	97	---	---	---	NC
Elgin O'Hare Exwy West Extension	U	---	---	-2,808	---	1,202	---	---	---	---	96	---	---	---	NC
Central Tri-State Mobility Imprvmt	U	$609	-15,245	-12,320	---	---	17,664	-66,690	---	---	94	-3,522	-3,219	---	NC
I-55 Add Lanes - I-80 to Coal City Rd.	U	---	---	-1,739	---	---	---	---	---	---	61	-522	-256	8.6	NC
I-57 Add Lanes	U	---	---	-6,664	---	---	---	---	---	---	69	-968	-895	7.7	NC
I-80 Managed Lanes - Ridge to US 30	U	---	---	-3,259	---	---	---	---	---	---	77	---	-218	8.5	NC
I-80 Managed Lanes - US 30 to I-294	U	---	---	-1,129	---	---	---	---	---	---	81	373	--	8.2	NC
I-80 to I-55 Connector	U	---	7,591	-520	---	---	---	-60,707	---	---	34	---	---	---	NC
IL 394	U	---	-9,054	-1,294	---	---	---	---	---	---	73	-377	-93	7.4	NC
Baseline*		$802,516	1,482,436	---	32.81	1,519,043	1,089,99	0.32 m	52,272	674,928	---	69,426	---	---	

* Baseline values of '---' are not included because the statistics are specific to each project. NC = not calculated for unconstrained projects.

Table 4. Evaluation results for transit projects: 2040 build minus no-build

Project	Fiscal constrain t status	Gross regional product ($ millions annually)	Regional congested VHT (daily)	Corridor congested VHT (daily)	Work trip travel time by transit (minutes)	Transit trips (daily)	Number of jobs accessible within 75 minutes by transit	Carbon dioxide emissions (tons/year)	Number of households located in Green Infrastructure Vision areas	New impervious surface in project corridor (acres)	Percent of trip origins within current municipal borders	Percent change in job accessibility in environmental justice areas
Red Line Extension (South)	C	---	---	-860	---	708	2,382	---	---	---	100	0.3
Red/Purple Line Modernization	C	---	---	-2,168	---	1,283	---	---	---	---	100	0.0
UP Northwest Extension	C	---	-8,135	-3,608	---	9,359	17,421	---	356	---	94	0.6
SouthWest Service Improvements	C	$127	---	956	---	1,722	6,156	---	---	---	98	0.2
UP North Improvements	C	---	-7,502	-4,711	-0.17	3,299	5,415	---	---	---	84	0.7
UP West Improvements	C	---	-9,216	-2,703	-0.20	4,315	19,063	---	---	---	99	1.0
Rock Island Improvements	C	---	---	-1,692	---	2,421	---	---	---	---	100	0.3
West Loop Transportation Center: Phase 1	C	---	---	---	---	---	---	---	---	---	---	---
West Loop Transportation Center: Phase 2	U	$417	---	---	-0.89	15,870	34,001	---	---	---	99	NC
Blue Line West Extension	U	---	---	---	---	4,372	8,153	---	---	---	100	NC
Brown Line Extension	U	$149	---	2,743	---	881	---	---	---	---	100	NC
Circle Line South (Phase II)	U	$416	---	---	-0.11	5,926	-8,379	-41,194	---	---	100	NC
Circle Line North (Phase III)	U	$437	---	---	---	5,583	-4,859	---	---	---	100	NC
Orange Line Extension	U	---	---	---	---	2,363	---	---	---	---	100	NC
Yellow Line Enhancements and Extension	U	---	---	---	---	4,124	---	---	---	---	100	NC
Express Airport Train Service	U	---	---	2,282	---	---	---	---	---	---	100	NC
BNSF Extension	U	---	---	-718	---	---	---	---	257	---	95	NC
BNSF Improvements	U	---	---	---	---	3,045	12,104	---	---	---	100	NC
Heritage Corridor Improvements	U	---	---	---	---	2,822	19,174	---	---	---	99	NC
Metra Electric Improvements	U	$211	---	---	---	5,800	---	---	---	---	99	NC
Metra Electric Extension	U	---	-10,678	---	---	---	---	---	---	---	83	NC
Milwaukee District North Extension	U	---	---	---	0.18	3,299	---	-42,130	551	524	99	NC
Milwaukee District West Extension	U	---	---	1,018	---	---	---	---	---	---	96	NC
Milwaukee District West Improvements	U	---	---	---	---	586	9,975	---	---	---	100	NC

Project	Fiscal constrain t status	Gross regional product ($ millions annually)	Regional congested VHT (daily)	Corridor congested VHT (daily)	Work trip travel time by transit (minutes)	Transit trips (daily)	Number of jobs accessible within 75 minutes by transit	Carbon dioxide emissions (tons/year)	Number of households located in Green Infrastructure Vision areas	New impervious surface in project corridor (acres)	Percent of trip origins within current municipal borders	Percent change in job accessibility in environmental justice areas
North Central Service Improvements	U	---	---	---	---	1,286	9,884	-43,180	---	---	98	NC
Rock Island Extension	U	---	---	493	---	---	---	---	243	---	84	NC
SouthEast Service	U	$190	---	---	---	5,016	14,381	-52,130	407	---	100	NC
SouthWest Extension	U	---	---	-56	---	---	---	---	---	---	82	NC
STAR Line	U	---	---	---	---	1,271	13,978	---	220	---	100	NC
Central Area Transitway	U	---	---	---	---	7,058	13,726	---	---	---	99	NC
Mid-City Transitway	U	$137	---	---	-0.22	4,594	31,697	---	---	---	100	NC
Baseline*		$802,516	1,482,436	---	43.96	1,519,043	840,121	32,192,565	52,272	674,928	---	

* Baseline values of '---' are not included because the statistics are specific to each project. NC = not calculated for unconstrained projects.

Unconstrained Major Capital Projects

The projects included under fiscal constraint were presented in a section above. This section describes the unconstrained projects to complete the full "universe" of capital projects considered. To develop the information presented here, CMAP staff consulted with the project implementing agencies to develop the universe of major capital projects for the plan update. CMAP staff met one-on-one with staff from the Chicago Department of Transportation (CDOT), Metra, Regional Transportation Authority (RTA), Illinois Toll Highway Authority (Tollway), Illinois Department of Transportation (IDOT), Chicago Transit Authority (CTA), and Pace Suburban Bus (Pace) to discuss existing major capital projects identified in GO TO 2040 and if they wished to submit new major capital projects to be included in the plan update. CMAP staff worked with project implementing agencies to update project description and status along with costs associated with the project.

Blue Line West Extension

Project description

This project would extend the CTA Blue Line to the west along the I-290 and I-88 corridors, with a western endpoint as far west as Lombard; an interim Mannheim Road terminus is currently under review as part of the I-290 corridor study.

Cost estimate

- Total project construction is estimated to cost $2.573 billion in 2014 $
- Year of construction: After 2040

Project status

- CTA has a Blue Line Vision study underway, which will evaluate facility conditions and improvement needs on the current service between the Forest Park and Clinton Street stations.
- The Cook-DuPage Corridor study recommends extending the Blue Line west to Mannheim Road with stations located at 1st Avenue, 25th Avenue and Mannheim Road.

BNSF Extension

Project description

This project would extend Metra BNSF service from its current terminus in Aurora to Oswego, in Kendall County. The project is nearly ready to begin Phase I engineering. It has been exempted from the New Starts evaluation process by federal action. Kendall County is currently

outside of the RTA service area. The project involves an extension outside the RTA service area, so project financing requires special attention. Metra has identified Kendall County as the sponsor for this project.

Cost estimate

- Total project construction is estimated to cost $84 million in 2014 $
- Year of construction: After 2040

Project status

- Metra has an Environmental Assessment and Preliminary Engineering contract underway. The PE contract will also develop estimates of capital and operating costs.
- The study so far has found no room for a yard in Oswego, so the project study has been extended to Yorkville, where yard and station space is available.
- Kendall County is currently outside of the RTA service area and must identify capital and operating funding for this project to proceed.

BNSF Improvements

Project description

This project would include making track, signal, and other improvements to the BNSF Line to support growth in ridership and upgrades to the core capacity of the line.

Cost estimate

- Total project construction is estimated to cost $447 million in 2014 $
- Year of construction: After 2040

Project status

- Identified as a potential future expansion project in Metra's Strategic Plan.

Brown Line Extension

Project description

This project would extend the CTA Brown Line from its current terminus near Kimball Avenue along Lawrence Avenue to connect with the CTA Blue Line at the Jefferson Park station. Intermediate stations would be provided at or near Pulaski Road and Cicero Ave. The project benefits would significantly decrease transit travel times in a heavily-travelled and congested corridor, while improving transit connectivity. The project is in early stages of development, and further investigation of the feasibility of this project, as well as alternative bus-based service such as ART or BRT, is needed.

Cost estimate

- Total project construction is estimated to cost $4.139 billion in 2014 $
- Year of construction: After 2040

Project status

- This project was identified during the Alternatives Analysis process for the Circle Line.
- The Brown Line extension is in an early stage of planning, and further investigation of the feasibility of this project, as well as alternative bus-based service such as ART or BRT is needed.

Central Area Transitway

Project description

This project includes a number of elements meant to improve circulation in downtown Chicago, including exclusive busways, bus rapid transit, light rail, and/or priority lanes on city streets. Several elements of this project, including any bus improvements on surface streets, can proceed at any time; the only elements of this project which are unconstrained are the construction of major capital facilities.

Cost estimate

- Estimated cost of the River North/Streeterville transitway portion of the project range from $250 million to $400 million depending on the vehicle technology selected.
- The project is estimated to cost $280 to $447 million in 2014 $ depending on vehicle technology
- Year of construction: 2020

Project status

- Several key initiatives are taking place now to support the Central Area Bus Rapid Transit Project.
- Prior feasibility studies have been prepared for the Carroll Avenue transitway element of the project, along a now unused railroad right-of-way along the north side of the Chicago River Main Branch.
- The City of Chicago is currently beginning an alternatives analysis for transit improvements focusing on connections between the River North/Streeterville and the rest of Chicago's Central Area.
- Transit improvements in the Clinton Street corridor are under study by CDOT and CTA as part of the West Loop Transportation Center proposal. For this element, property rights necessary for the project are being sought as the adjacent properties are

developed. Surface bus lane improvements in the Clinton Street corridor are included as an element within the City of Chicago's ongoing Central Loop BRT project.

- $24.6 million dollars in federal grants were awarded to CDOT to initiate the Central Loop BRT project, including bus lanes along Clinton, Canal, Washington, and Madison Streets. Construction completion is expected in late 2014/early 2015.

Circle Line (Phase II, South)

Project description

The Circle Line is a proposed new rail service that will connect several existing CTA rail lines. The southern portion of the Circle Line will travel south from the Ashland station of the Green and Pink Lines, have a transfer connecting to the Blue Line (Forest Pak Branch) at Congress and continue to the Orange Line. After this, the route will use the Orange Line alignment to travel into the Loop, with a transfer connection to the Red Line near 18th/Clark. Other intermediate stations would be provided at Madison, Roosevelt, and Blue Island/Cermak. Transfer connections with intersecting Metra lines would also be accommodated.

Cost estimate

- Total project construction is estimated to cost $1 billion in 2014 $
- Year of construction: After 2040

Project status

- The selection of a Locally Preferred Alternative for the southern portion of the Circle Line is underway through the Alternatives Analysis process.
- More documentation on this, including detailed reports and maps, is available at http://w.transitchicago.com/news_initiatives/planning/circle.aspx.

Circle Line (Phase III, North)

Project description

The Circle Line is a proposed new rail service that will connect several existing CTA rail lines. The northern portion of the Circle Line will connect the Ashland station of the Green and Pink Lines (also the northern terminus of the southern portion of the Circle Line) to the Red, Brown, and Purple Lines in the vicinity of North/Clybourn, with a transfer connection to the Blue Line (O'Hare Branch) at Division/Milwaukee. Other intermediate stations would be provided at Chicago and North/Ashland. Transfer connections with intersecting Metra lines would also be accommodated.

Cost estimate

- Total project construction is estimated to cost $2.237 billion in 2014 $
- Year of construction: After 2040

Project status

- The selection of a Locally Preferred Alternative is underway through the Alternatives Analysis process.
- More documentation on this, including detailed reports and maps, is available at http://w.transitchicago.com/news_initiatives/planning/circle.aspx.

Elgin-O'Hare Far West Extension

Project description

This project would build on the Elgin-O'Hare Expressway West Extension (described below) by upgrading US 20 through northwest Cook County. It is contingent on the completion of other projects.

Cost estimate

- Total project construction is estimated to cost $235 million in 2014 $ - *Neither engineering nor ROW acquisition included*
- Reconstruction costs: 0%
- Year of construction: After 2040

Project status

- There are no Phase I studies at this time
- This project is considered contingent on completion of Elgin O'Hare Expressway projects further east, and is in an early stage of planning.

Elgin O'Hare West Extension

Project description

This project would extend the Elgin O'Hare Expressway west from its current terminus in Hanover Park to a location along US 20 near Bartlett Road in Streamwood. A transit element may be included as part of this project.

Cost estimate

- Total project construction is estimated to cost $201 million in 2014 $
- Year of construction: After 2040

Project status

- The Village of Hanover Park is conducting a high level feasibility study.

Express Airport Train Service

Project description

This project would provide express service along the CTA Blue and Orange Lines, speeding connections to downtown Chicago. It also would include upgraded vehicles and a new downtown terminal that would allow airline and baggage check-in.

Cost estimate

- Total project construction is estimated to cost $1.8 billion in 2014 $
- Year of construction: After 2040

Project Status

- The City of Chicago has discussed the possibility of encouraging foreign capital investment in this project.
- The Chicago Department of Aviation contracted with AECOM to develop demand forecasts for this service.
- In the summer of 2013, AECOM released its findings, which focused primarily on express rail service between O'Hare Airport and the Chicago CBD based on market demand.
- The report studied potential rail alignments ranging from expanding existing CTA Blue Line service, to Metra railways, abandoned rail, and included automated guideway service.

Heritage Corridor

Project description

This project would improve operations on the Metra Heritage Corridor, which currently serves southwest Cook and Will Counties. The project includes reducing freight conflicts (including addressing some elements of CREATE), upgrading infrastructure, increasing service levels, and adding stations. Many elements of this project (including those associated with CREATE) are considered capital improvements with independent utility and therefore can be pursued at any time. It is currently in early stages of planning.

Cost estimate

- Total project construction is estimated to cost $199 million in 2014 $
- Year of construction: After 2040

Project status

- This project has not undergone Alternatives Analysis or any Phase I engineering component of the federal planning process.
- $20,000,000 for CREATE improvements has been programmed in the 2010-2014 Northeastern Illinois Transportation Improvement Program (TIP); however no work has been awarded.
- IDOT awarded funding for a passenger service improvement feasibility study, which was completed by the CN railroad.
- The Heritage Corridor was added as a passenger corridor of CREATE.

I-294 Central Tri-State Mobility Improvements

Project description

Move Illinois, the Illinois Tollway Driving the Future capital program anticipates reconstruction of the eight lanes on the Central Tri-State Tollway over the 22.3 miles length from 95th Street to Balmoral Avenue. Reconstruction years in the program are 2020 to 2022. Roadway design will be upgraded to current standards and operational requirements.

The Central Tri-State, designated Interstate Route I-294, connects five additional interstates; I-90, I-190, I-290, I-88, and I-55. This corridor has the Tollway's highest daily traffic, and produces half the Tollway system-wide recurring congestion. The Central Tri-State is nationally significant for freight movement and in the support of Midwest regional manufacturing. Concurrent with the need to reconstruct base pavement that is over fifty years old; roadway capacity and system interchange improvements are anticipated to enhance freight, transit, and economic mobility.

Project planning will require coordination with the Illinois Department of Transportation and Federal Highway Administration due to potential impacts to Interstate 55 and Interstate 290. This project will coordinate with I-55 Managed Lanes, the I-290 Multimodal Corridor, and the Elgin-O'Hare Western Bypass GoTo2040 capital projects.

Cost estimate

- Reconstruction cost estimate is $1.53 billion in 2014$. Including some potential capacity enhancement and system interchange improvements costs.
- Year of construction: 2020-2023

Project Status

- Illinois Tollway Engineering is furthering feasibility and cost estimates for the proposed improvements.

I-55 Add Lanes and Reconstruction I-80 to Coal City Road

Project description

This project would reconstruct I-55, add a lane in each direction, and improve interchanges through western Will County, from the I-80 interchange south. This project follows similar projects that have been completed on segments of I-55 farther north.

Cost estimate

- Total project construction estimated to cost $839 million in 2014 $
- Year of construction: After 2040

Project status

- IDOT is not currently engaged in any Phase I studies for this corridor
- IDOT will perform maintenance improvements along the corridor, as well as interchange improvements as appropriate in the near term.
- A new interchange connecting I-55 and the planned Illiana Expressway is being studied. This interchange would be located in the vicinity of IL 129/Lorenzo Road. The need for any auxiliary lanes on I-55 will be evaluated as part of the Illiana study.

I-57 Add Lanes

Project description

This project would add one lane in each direction to I-57 in eastern Will County, from I-80 south to the proposed South Suburban Airport. Project planning for this project is in its early stages.

Cost estimate

- The project is estimated to cost $895 million in 2014 $ - *Neither engineering nor ROW acquisition included*
- Year of construction: After 2040

Project status

- No project planning activities or studies are scheduled in the near future.

I-80 Add / Managed Lanes - Ridge Road to US 30

Project description

This project would add a lane to I-80 through southwestern Cook and Will Counties, from Ridge Road to US 30. This may be considered as a managed lane over some or all of its length.

Cost estimate

- Total project construction is estimated to cost $750 million in 2014 $
- Year of construction: 2020

Project status

- Planning is ongoing for a series of interim improvements that would address bridge condition, as well as a long term improvement of I-80 (complete reconstruction)

I-80 Managed Lanes – US 30 to I-294

Project description

A managed lane could be added to the existing six lane cross section by adding a lane in each direction.

Cost estimate

Cost is for additional lane only, given that a majority of this section of I-80 is not in need of reconstruction east of US 30. Construction of the additional lane and associated IT infrastructure improvements is estimated to be $450 million.

- Total project construction is estimated to cost $450 million in 2014 $
- Year of construction: After 2040

Project status

- Adding a managed lane is considered a longer term objective. No studies are active at this time.

I-80 to I-55 Connector

Project description

This project would connect the Illiana Expressway (which has a western terminus at I-55) and I-80. It is contingent on the completion of the Illiana Expressway.

Cost estimate

- Total project construction is estimated to cost $100 million in 2014 $
- Year of construction: After 2040

Project status

- This project is viewed as contingent upon the completion of the Illiana Corridor.
- The Prairie Parkway Record of Decision was rescinded.
- Funding for the Prairie Parkway has been redirected to other local improvements.
- No planning or engineering activities are scheduled for the connector at this time.

IL 394

Project description

This project would add lanes to IL 394 from I-80 south in southern Cook and Will Counties to Exchange Street, and convert the roadway from an arterial to an expressway. Local officials in the area have expressed concern about the effect of the conversion of the roadway to an expressway on nearby economic development. This project should be examined to determine if operational alternatives to expressway conversion are available. Per FHWA regulations, conversion of the facility to an expressway may not advance to Phase II engineering unless the project is fiscally constrained. However, any operational or arterial-based improvements may occur at any time.

Cost estimate

- Total project construction is estimated to cost $604 million in 2014 $ - *Neither engineering nor ROW acquisition included*
- Year of construction: After 2040

Project status

- A locally led corridor feasibility study is being conducted, and would be intended to lay the groundwork for a Phase I study.

Metra Electric District (MED) Improvements

Project description

This project would include making track, signal, and other improvements to the Metra Electric District to support growth in ridership and upgrades to the core capacity of the line.

Cost estimate

- Total project construction is estimated to cost $447 million in 2014 $
- Year of construction: After 2040

Project status

- Identified as a potential future expansion project in Metra's Strategic Plan.

Metra Electric Extension

Project description

This project would extend Metra Electric service to the proposed South Suburban Airport in Will County from its current terminus in University Park, as well as create a new rail yard facility. Supportive land use planning should accompany this and other transit extension projects.

Cost estimate

- Total project construction is estimated to cost $291 million in 2014 $
- Year of construction: After 2040

Project status

- This project has not undergone Alternatives Analysis or any Phase I engineering component of the federal planning process.
- Progress on this project may ultimately be dependent on the progress of the South Suburban Airport project.

Mid-City Transitway

Project description

This project would create a new north-south transit corridor in the vicinity of Cicero Avenue in central Cook County, and also connecting east to the CTA Red Line. The mode of this project is not yet certain, ranging from an on-street BRT service to rail service. This project is in the early stages of planning, and was evaluated further as part of the continuation of the Cook-DuPage corridor study.

Cost estimate

- Total project construction is estimated to cost $1.6 billion in 2014 $
- Year of construction: After 2040

Project status

- A physical feasibility study was completed by the City of Chicago in 2013; the study determined that the east-west part of the corridor is not likely to be feasible within or near the existing 75th Street freight and commuter rail corridor.
- No formal alternatives analysis, environmental, or preliminary engineering studies have been scheduled thus far.

Milwaukee District North Extension

Project description

This project would extend the Metra Milwaukee District North line to Wadsworth in Lake County from the Rondout junction. A feasibility study for this project has been completed, but further planning is needed to advance it.

Cost estimate

- Total project construction is estimated to cost $644 million in 2014 $
- Year of construction: After 2040

Project status

- Metra completed the Wadsworth Extension Commuter Rail Feasibility Study in 2001 to examine the potential for establishing commuter rail service.
- No additional or revised planning and analysis or construction activity has been scheduled thus far.

Milwaukee District West Extension

Project description

This project would extend the Metra Milwaukee District West line from its current terminus in Elgin to Marengo in McHenry County.

Cost estimate

- Total project construction is estimated to cost $422 million in 2014 $
- Year of construction: After 2040

Project status

- A Phase I feasibility study to Marengo was completed in 2010. Commuter service to Marengo appears to be operationally and physically feasible, but significant environmental issues need further examination, and significant capital improvements will be needed including two segments of double track, a new coach yard, a grade separation at IL-47, as well as other track and signal improvements.

- No further work on the Hampshire routing has been completed. This option is not consistent with NICTI plans to extend passenger rail service beyond the CMAP region to Rockford.
- Due to the further analysis of the Marengo routing and the incompatibility of the Hampshire routing with other plans, Metra plans to maintain the Marengo extension in the unconstrained plan, while removing the Hampshire routing from the unconstrained plan.

Milwaukee District West (MD-W) Improvements

Project description

This project would include making track, signal, and other improvements to the Milwaukee District West Line to support growth in ridership and upgrades to the core capacity of the line.

Cost estimate

- Total project construction is estimated to cost $447 million in 2014 $
- Year of construction: After 2040

Project status

- Identified as a potential future expansion project in Metra's Strategic Plan.

North Central Service Improvements

Project description

This project would upgrade Metra North Central Service to allow for full service levels. This project is currently in early stages of planning.

Cost estimate

- Total project construction is estimated to cost $332 million in 2014 $
- Year of construction: After 2040

Project status

- This project for assuring full level of service is in an early stage of planning.

Orange Line Extension

Project description

This project would extend the CTA Orange Line to the Ford City shopping center, in southwest Cook County, from its current terminus at Midway airport.

Cost estimate

- Total project construction is estimated to cost $498 million in 2014 $
- Year of construction: After 2040

Project status

- The Locally Preferred Alternative for this project was selected in August 2009, completing the Alternatives Analysis process.
- This led to the preferred alignment being selected over several other potential alternatives.
- The next step in the process is to prepare a draft Environmental Impact Statement and begin preliminary engineering through the federal New Starts process.
- More documentation on the Alternatives Analysis process, including detailed reports and maps, is available at: http://w.transitchicago.com/orangeeis/documents.aspx.

Rock Island District Extension

Project description

This project would extend the Metra Rock Island District line from its current terminus in Joliet to Minooka in Will and Grundy Counties. This project is currently in early stages of planning. Improvements to the Rock Island District line which do not include the extension are included among the fiscally constrained projects.

Cost estimate

- Total project construction is estimated to cost $317 million in 2014 $
- Year of construction: After 2040

Project status

- This project has not undergone Alternatives Analysis or any Phase I engineering component of the federal planning process.

SouthEast Service

Project description

This project would create a new rail line that provides service to communities in southern Cook and northern Will Counties. It has been undergoing Alternatives Analysis by Metra, and the identification of a Locally Preferred Alternative (LPA) is in process. The proposed route runs north from Balmoral Park, through Crete, using primarily UP/CSX railroad tracks, joining the Metra Rock Island District at Gresham to LaSalle Street Station.

Cost estimate

- Total project construction is estimated to cost $830 million in 2014 $
- Year of construction: After 2040

Project status

- Alternative Analysis was completed for this project in August 2011, with the commuter rail alternative identified as the LPA. Metra did not apply to enter preliminary engineering for this project due to the lack of a viable financial plan.
- Legislation provided for the establishment of the Southeast Commuter Rail Mass Transit District. The group is now working to identify funding, and has secured IDOT/DCEO funding to support operation simulation and other pre-engineering activities.

SouthWest Service Extension

Project description

This project would extend Metra SouthWest Service to Midewin in Will County from its current terminus in Manhattan. This project is currently in early stages of planning. Supportive land use planning should accompany this and other transit extension projects. (Improvements to SouthWest Service which do not include an extension are included among the fiscally constrained projects.)

Cost estimate

- Total project construction is estimated to cost $328 million in 2014 $
- Year of construction: After 2040

Project status

- This project has not undergone Alternatives Analysis or any Phase I engineering component of the federal planning process.

STAR Line Corridor

Project description

This project would create a new rail service from Joliet to Hoffman Estates through western Will, DuPage, and Cook Counties, and also connect from Hoffman Estates to O'Hare airport along I-90.

Cost estimate

- Total project construction is estimated to cost $3 billion in 2014 $
- Year of construction: After 2040

Project status

- Alternative Analysis for this project was completed in June 2012, with the commuter rail alternative identified as the Long Term Vision for the corridor. Metra did not apply to enter preliminary engineering for this project due to the lack of a viable financial plan.
- More information is on Metra's website at http://metraconnects.metrarail.com/star.php.
- In 2012, CMAP awarded a CMAQ grant to Pace for transit improvements in the corridor, including additional park and ride lots and new express bus service.

West Loop Transportation Center: Phase 2, West Loop Subway Component

Project description

Findings of the Phase I Union Station Master Plan determined that work on the project should take place in two key phases: 1) improvements to existing facilities east of and within Union Station and 2) a new underground transitway in the West Loop. Phase 2 comprises the West Loop Transportation Center, a group of projects that accommodate and facilitate easy transfers between inter - city rail, commuter rail, rapid transit, bus and bus rapid transit services in Chicago's West Loop. These improvements facilitate connections with proposed Central Area Transitway improvements, serving destinations including the North Michigan Avenue Area, River North, McCormick Place, and the eastern part of the Loop. The West Loop Subway component of the West Loop Transportation Center is a proposed new underground transitway along Clinton and/or Canal Streets with key transfer stations located between the Eisenhower Expressway and Lake Street in Chicago. The route allows alternative routing of existing CTA rail services, increases CTA rail capacity between Chicago's Central Area and outlying neighborhoods, and facilitates transfers between inter - city rail, commuter rail, rapid transit and bus services. The subway may also include multiple levels or alignments within the West Loop area to accommodate additional tracks and platforms for inter-city and or commuter trains. This project cost is $2.5 billion.

Cost estimate

- Total project construction is estimated to cost $2.094 billion in 2014 $
- Year of construction: After 2040

Project status

- Stage 1 of the Union Station Master Plan was concluded in May 2012.
- The second stage of the Study started in December, 2012. This work will include three key components: 1) A train operations simulation model of existing and possible future conditions at Chicago Union Station (CUS); 2) A pedestrian flow model of existing and possible future conditions within CUS's passenger areas; 3) A street traffic simulation model of existing and possible future conditions on 40 blocks surrounding CUS. The goal of this stage of the Study will be to establish a robust technical case for implementing the Stage 1 Study's "medium term" recommendations as soon as possible, and it will determine how much demand (i.e., how many years of growth) these improvements are likely to accommodate. It is anticipated that this stage of the Study will be completed in mid-2014.
- Projects to create a surface bus transfer center adjacent and connected to Union Station and BRT transitway improvements to the Central Loop are funded and underway by the City of Chicago. The projects will begin to address improving connections between Union Station and other transportation services upon construction completion, expected in late 2014/early 2015.
- This project was fiscally constrained in GO TO 2040 as the "West Loop Transportation Center" before phasing was determined to be the best pathway forward, based on findings from the Phase 1: Union Station Master Plan.

Yellow Line Enhancements and Extension

Project description

This project would extend the Yellow Line from its current terminus in Skokie to Old Orchard Mall in northern Cook County.

Cost estimate

- Total project construction is estimated to cost $294 million in 2014 $
- Year of construction: After 2040

Project status

- The Locally Preferred Alternative for this project was selected in August 2009, completing the Alternatives Analysis process.
- This led to the selection of a preferred alignment that follows the UP railroad to a terminal to the east of the Edens Expressway.

- The next step in the process is to prepare a draft Environmental Impact Statement and begin preliminary engineering through the federal New Starts process.
- More documentation on the Alternatives Analysis process, including detailed reports and maps, is available at: http://w.transitchicago.com/yelloweis/documents.aspx.

Projects Reclassified or Not Evaluated

In the course of evaluating the major capital projects, it was evident in several cases that the project did not meet the definition of major capital project that CMAP uses. In other cases, further information suggested that the project was infeasible given other commitments or circumstances. Although they were included in the "universe" of major capital projects discussed with the Transportation Committee, these projects were not modeled. The projects are listed and discussed below.

DuPage "J" Line

Project description

This project involves the construction of a new bus-only lane on I-88 through DuPage County from Naperville Road to IL 83. It also includes service on nearby arterial streets and improvements to these streets, though these are not considered part of the major capital project. The DuPage "J" Line may initiate operations as an express bus or ART-type service at any time, and this is supported by GO TO 2040; the only portion of this project which is fiscally unconstrained is the construction of a new lane on I-88. As indicated in the Cook-DuPage corridor study, there is a significant need for north-south transit alternatives in western Cook and eastern DuPage Counties, and this project may be able to address this need. Pace is currently developing a phased transit investment plan for DuPage County and western Cook County, which will seek to establish an actionable plan to implement ART.

Cost estimate

- Total project construction project is estimated to cost $1.10 billion in 2009
- Year of construction: After 2040

Project Status

- No Phase I engineering activities (e.g. alternatives analysis) have been scheduled thus far.
- CMAP reclassified this project for the GO TO 2040 plan update, per discussion with the implementing agency. The Cook-DuPage Corridor study found that an ART system on the arterials is more feasible. This removed the construction of a bus only lane on I-88. The ART system will appear in the plan update as an improvement to the region's transportation system, along with other proposed BRT and ART routes.

Prairie Parkway

Project description

This project would create a new expressway between I-88 and I-80 in Kane and Kendall Counties. Phase I engineering for this project has been completed, and federal earmarks to cover a portion of project costs have been received, but funding is insufficient to construct the entire project. However, one element of this project, involving a bridge over the Fox River in Yorkville to connect US 34 and IL 71, has independent utility and can be completed with the earmarks received. This project element may be pursued at any time. For the remainder of the project, corridor preservation activities should be continued in order to preserve a transportation corridor in this area for future use.

Cost estimate

- Total project construction is estimated to cost $1 billion in 2014 $
- Year of construction: After 2040

Project status

- Phase I engineering for this project was completed, and federal earmarks to cover a portion of project costs were received.
- The Record of Decision for this project was rescinded, and the earmarks were redirected to other projects in the vicinity. It was removed from consideration per the rescission of the record of decision.

McHenry-Lake Corridor

Project description

This project would create a new expressway through McHenry and western Lake Counties, from the terminus of the US 12 freeway at the Wisconsin border to the upgraded IL 120 roadway (see the IL 53/120 Tollway project for a further description). This project is in early stages of planning and relies on the completion of the Central Lake County corridor.

Cost estimate

- Total project construction is estimated to cost $1.119 billion in 2014 $ (neither engineering nor ROW acquisition included)
- Year of construction: After 2040

Project status

- At this juncture no planning or engineering processes are scheduled or underway, nor have there been any funding sources identified.
- No sponsor was identified for this project.

Inner Circumferential Rail Service

Project description

This project would create a new north-south transit connection through western Cook County, connecting to both O'Hare and Midway airports. Both this project and the Mid-City Transitway

appear to have potential to serve the need for north-south transit travel in central and western Cook County. A feasibility study for this project has been completed, but further planning is needed to advance it. This project should be evaluated further as part of the continuation of the Cook-DuPage corridor study. The proposed new service will use the IHB and BRC railroad tracks to travel between O'Hare Airport and Midway Airport, with intermediate stations at Franklin Park, Melrose Park, Bellwood-25th Ave, Broadview, LaGrange Park, LaGrange, Summit, Harlem/59th St, and Midway Airport. It has been studied as a branch of the STAR Line (STAR Line Feasibility Analysis, 2003).

Cost estimate

- Total project construction is estimated to cost $1.275 billion in 2014 $ - *Likely higher due to CREATE*
- Year of construction: After 2040

Project Status

- In cooperation with the North Central and West Central Council of Mayors, Metra studied the potential benefits and capital costs associated with its implementation of the Inner Circumferential Rail Service as part of the STAR Line feasibility study (2003).
- No further planning or engineering activities have been scheduled thus far.
- The CREATE Program identified this route as the Beltway Corridor and directs significant capital investments to support increased freight service to this corridor. The CREATE Beltway Corridor will function as a bypass route for intermodal and carload train interchanges between eastern and western railroads and will include six highway/rail grade separations, 4.8 miles of new track, 66 new switches, and more than 13 miles of new CTC signals. Accommodating passenger service in this corridor after the increases in freight service may significantly increase this project's capital costs and/or decrease reliability or feasibility of any new passenger service.
- CMAP removed this project from consideration for the GO TO 2040 plan update, as study has shown freight conflicts make this project infeasible.

O'Hare to Schaumburg Transit Service

Project description

This project would include both a transit component of the Elgin O'Hare eastern extension (part of the Western Access project on the fiscally constrained list) and a new transit service on IL 53 from the Elgin-O'Hare Expressway to Schaumburg.

Cost estimate

- Total project construction is estimated to cost $1.119 billion in 2014 $
- Year of construction: After 2040

Project status

- This project is in an early stage of planning and has not entered the federal Alternatives Analysis process. This was one of three projects selected to advance in the Cook-

DuPage Corridor Study. As part of Pace's current work to create the Cook DuPage Area Rapid Transit Investment Plan, an incremental transit service design and implementation plan for this corridor will be developed in 2015.

- The Elgin-O'Hare Expressway project is being built to allow bus on shoulder operation.
- This project does not fit the definition of a major capital project that CMAP uses, which does not include BRT service not running in a dedicated busway.

Milwaukee District North Improvement

Project description

This project would improve service along the Metra Milwaukee District North line between Fox Lake and the Rondout junction in Lake County by making track, signal, and other improvements. Many elements of this project are considered capital improvements with independent utility and therefore can be pursued at any time. This project is currently in early stages of planning.

Cost estimate

- Total project construction is estimated to cost $130 million in 2014 $
- Year of construction: 2020

Project status

- This project is currently in an early stage of planning.
- Improvements to this line have been considered during WISDOT's EA for expanded Amtrak Hiawatha service which also operates on this line. Operations simulations have been completed to determine what additional elements of capital improvements will be necessary, especially in the area between Rondout and A-20 junctions where Metra, Amtrak, and CP freight all have significant operations. The proposed improvements would allow existing service on the line to operate with more flexibility and greater reliability.
- Further discussion with Metra suggested that this project would not expand capacity and that increased service was not expected.

South Lakefront Corridor

Project description

This project would improve service along Chicago's lakefront from downtown Chicago to the south. It could include a new light-rail service or operational improvements to existing Metra services; variations of this concept have been referred to as the Gray Line or the Gold Line. It is recommended that service in this area be studied with participation by CDOT, CTA, and Metra, considering whether operational improvements can be made rather than a major capital project.

Cost estimate

- Total project construction is estimated to cost $1 billion in 2014 $
- Year of construction: After 2040

Project status

- The City of Chicago is undertaking a South Lakefront Corridor Transportation study with financial assistance from the RTA.
- The Chicago South Lakefront Corridor Study recommended that the rail component part of the project not advance as a feasible alternative. However, if further studies support a BRT system in the South Lakefront Corridor, it will appear in the plan update as an improvement to the region's transportation system, along with other proposed BRT and ART routes.

Projects Not Included in Universe

At least three additional projects were not included in the "universe" of major capital projects brought to the Transportation Committee for discussion, either because they were submitted late, lacked important details, or because in discussions with project sponsors they did not appear to be major capital projects. They are documented here.

CrossRail Chicago

Project description

This multi-faceted, phased project would retool Union Station to handle electrified trains, build new Metra stations at O'Hare International Airport, and connect the Metra Electric, the Rock Island Line, and Union Station via elevated tracks along 16th Street. Later phases would provide commuter rail between Elgin and O'Hare, between Elgin and Rockford, and extend the Metra Electric line. See **http://www.midwesthsr.org/crossrail-chicago**.

Cost estimate

- Phase I construction is estimated to cost $2.0 billion, with other phases costing an additional $7.6 billion. The year of the cost estimates is unknown.
- Year of construction: Unknown

Project status

- This project is currently in an early stage of planning. Project supporters should continue to study this project, identify funding sources, and identify a project implementer.

South Suburban Airport Access

Project description

This IDOT project would provide access to the proposed South Suburban Airport from I-57. As it only encompasses improving an existing expressway-arterial interchange, it does not appear to meet the definition of major capital project.

Cost estimate

- Project cost is $85 million (2014) with a reconstruction cost of $20 million and a new capacity cost of $65 million
- Year of construction: 2020

Project status

- This project is currently in an early stage of planning.

West Lake Corridor

Project description

This project is an approximate nine-mile extension of the existing South Shore Line (SSL) operated by the Northern Indiana Commuter Transportation District (NICTD). The proposed project would include an initial start-up extension of service between Hammond and Dyer, with a possible future extension further south to St. John, Indiana. Trains on the new branch line would connect with the existing SSL, terminating at Metra Electric District's Millennium Station in downtown Chicago.

Cost estimate

- Estimated capital cost of $571 million (YOE)
- Project engineering and construction will span the period of 2016-23

Project status

- The draft Environmental Impact Statement is expected to be completed in fall 2015.
- A Record of Decision is then estimated in 2016.
- Service start-up for the project is targeted for 2023.



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CMAP

GO TO 2040
UPDATE APPENDIX

Financial Plan for Transportation



October 2014

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Introduction

In October 2014, the GO TO 2040 comprehensive regional plan was updated in accordance with federal law. As required by Moving Ahead for Progress in the 21st Century (MAP-21),[1] the Chicago Metropolitan Agency for Planning (CMAP) must prepare a financial plan, including expected revenue sources to carry out the operation, maintenance, and construction of the region's transportation system over the planning period. Specifically, federal regulations require that "for purposes of transportation system operations and maintenance, the financial plan shall contain system-level estimates of costs and revenue sources that are reasonably expected to be available to adequately operate and maintain Federal-aid highways . . . "[2]

MAP-21 requires that regional long-range transportation plans in areas noncompliant with air quality standards be updated every four years. The GO TO 2040 update financial plan compares estimated revenue from existing and proposed funding sources with the estimated costs of constructing, maintaining, administering, and operating the region's transportation system. CMAP expects that $371 billion will be available between 2015-40 to support the region's transportation network. Within the financial plan, expenditures are allocated to three major categories consistent with the original GO TO 2040 financial plan: (1) operations and maintenance to a safe and adequate level, (2) moving the system toward a state of good repair and systematic enhancements, and (3) major capital projects. Consistent with GO TO 2040, the update provides the fiscal constraint for transportation system investments. It does not provide an analysis of the costs associated with achieving the GO TO 2040 indicator targets.

Long-range financial forecasting requires determining a base set of assumptions regarding revenue and expenditure trends, understanding the future implications of current policies, and developing a robust, accurate, and straightforward methodology that is appropriate for a planning-level forecast. For the financial plan update, CMAP relied heavily on consultations with transportation implementers to prepare revenue and expenditure forecasts.

The process began in July 2013, when CMAP had its first of several meetings and follow-up communications with the Regional Transportation Authority (RTA) to discuss transit revenue and expenditure forecasting. In August 2013, a group of highway implementers representing the Illinois Department of Transportation (IDOT), the Illinois Tollway, and several county highway departments met to determine unit cost and lifecycle assumptions for highway capital maintenance expenditures. Staff from several municipalities also reviewed these assumptions. CMAP also consulted with staff from state and local highway departments regarding revenue and expenditure forecasting. Throughout the process, progress on the financial plan forecasts were presented to the CMAP Transportation Committee.[3] In response to feedback received

[1] Moving Ahead for Progress in the 21st Century, 23 USC 134 (i)(2)(E)

[2] § 450.322 (f) (10).

[3] Interim staff memorandums can be found at http://www.cmap.illinois.gov/about/2040/update.

from the Transportation Committee, CMAP presented, in detail, the methodology used in the financial plan forecast to interested Transportation Committee members in February 2014.

Summary of the Financial Plan

The fiscally-constrained financial plan for implementing the Regional Mobility chapter of the GO TO 2040 plan update is summarized in Table 1. Pursuant to federal regulations, revenue and cost estimates reflect "year of expenditure dollars," based on inflation rates developed cooperatively with transportation implementers using historical data. Details and definitions of each revenue and expenditure forecast can be found on page 21.

Table 1. Summary of financial plan revenue forecasts and expenditure allocations, 2015-40, in millions (year of expenditure dollars)

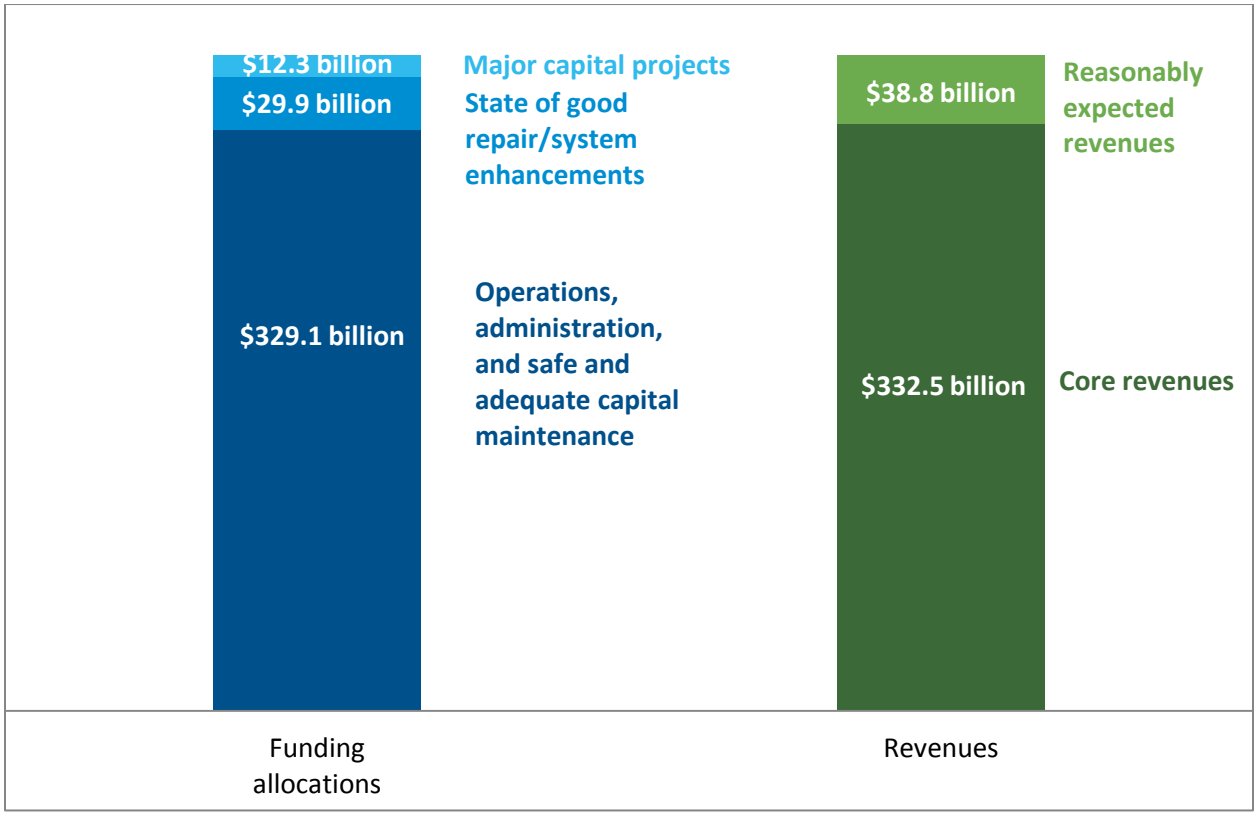
Federal revenues	$53,521
State revenues	$111,912
Local revenues	$167,107
Subtotal core revenues	**$332,540**
State motor fuel tax increase and long-term replacement	$17,300
Congestion pricing on the existing system	$11,700
Performance-based funding	$8,300
Variable parking pricing	$1,500
Subtotal reasonably expected revenues	**$38,800**
Total revenues	**$371,340**
Highway operating and administrative expenditures	$84,087
Transit operating and administrative expenditures	$113,266
Safe and adequate capital maintenance for highway	$100,759
Safe and adequate capital maintenance for transit	$31,006
Subtotal operating, administrative, and capital maintenance expenditures	**$329,118**
Subtotal moving the system toward a state of good repair/systematic enhancements	**$29,892**
Subtotal major capital projects	**$12,330**
Total expenditures	**$371,340**

Source: Chicago Metropolitan Agency for Planning analysis.

The financial plan forecasts indicate that the core revenues forecasted to be available over the planning horizon of 2015-40 will minimally exceed the $329.1 billion expenditures for operating, administering, and maintaining the transportation system by approximately $3.4 billion. This will only allow for modest investments to bring the system toward a state of good repair, as well as provide for additional enhancements and expansions to the system. GO TO 2040 prioritizes investments in maintaining the existing transportation system, as well as improvements and enhancements to achieve the goal of a modern, world-class transportation system. Pursuing major capital projects, while important, remains a lower priority than these other activities in the GO TO 2040 update. In order to fiscally constrain desired modernization and expansion activities within the long-range planning context, new sources of reasonably

expected revenues are included as major transportation policy priorities in the GO TO 2040 update.

Figure 1. GO TO 2040 update fiscal constraint, 2015-40



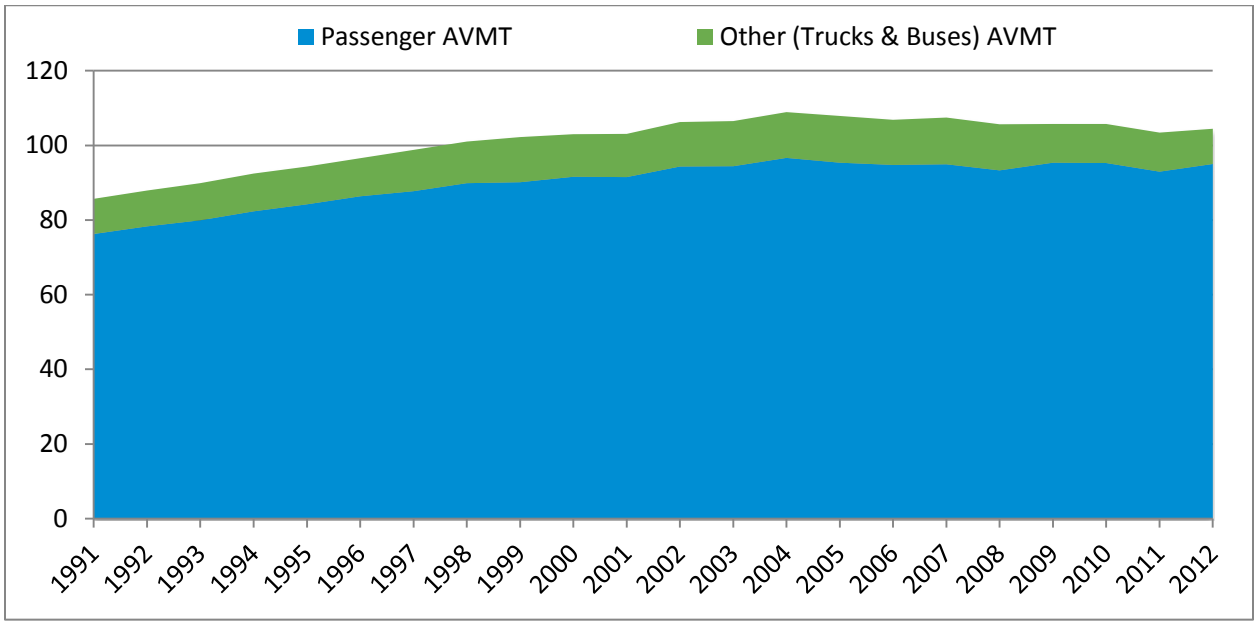
Source: Chicago Metropolitan Agency for Planning analysis.

Trends Affecting Transportation Finance

Future revenues and expenditures available for the transportation system will be affected by economic and demographic changes over the planning period. Accordingly, population forecasts generated for the GO TO 2040 update were used to produce the foundation of the financial plan forecast. Reviewing broader historical economic trends that have occurred in the region played a role in ensuring the accuracy of forecasting.

These economic and demographic trends can also drive changes in the utilization of the region's transportation system. For example, trends in roadway travel help guide motor fuel tax revenue forecasts. Figure 2 provides an overview of growth in vehicle miles traveled (VMT) in Illinois. While VMT grew steadily throughout the 1990s and early 2000s, it peaked in 2004 and has held fairly steady since then. Overall, the compound annual growth rate of VMT statewide was 0.9 percent between 1991 and 2012.

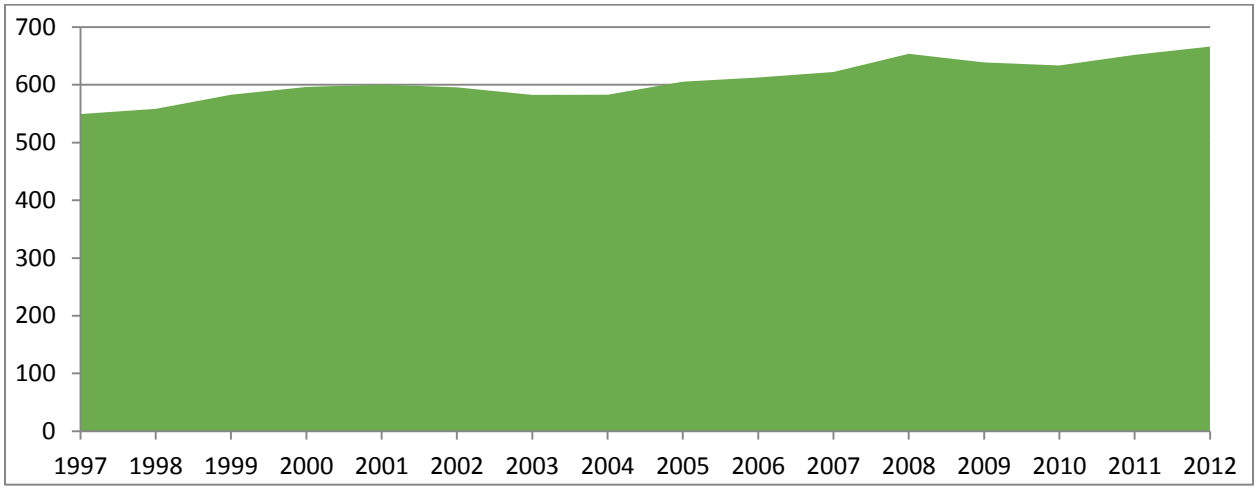
Figure 2. Annual vehicle miles traveled (AVMT) in Illinois, 1991-2012, in billions



Source: Illinois Department of Transportation, Illinois Travel Statistics.

The financial plan is also informed by trends in transit usage. CMAP analyzed data on unlinked transit trips and found that the compound annual growth rate was 1.3 percent between 1997 and 2012. Figure 3 provides an overview of growth in transit use in northeastern Illinois.

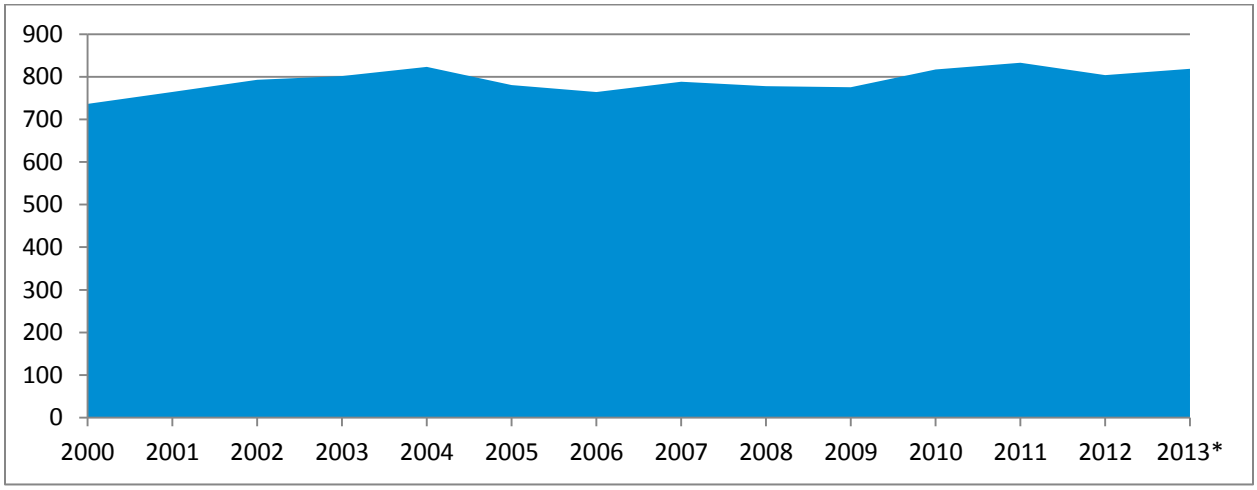
Figure 3. Unlinked transit trips, 1997-2012, in millions



Source: Regional Transportation Authority Mapping and Statistics (RTAMS).

Revenue generated on Illinois Tollway facilities are driven by toll transactions, as well as the toll rate. Figure 4 illustrates toll transactions, which have remained fairly stable since 2000.

Figure 4. Illinois Tollway transactions, 2000-13, in millions



**Projected.*
Source: Illinois Tollway.

Core Revenues

Forecasts of core revenues include funding sources the region currently receives for transportation purposes and do not include any new sources. The forecasts assume that northeastern Illinois will continue to receive revenues from federal, state, and local sources for building, operating, administering, and maintaining the current roadway and transit system. Table 2 summarizes the various sources of estimated revenues totaling $332.5 billion over the 26-year planning period.

Table 2. Core revenue forecasts, 2015-40, in millions (year of expenditure dollars)

Federal	Locally-programmed federal revenue	$11,011
	Federal transit revenue	$17,086
	State-programmed federal highway revenue	$25,424
State	Public Transportation Fund	$13,289
	State motor fuel tax (MFT)	$4,972
	Motor vehicle registration fees and other user fees	$26,737
	Tollway revenue	$51,255
	State bonding programs	$12,498
	Other state transit	$3,160
Local	RTA sales tax	$42,688
	Local allotment of state MFT	$7,298
	Collar County Transportation Empowerment Program	$5,267
	County option MFTs	$750
	Other local revenues	$61,183
	Real estate transfer tax (portion for CTA)	$1,609
	Transit passenger fares	$42,082
	Other transit operating revenue	$6,230
	Total core revenues	**$332,540**

Source: Chicago Metropolitan Agency for Planning analysis.

Reasonably Expected Revenues

Revenues from existing transportation funding resources are forecast to be sufficient to operate and maintain the roadway and transit system at a safe and adequate level in northeastern Illinois over the 2015-40 planning period. However, the expected funding will only allow for modest investments in performing maintenance at a level that brings the system toward a state of good repair and will not provide significant funding for additional enhancements or expansions to the system.

Fiscally constraining these activities within the long-range planning context will necessitate future policy changes to bring additional revenues to the region. Federal guidance permits the inclusion of these types of revenues, called "reasonably expected revenues," to be included in the financial plan: "All necessary financial resources from public and private sources that are reasonably expected to be made available to carry out the transportation plan shall be identified."[4] GO TO 2040 makes several policy recommendations regarding reasonably expected revenues, including increasing the state motor fuel tax by 8 cents and indexing the rate to an inflationary measure, implementing congestion pricing on a portion of the expressway system, and employing variable parking pricing.

GO TO 2040 also recommends the exploration of other innovative financing sources for implementing specific transportation projects. These strategies include value capture, congestion pricing on new expressway capacity, other user fees imposed by highway and transit implementers, and potential cost efficiencies resulting from public-private partnerships. As in the original plan, the GO TO 2040 update assumes these types of strategies may be instituted on a project-by-project basis to close a specific revenue gap or lower project costs. These funding sources serve to lower specific major capital project costs in the GO TO 2040 update. CMAP staff worked with regional transportation implementers to help incorporate these sources into major capital project costs.

Table 3 provides an overview of reasonably expected revenue forecasts included in the GO TO 2040 update. In addition to being incorporated into the financial plan, the options selected are major policy recommendations from the Regional Mobility chapter of the GO TO 2040 update.

Table 3. Reasonably expected revenue forecasts, 2015-40, in millions (year of expenditure dollars)

State motor fuel tax increase and long-term replacement	$17,300
Congestion pricing on the existing system	$11,700
Performance-based funding	$8,300
Variable parking pricing	$1,500
Total reasonably expected revenues	**$38,800**

Source: Chicago Metropolitan Agency for Planning analysis.

[4] § 450.322 (f) (10).

Federal guidelines allow financial plans to include revenues that are reasonably expected to be available during the planning period. Reasonably expected revenues will be necessary to make additional investments in the region's transportation system, but will only be realized through action by federal, state, regional, and local policymakers.

To move forward, the region must work collaboratively to protect its transportation assets. The region's financial challenges can become opportunities for bold, cooperative actions to enact policy changes. By acting in cooperation with one another, the region can ensure the long-term sustainability of the region's transportation system, which is a major contributor to the economy and the livability of northeastern Illinois. This section outlines policies that must be implemented to ensure the future viability of the region's transportation system. Table 4 identifies who would need to implement them, when they would be implemented, and what would be required legislatively.

Table 4. Reasonably expected revenues action plan summary table

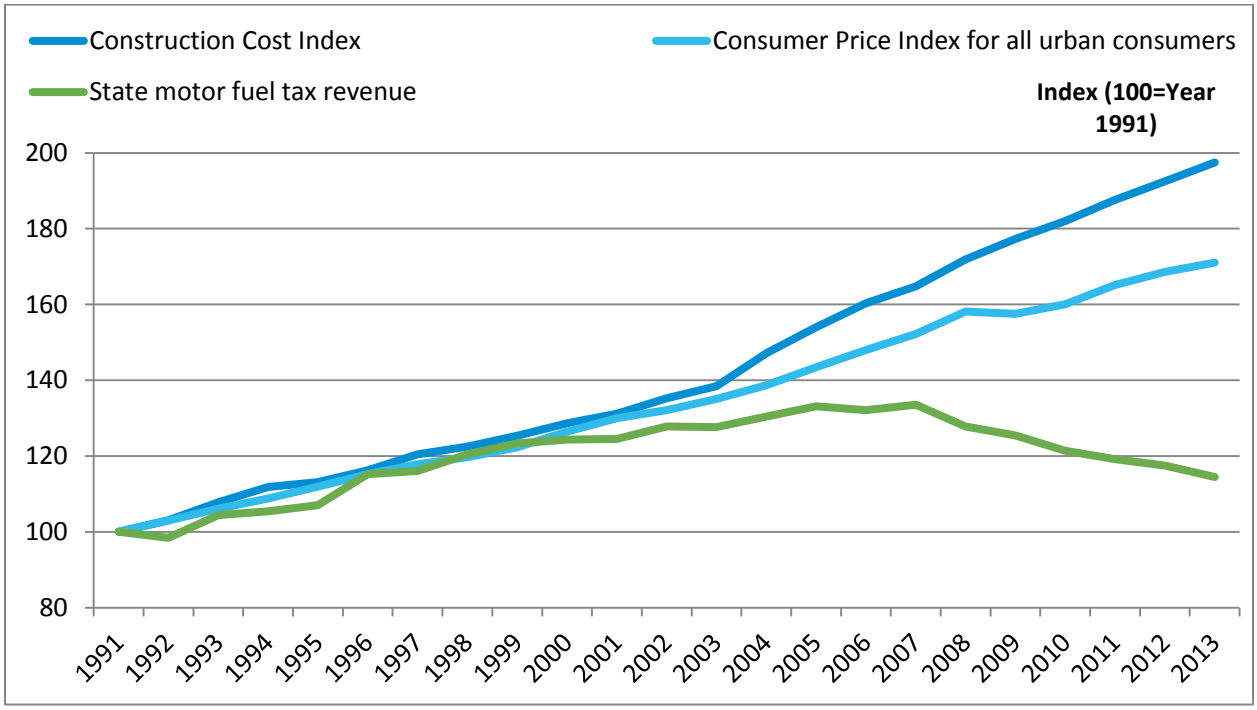
POLICY CHANGE	LEAD IMPLEMENTERS	TIMELINE FOR IMPLEMENTATION	LEGISLATIVE REQUIREMENTS
State motor fuel tax increase and replacement	MFT increase: Illinois General Assembly and Governor Long-term replacement: U.S. Congress and the President; Illinois General Assembly and Governor	MFT increase: Legislation in 2015, implementation in 2016, inflationary increases throughout planning period Long-term replacement: Research and advocacy through the 2020s, legislation and implementation by 2025	MFT increase: State legislation required Long-term replacement: State legislation required, federal legislation could play a supportive role
Congestion pricing on the existing system	U.S. Congress, President, IDOT, Illinois Tollway, potentially Illinois General Assembly and Governor	Research and advocacy over the next five years, legislation and implementation by 2020	Federal legislation required, state legislation could play a supportive role
Performance-based funding	IDOT	Research and analysis in 2014, implementation in 2015, continuation throughout planning period	None, policy could be implemented through administrative action
Variable parking pricing	Municipalities	Ordinances and implementation throughout planning period	None, policy could be implemented through local action

Source: Chicago Metropolitan Agency for Planning analysis.

State motor fuel tax increase and long-term replacement

The GO TO 2040 update continues the plan's recommendation that the state motor fuel tax (MFT) be increased by 8 cents and indexed to an inflationary measure. Although the rate has been increased nine times since its 1927 enactment, the state MFT has remained $0.19 per gallon since 1991. As a per-gallon tax, MFT revenues have failed to keep pace with inflation in construction costs over time. Figure 5 compares the growth in state motor fuel tax revenue to growth in inflation and construction costs. For this analysis, the consumer price index for all urban consumers is used for inflation, while the Engineering News Records' national construction cost index is used to measure construction costs.

Figure 5. State motor fuel tax revenue compared to Consumer Price Index and national Construction Cost Index, 1991-2013



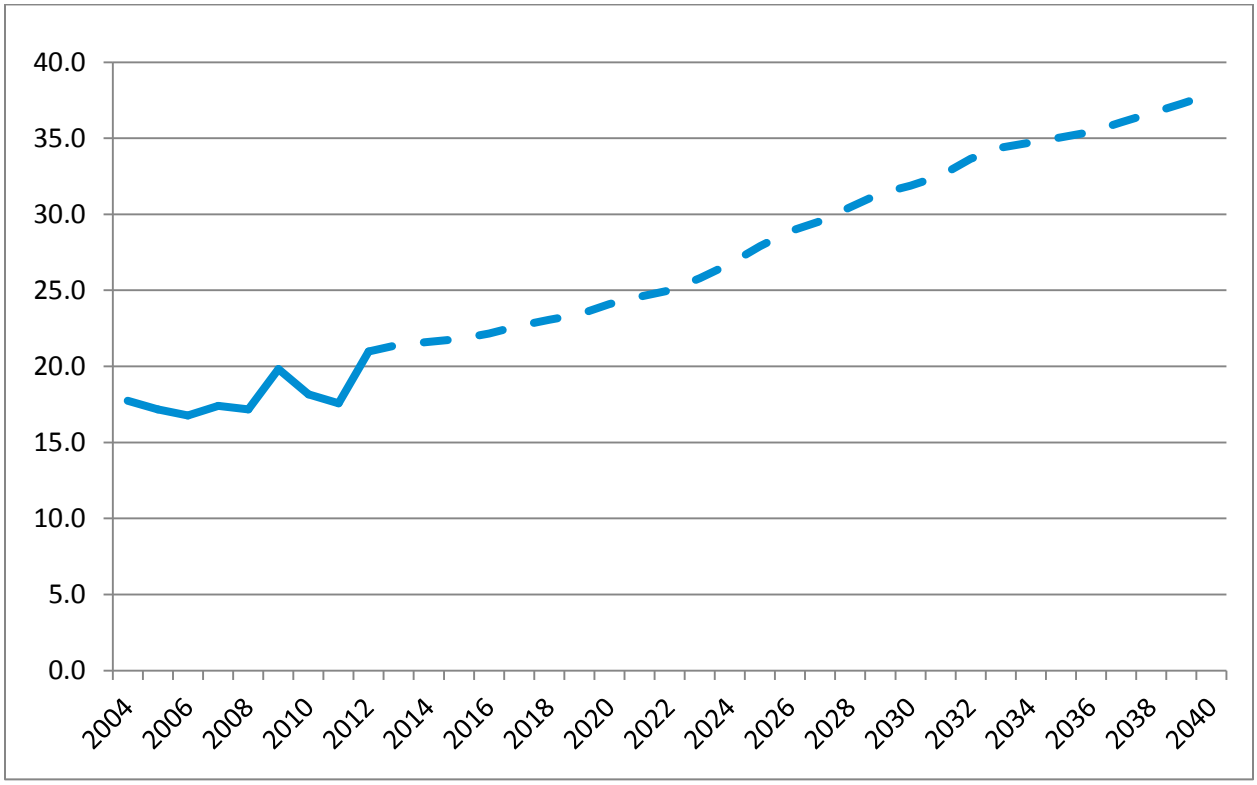
Source: Chicago Metropolitan Agency for Planning analysis of data from Illinois Department of Transportation, U.S. Bureau of Labor Statistics, and Engineering News Record.

GO TO 2040 originally forecast that this enhancement would generate an additional $19.4 billion if it were implemented in 2012. However, no increase has been enacted since the plan's adoption in 2010. In addition, state MFT revenues have been declining annually since 2007, when revenues reached a high of $1.4 billion statewide. While this decline is partially a result of a reduction in vehicle miles traveled, the consumption of motor fuel has declined even faster, primarily as a result of rising vehicle fuel economy.

As motor fuel consumption continues to slow and vehicle fuel economy rises, GO TO 2040's original assumption of a rate increase and inflationary index will be insufficient to keep

revenues growing with the cost of construction. Figure 6 charts the estimated average statewide vehicle fuel economy since 2004, as well as the projected growth in average fuel economy through 2040. The compound annual growth rate of MFT revenues under GO TO 2040's rate increase and inflationary index would be just 1.7 percent over the 2015-40 planning period due to changes in vehicle fuel economy.

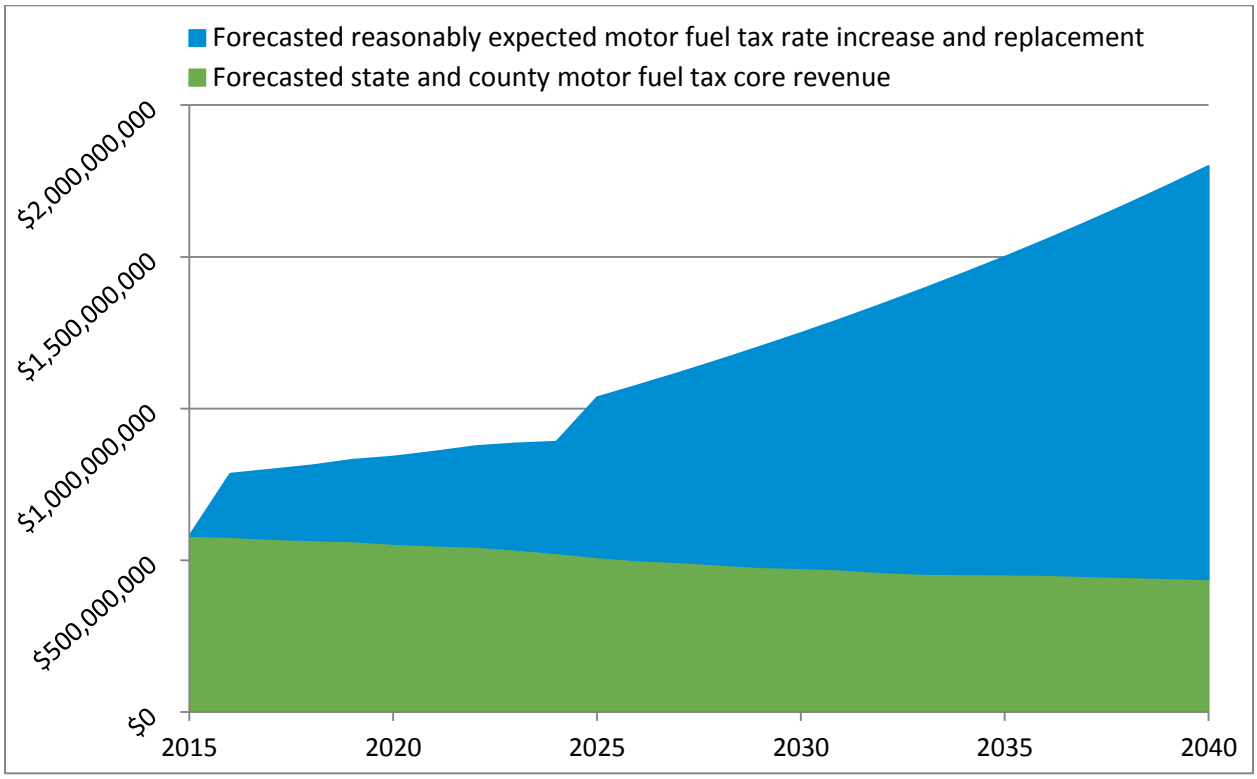
Figure 6. Estimated and projected average miles per gallon estimates for light duty vehicles statewide, 2004-40



Source: Chicago Metropolitan Agency for Planning analysis of National Highway Traffic Safety Administration (NHTSA) Corporate Average Fuel Economy (CAFE) Fuel Economy Fact Sheets; IDOT data; 2009 National Household Travel Survey data.

A replacement for the MFT, assumed to begin in 2025, would provide an annual revenue growth of roughly 3.7 percent for the remainder of the planning period. Revenues growing at this rate will account for both increases in construction costs as well as growth in the overall transportation system. The GO TO 2040 update does not specify what this replacement would be, only that it is necessary to provide adequate revenue to maintain and operate the transportation system. Figure 7 provides an illustration of the state and county motor fuel tax revenue forecast during the planning period.

Figure 7. State and county motor fuel tax revenue forecast, core, and reasonably expected revenues, 2015-40



Source: Chicago Metropolitan Agency for Planning analysis.

If the state MFT rate increase and indexing were implemented in 2016, followed by the enactment of a replacement for both state and county MFT revenues in 2025 that includes revenues from the reasonably expected state MFT rate increase, an additional **$17.3 billion** would be generated.

Action plan

The region will need to build a coalition that includes transportation implementers, as well as other stakeholders such as business and community groups, to lead an effort to promote a motor fuel tax rate increase to the Illinois General Assembly and the Governor. Increasing transportation revenues through the state motor fuel tax has found support in other states across the country. For example, in 2013, both Massachusetts[5] and Maryland[6] indexed their motor fuel tax rates to inflation, with Maryland also indexing transit fares to inflation. Legislation filed in the Illinois General Assembly in May 2013 signals recent legislative interest in reforming the state's transportation funding system. Reforms proposed in House Bill 3637 include eliminating the state MFT and replacing with a motor fuel sales tax and raising numerous vehicle registration fees.

[5] Transportation for America, Tracking State Transportation Funding Plans, http://t4america.org/maps-tools/state-plans-tracker.

[6] General Assembly of Maryland, Synopsis of House Bill 1515 of 2013, http://mgaleg.maryland.gov/webmga/frmMain.aspx?pid=billpage&stab=01&id=hb1515&tab=subject3&ys=2013RS.

With regard to a long-term replacement for the MFT, to the extent that transportation funding will continue to be user-fee based, a policy change is foreseeable in the next decade. Implementation by 2025 will likely occur in tandem with similar policy changes in other states and at the federal level. Other state governments and metropolitan planning organizations across the country are considering replacements for the MFT. Replacements currently being considered in Illinois and elsewhere across the U.S. include a fee on vehicle miles traveled or road usage and a sales tax on wholesale motor fuel. Both Pennsylvania[7] and Virginia[8] enacted legislation in 2013 that would increase transportation revenues and replace their flat per gallon motor fuel tax with a sales tax on the wholesale price of motor fuel.

With regard to vehicle miles traveled fees, in July 2013, the Oregon legislature voted to establish a road usage fee program.[9] In addition, a bill was introduced in the U.S. House of Representatives in December 2013 to establish a program that would distribute $30 million in competitive grants for road usage pilot programs that collect and report miles driven, determine payment, provide enforcement, and ensure privacy.[10]

Congestion pricing on the existing system

The implementation of congestion pricing, or "express toll lanes," will help manage traffic and give drivers the option to avoid congestion. Congestion pricing has existed in the U.S. since 1995, when the SR 91 Express Lanes opened in Orange County, California. Since then, express toll lanes have opened in regions across the country, including I-394 and I-35W in Minneapolis, I-95 in Miami, and I-25 in Denver. There are currently more than 25 express toll lanes or high occupancy toll facilities operating or under construction in the United States.[11]

GO TO 2040 originally assumed revenues from congestion pricing on a portion of existing expressways would begin to flow to the region in 2020. These revenues are separate from congestion pricing on the new capacity provided via major capital projects, which will be incorporated in the public costs of those projects. If congestion pricing on a selection of expressways equivalent to 25 percent of the region's existing expressway network occurred beginning in 2020 and revenue grew at a rate of 3 percent annually, CMAP forecasts that **$11.7 billion** would be generated.

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[7] Transportation for America, Tracking State Transportation Funding Plans, http://t4america.org/maps-tools/state-plans-tracker.

[8] Virginia House Bill 2313, Summary as enacted with Governor's Recommendation, http://leg1.state.va.us/cgi-bin/legp504.exe?131+sum+HB2313.

[9] CMAP, Road Usage Fee Moves Forward in Oregon, July 17, 2013, http://www.cmap.illinois.gov/about/updates/-/asset_publisher/UIMfSLnFfMB6/content/road-usage-fee-moves-forward-in-oregon.

[10] CMAP, Legislation Would Establish VMT Fee Pilot Program, December 6, 2013, http://www.cmap.illinois.gov/about/updates/policy/-/asset_publisher/U9jFxa68cnNA/content/id/135558.

[11] See a map at http://www.cmap.illinois.gov/mobility/roads/congestion-pricing/instances.

Action plan

Since GO TO 2040 was adopted in 2010, CMAP has explored the benefits of implementing congestion pricing on five of the highway major capital projects recommended in the plan,[12] as well as the existing expressway network. As part of its campaign to implement congestion pricing, CMAP has met with business, civic, government, and philanthropic organizations to discuss the policy's many benefits. CMAP's campaign has also received significant media attention, including both news and editorial coverage.[13] To date, six suburban councils of governments have passed resolutions in support of congestion pricing in the region, and business owners have also written public letters of support.

Previous surveys in the Chicago region suggest that the public would accept congestion pricing. In a 2008 Illinois Tollway survey of its existing users, 54 percent said they would pay an extra toll if it would ensure congestion-free travel.[14] In that same survey, 58 percent of individuals given information about express lanes were in favor of the Tollway building them. A more recent survey from 2012 for the northwest corridor indicated that 78 percent of individuals would pay a higher toll if it meant they would not experience congestion. In the same survey, 68 percent said they would pay a toll that guarantees a reliable travel time.

Recent CMAP research has examined the revenue potential of congestion pricing the existing expressway network. Implementing congestion pricing on the existing expressway network requires legislative action at both the federal and state levels. While federal law allows the tolling of new Interstate facilities or reconstructed bridges and tunnels, it does not generally permit the tolling of facilities that are currently unpriced. However, higher levels of revenues can be generated from pricing non-tolled facilities than facilities that are already tolled. Therefore, amending federal law is a key part of the implementation process. In addition, implementers such as IDOT and the Illinois Tollway may benefit from the enactment of state legislation that authorizes or encourages congestion pricing prior to implementation.

Implementation of congestion pricing on the existing expressway network will likely be phased in over a period of years. The first step of the process would not likely impact the existing system, but instead focus on a project that expands the system such as a new managed lane or new expressway facility. Policymakers at the state and federal levels may respond to a groundswell of support that is organized from the many stakeholders, policymakers, businesses, and residents that support the implementation of congestion pricing. Because of its past research and outreach, CMAP is well-positioned to advocate for congestion pricing. CMAP will continue to organize support for congestion pricing and advocate for legislative changes at the state and federal level.

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[12] CMAP, Congestion Pricing: An Analysis of the GO TO 2040 Major Capital Projects, October 2012, http://www.cmap.illinois.gov/documents/10180/24896/FY13-0028+CONGESTION+PRICING+STUDY.pdf.

[13] See http://www.cmap.illinois.gov/mobility/roads/congestion-pricing/resources for links to media coverage.

[14] Illinois Tollway, Chicago Regional Congestion Pricing Study, 2010, http://www.illinoistollway.com/construction-and-planning/community-outreach/chicago-regional-congestion-pricing-study.

Performance-based funding

The State of Illinois highway program is subject to a long-standing informal policy that directs 45 percent of transportation funds to northeastern Illinois and the remaining 55 percent downstate. This 55/45 Split is not a law -- it is an agreement established decades ago within the General Assembly and followed by IDOT.

In contrast to this approach, CMAP recommends that Illinois implement performance-based funding of highway and bridge projects in order to set transparent priorities for investments in maintaining, modernizing, and expanding our transportation system. While CMAP does not advocate for the implementation of a different arbitrary formula, it is reasonable to assume that the implementation of performance-based funding would result in increased funding for the region, which has the vast majority of the state's population and economic activity. A 5-percentage point increase in federal and state highway revenues toward northeastern Illinois would result in a net increase of **$8.3 billion** over the 2015-40 planning period, including both core and reasonably expected highway revenues.

Action plan

Performance-based funding is a top policy priority for CMAP. Over the past several years, staff has researched capital programming practices within the state and region, as well as best practices nationwide. This research has been compiled into a single compendium[15] and is also published on-line as an interactive "microsite."[16] Following the direction of the CMAP Board and MPO Policy Committee, staff is currently working to develop performance measures and collect data for application to CMAP's programming and planning activities, particularly the Congestion Mitigation and Air Quality Improvement (CMAQ) program. In a memorandum approved in October 2012, the CMAP Board and MPO Policy Committee also called on the state to establish a technical advisory group to implement performance-based funding on the state level.[17]

It is important to note that some of the research and analysis required to fully implement performance-based funding is underway as a result of federal requirements. IDOT's Technical Advisory Group, convened to help address the performance management requirements in MAP-21, has been meeting periodically since May 2012. While that effort is not designed to

[15] CMAP, Performance-Based funding for Transportation: A Compendium, April 2013, http://www.cmap.illinois.gov/documents/10180/17400/FY13-0093+Performance+Based+Funding+Compendium_FINAL.pdf/f5f03f5a-3fd4-4502-9ea8-97be10cf7342.

[16] See http://www.cmap.illinois.gov/mobility/strategic-investment/performance-based-funding.

[17] CMAP staff to CMAP Board and MPO Policy Committee, memorandum, Performance-Based Evaluation Criteria for Transportation Funding, October 3, 2012, http://www.cmap.illinois.gov/documents/10180/144110/BoardMemo--PerfBasedEvalCriteria10-03-2012.pdf.

address the specifics of implementing performance-based funding, it will help to catalog and assess available performance data.

The financial plan assumes that performance-based funding will be implemented in 2015. While there is a need for additional data collection and research, performance-based funding could be implemented in the near term. Doing so would not require a statutory change, although a robust performance-based funding process could benefit from a formal codification in law. Rather, IDOT could implement performance-based funding directly through its own administrative action. In fact, IDOT largely takes this approach today in selecting projects across its eight downstate districts; the arbitrary "55/45 split" applies to District 1 only.

Variable parking pricing

Local governments with commercial areas experiencing high demand for parking could implement variable parking pricing. This strategy is used to balance parking supply and demand by raising prices for parking during peak periods, helping improve traffic flow and increase the availability of parking. GO TO 2040 originally assumed that additional local funds would be generated for transportation purposes through pricing an additional 1.7 percent of off-street parking spaces annually during the planning period. An average rate of $1 per day was used and the forecast assumed that half of the revenues generated would be used for transportation. Assuming that an additional 1 percent of off-street parking spaces were priced annually during the planning period and that the $1 average rate is indexed to inflation**, $1.5 billion** would be generated between 2015-40.

Action plan

This could be implemented at any time through the passage of ordinances, as local governments have broad powers to regulate parking. While some municipalities have priced parking, no additional priced spaces have been added, to CMAP's knowledge, since the adoption of GO TO 2040. CMAP has continued to dedicate resources to implementing variable parking pricing. In April 2012, CMAP released a toolkit, "Parking Strategies to Support Livable Communities."[18] In addition, CMAP has been working with local governments to implement parking strategies, which may include pricing, through its Local Technical Assistance program, including projects in the Village of Hinsdale[19] and in Chicago's Wicker Park-Bucktown[20] neighborhood. Beginning in 2014, other projects will include parking strategies for Chicago's Loop, as well as for the City of Berwyn.[21]

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[18] CMAP, Parking Strategies to Support Livable Communities, April 2012, http://www.cmap.illinois.gov/programs-and-resources/local-ordinances-toolkits/parking.

[19] See Innovative Parking Strategies for Hinsdale: http://www.cmap.illinois.gov/programs-and-resources/lta/hinsdale.

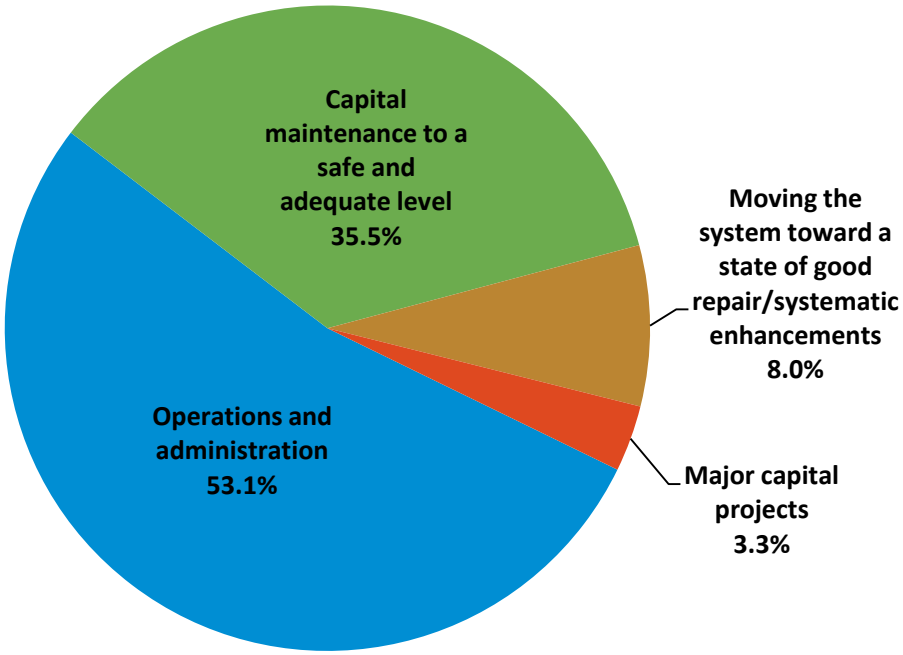
[20] See Innovation in Parking Management in Wicker Park-Bucktown: http://www.cmap.illinois.gov/programs-and-resources/lta/wpb.

[21] See Parking Strategies for Berwyn: http://www.cmap.illinois.gov/programs-and-resources/lta/berwyn-parking.

Expenditures

The financial plan update includes a plan for funding the operations, administration, maintenance, enhancement, and expansion of northeastern Illinois' transportation system. The total transportation expenditures must be constrained by the forecasted amount of future revenue, including core and reasonably expected revenues. As illustrated in Figure 8, the costs are allocated based on four categories.

Figure 8. GO TO 2040 update funding allocations



Source: Chicago Metropolitan Agency for Planning analysis.

Operating, administrative, and capital maintenance expenditures

Operating and administrative expenditures include the cost of administering, operating, and servicing debt for the region's roadway and transit system by state, county, township, municipal, and transit agencies. Forecasts for IDOT District 1, the Illinois Tollway, the RTA, and transit service boards were estimated from historical expenditures or were directly provided to CMAP by the implementing agencies. Local government operating forecasts were derived from U.S. Census of Governments data on highway operating expenses from 2007, the most recent year available.

Capital maintenance expenditures were estimated in consultation with highway and transit implementers. Because maintenance can be performed on a more aggressive or less aggressive basis, CMAP makes a distinction between expenditures for maintaining the transportation

system at a safe and adequate level and expenditures that go beyond this level, including state of good repair projects.

Similar to the original GO TO 2040 financial plan, expenditures were forecast assuming a safe and adequate level, which means performing sufficient maintenance to assure the safety of the system's users and the general public. Calculations of future maintenance costs at the safe and adequate level were based on actual current practice, meaning the typical cycles with which maintenance projects are performed today. While this results in a significant backlog of facilities that are in fair or poor condition at any given time, the resulting system condition remains safe and adequate. This category does not include funding to move the entire system to a state of good repair, but instead to attain a safe and adequate level of service.

This forecast is inclusive of expenditures for maintaining the existing system to a safe and adequate level that are completed in tandem with system expansions, namely the $8.5 billion in reconstruction activities associated with the constrained major capital projects. For example, if an existing roadway is rebuilt and has new lanes added, the capital maintenance allocation would include the reconstruction portion of those costs.

Investments that ensure that the existing transportation system is safe and adequate are a regional priority. These activities constitute the largest portion of the financial plan, totaling $329.1 billion between 2015-40, or 88.6 percent. Table 5 provides an overview of operating, administrative, and capital maintenance expenditure forecasts for the GO TO 2040 update.

Table 5. Forecast of operating, administrative, and capital maintenance expenditures to a safe and adequate level, 2015-40, in millions (year of expenditure dollars)

Highway operations and administration	$84,087
Transit operations and administration	$113,266
Highway capital maintenance	$100,759
Transit capital maintenance	$31,006
Total expenditures	**$329,118**

Source: Chicago Metropolitan Agency for Planning analysis.

Moving the system toward a state of good repair and systematic enhancements

Investing in moving the existing transportation system toward a **state of good repair** is a regional priority in GO TO 2040 and remains a regional priority in the GO TO 2040 update. Performing maintenance at levels necessary to assure a state of good repair means that facilities not in good or better condition would be brought up to that level and that maintenance would be scheduled such that no significant backlog would arise.

The capital maintenance estimates also do not provide for **systematic enhancements**, which include projects that improve system performance or expand its capacity but are not considered major capital projects. Examples of projects in this area may include:

- Arterial add-lanes projects
- Transit operational improvements
- Transit signal priority projects
- New or enhanced bus services
- Expansion of paratransit service
- Pedestrian or bicycle improvements
- Congestion pricing projects on existing facilities
- Interchange reconstructions that include operational improvements
- Signal interconnects
- Intelligent transportation systems
- Transportation demand management

Federal guidance indicates that Bus Rapid Transit (BRT) projects must be specified in the fiscal constraint in order to enable their eligibility for certain federal funding sources. Since most BRT projects under consideration in the region do not include expanding existing right of way or adding new lanes to existing expressway facilities, they are allocated under systematic enhancements rather than being assessed as major capital projects.

BRT is an evolving transportation mode. Given this changing framework, definitions and costs for BRT systems are not yet fully outlined. However, transit agencies in the region are currently evaluating BRT and enhanced bus services. Through their own planning and evaluation activities, the Chicago Transit Authority (CTA) and PACE have identified several projects for further planning and implementation in the near term. CTA and the Chicago Department of Transportation are currently evaluating arterial corridors for BRT potential and have already begun analysis of two projects. PACE is exploring projects with BRT components through its Arterial Rapid Transit (ART) program. BRT projects, such as those identified below, are considered fiscally constrained as systematic enhancements and can continue in all aspects of planning and implementation.

- Ashland Avenue BRT
- Central Loop BRT
- Milwaukee Avenue ART (Jefferson Park CTA Station to Golf Mill Mall)
- Dempster Street ART (Davis Street Station to the O'Hare Kiss-n-Fly)
- Cermak Street ART (Forest Park CTA Station to Yorktown)
- Harlem Avenue ART (Milwaukee Ave to 95th Street)
- Halsted Street ART (CTA 95th Street Station to 159th Street)
- 95th Street ART (95th Street CTA Station to Harlem Ave)
- J-route ART (From Oak Brook to O'Hare and Schaumburg)

As with safe and adequate costs, the costs of state of good repair or systematic enhancement projects completed in tandem with a major capital project are included under this category. Given available revenues, the GO TO 2040 update is unable to constrain the full cost of bringing the region's transportation system to a state of good repair and making all desired systematic enhancements. However, these activities are a regional priority, and the GO TO 2040 update allocates $29.9 billion for these types of activities.

Major capital projects

Capital maintenance, operations, administration, and systematic enhancements do not include expenditures on **major capital projects**, which are defined as large projects with a significant effect on the capacity of the region's transportation system, including extensions or additional lanes on the interstate system, new expressways, major new expressway-to-expressway interchanges, or similar changes to the public transit system. Arterial expansions and intersection improvements are not defined as major capital projects; neither are bus facilities, unless they involve adding a dedicated lane on an expressway.

Expenditures allocated to major capital projects only include the costs associated with expanding capacity, and also include future costs associated with operating or maintaining the additional capacity. To lower the public costs of major capital projects, implementers can include other project-specific financing sources. Examples include value capture, congestion pricing on new expressway capacity, other transportation user fees, or potential cost efficiencies resulting from public-private partnerships. For projects in which implementers have provided estimates from these innovative sources, total public costs of projects have been reduced.

Pursuing major capital projects, while important, remains a lower priority than investing the maintenance and modernization of the existing system, and so only $12.3 billion is allocated toward these activities.

Forecast Methodology

This section discusses the specific methodologies used for projecting revenues, operating and administrative expenditures, and capital maintenance expenditures to a safe and adequate level for the GO TO 2040 update over the 2015-40 planning period.

Core revenues

Locally-programmed federal revenue

Forecast: $11.0 billion	**Forecast assumptions for GO TO 2040 update**
Portion of annual federal apportionment that is sub-allocated to the Chicago region for programming. This includes the federal fund sources of CMAQ, Transportation Alternatives Program - Local, Surface Transportation Program - Local, Surface Transportation Program-Counties, and discretionary programs.	Revenues for 2015 were assumed to be 0.1percent greater than 2014 apportionments. This short-term growth rate was based on the difference between 2014 and 2013 apportionments (excluding discretionary). After 2015, a growth rate of 3.6 percent was assumed. This growth rate was based on the compound annual growth rate of locally-programmed federal apportionments combined with state-programmed federal highway apportionments between 2000-14.

Other federal transit revenue

Forecast: $17.1 billion	**Forecast assumptions for GO TO 2040 update**
Projection includes New Starts, bus and bus facilities, State of Good Repair, and Urban Formula programs.	Forecast was provided by the RTA. Revenues for 2015-18 are based on preliminary capital funding marks for 2014-2018 period. After 2018, revenues are forecast to grow at a rate of 2.4 percent.

State-programmed federal highway revenue

Forecast: $25.4 billion	**Forecast assumptions for GO TO 2040 update**
Portion of annual federal apportionment that is allocated to the State of Illinois for programming. This includes the federal fund sources of National Highway Performance Program, Surface Transportation Program-Urban, Highway Safety Improvement Program, Transportation Alternatives Program, Recreational Trails, and discretionary programs.	Forty-five percent of the statewide total annual apportionment was assumed to go to northeastern Illinois. Revenues for 2015 were assumed to be 0.1 percent greater than 2014 apportionments. This short-term growth rate was based on the difference between 2014 and 2013 apportionments (excluding discretionary). After 2015, a growth rate of 3.6 percent was assumed. This growth rate was based on the compound annual growth rate of locally-programmed federal apportionments combined with state-programmed federal highway funds between 2000-14.

State Public Transportation Fund

Forecast: $13.3 billion	Forecast assumptions for GO TO 2040 update
State funds equal to 30 percent of RTA sales tax and real estate transfer tax revenues.	Revenues from this matching fund equals 30 percent of forecasted RTA sales tax and real estate transfer tax estimates.

State motor fuel tax

Forecast: $5.0 billion	Forecast assumptions for GO TO 2040 update
Portion of state MFT retained by IDOT for the Road Fund and State Construction Account. The current rate is 19 cents per gallon (21.5 cents per gallon of diesel).	Using a methodology to account for increasing vehicle fuel economy, revenues decreased annually, with an average annual decrease of 1.4 percent. CMAP forecasted annual vehicle miles traveled (AVMT) and average miles per gallon (MPG) to estimate revenue. To forecast AVMT, CMAP used actual statewide AVMT data for passenger vehicles and for all other vehicles for 1991-2012 to calculate linear trendlines for AVMT. Average annual percent change in AVMT 2012-40 was 0.9 percent for passenger vehicles and 1.2 percent for other vehicles. For MPG for non-passenger vehicles, the average of AVMT divided by gallons of diesel sold was used as a base, and an annual 1.0 percent improvement was assumed. For MPG estimates for passenger vehicles over the planning horizon, CMAP created estimates based on National Highway Traffic Safety Administration rules for Corporate Average Fuel Economy (CAFE) standards, estimated standards for 1978 through 2025 model years for cars and light trucks, and information about vehicle fleet from the Federal Highway Administration's (FHWA) 2009 National Household Travel Survey. After accounting for various statutory deductions, the region is assumed to receive 45 percent of these revenues for the purposes of funding highway construction and maintenance projects.

State motor vehicle registration fees and other user fees

Forecast: $26.7 billion	Forecast assumptions for GO TO 2040 update
Annual vehicle registration fees, certificate of title fees, and operator's license fees collected by the State, excluding those used to fund the state capital program. Most of this revenue is deposited into the Road Fund and State Construction Account.	Fee revenues to the Road Fund and State Construction Account were assumed to grow at 3.0%, which was the compound annual growth rate between 2000-13.

Tollway revenue

Forecast: $51.3 billion	Forecast assumptions for GO TO 2040 update
Toll revenues forecasted to be collected on the 286 mile system. The current toll rate structure went into effect in 2012, and includes commercial vehicle toll increases between 2015-17. Following 2017, the commercial rate will be adjusted annually for inflation.	Toll revenue projections were derived from estimates prepared for the Illinois Tollway by CDM Smith in April 2013. The projection assumed that the annual adjustment in commercial vehicle toll rates beginning in 2017 would be 2 percent annually. CMAP also included an assumption of a passenger vehicle toll rate adjustment in 2030. Other operational revenues, such as concessions and miscellaneous income, were forecast by CMAP to grow at a rate of 0.5 percent annually.

State bonding programs

Forecast: $12.5 billion	Forecast assumptions for GO TO 2040 update
State bonding programs are typically funded with a variety of revenue increases, including fee increases on sources like vehicle registration and certificate of title.	Assumes that the region will receive $540 million as part of the current state capital program in 2015. For future programs, it is assumed that two more will be awarded during the planning period, with the first being 16 percent more than Illinois Jobs Now!, and the second being 16 percent greater than the first plan.

Other state transit

Forecast: $3.2 billion	Forecast assumptions for GO TO 2040 update
The State has provided the RTA with debt service assistance for SCIP I and SCIP II bonds since 1992 with General Revenue Funds. The State has provided $8.5 million annually to support Pace ADA since 2010. The State also provides reduced fare reimbursements to the service boards.	Revenues for debt service assistance are assumed to be flat through 2019, followed by annual reductions in funding until the bonds are fully repaid in 2035. Reduced fare reimbursements from the State are forecast to grow at a rate of 1.5 percent annually. ADA support is forecast to remain flat for the duration of the planning period.

RTA sales tax

Forecast: $42.7 billion	Forecast assumptions for GO TO 2040 update
The RTA sales tax is equivalent to 1.25 percent of sales in Cook County and 0.75 percent of sales in DuPage, Kane, Lake, McHenry, and Will Counties. The RTA receives two-thirds of the collar county revenues. The collar county 0.25 percent portion is listed under Collar County Transportation Empowerment Program.	Forecast was provided by the RTA. RTA sales tax revenues are assumed to grow 3 percent annually throughout the planning period.

Collar County Transportation Empowerment Program

Forecast: $5.3 billion	Forecast assumptions for GO TO 2040 update
One-third of collar county revenues generated from the RTA sales tax are returned to DuPage, Kane, Lake, McHenry, and Will Counties to be used for roads, transit, and public safety.	The revenues are assumed to be available for transportation purposes. Growth in revenues generated for the collar counties are based on projected population growth combined with inflationary assumptions. During the planning period, annual growth averages 3.4 percent.

Local allotment of state motor fuel tax

Forecast: $7.3 billion	Forecast assumptions for GO TO 2040 update
Counties, townships, and municipalities receive a disbursement of state MFT revenue. County share is based on motor vehicle registration fees received, township share is based on share of mileage of township roads, and municipal share is based on population.	State MFT revenue was forecasted using the methods explained above. County vehicle registrations and township road miles relative to the rest of the State are assumed to remain constant. Municipal population in the region relative to the rest of the State is forecast to increase according to historical trends at about 0.1 percentage points annually.

County option motor fuel taxes (those used for transportation)

Forecast: $0.75 billion	Forecast assumptions for GO TO 2040 update
DuPage, Kane, and McHenry counties impose a 4 cent per gallon MFT. County departments of transportation use these revenues for maintaining county roads. Any other local government imposing an MFT for transportation purposes is included in other local revenues.	The methodology for forecasting revenue for each county was similar to the forecast for the state MFT. For MPG, estimated 2012 MPGs for each county were used as the base (17.5, 15.9, 22.0 respectively), rather than the statewide base of 21.0. Growth in AVMT was calculated using growth rates in AVMT for each county for each air quality conformity analysis year.

Other local revenues

Forecast: $61.2 billion	Forecast assumptions for GO TO 2040 update
These are local revenues, such as property tax revenue, sales tax revenue, and impact fees used for transportation, excluding county MFTs, the RTA sales tax, state funds, and federal funds. Local governments with jurisdiction over transportation include counties, townships, and municipalities.	Revenues were calculated for municipalities and townships using 2007 U.S. Census of Governments data, which includes all local governments in the region. County revenues were obtained from recent county budget documents. Revenues were adjusted to the current year using the change in the FHWA National Highway Construction Cost Index and the U.S. Census of Governments Illinois Local Government Payroll data for highway. To forecast to 2040, growth rates for CMAP population forecasts for each locality were added to an annual 2.5 percent inflationary adjustment. Average annual growth regionwide was 3.6 percent.

Chicago Real Estate Transfer Tax (RETT)

Forecast: $1.6 billion	Forecast assumptions for GO TO 2040 update
The $1.50 per $500 of value of the City of Chicago's RETT is transferred to the CTA.	Revenues were forecast to grow at a rate of 3.5 percent annually.

Transit passenger fares

Forecast: $42.1 billion	Forecast assumptions for GO TO 2040 update
This includes passenger fares for the CTA, Metra, Pace, and Pace ADA.	Forecast was provided by the RTA. Revenues were forecast to grow at a rate of 3.2 percent annually.

Other transit operating revenue

Forecast: $6.2 billion	Forecast assumptions for GO TO 2040 update
This included other revenues for the RTA, CTA, Metra, Pace, and Pace ADA such as advertising revenue, investment income, and Medicaid reimbursements.	These revenues are assumed grow at a rate of 2.7 percent annually, which was derived from growth rates forecast by each service board.

Expenditures for operating and capital maintenance

Highway operations and administrative expenditures

Forecast: $84.1 billion	Forecast assumptions for GO TO 2040 update
Includes highway operations and administrative costs for IDOT District 1, Illinois Tollway, counties, townships, and municipalities. Also includes Tollway debt service and state debt service for Series A bonds.	IDOT District 1 expenditures were estimated using a linear trendline based on 2000-13 data. During the planning period, annual growth averaged 2.2 percent for IDOT District 1. Series A bond payments were forecast to grow 2.5 percent annually during the planning period, and it was assumed that 45 percent of these costs were attributable to the region. Illinois Tollway provided forecasts of operations expenditures, which include both operations on the existing system and operations for the Elgin O'Hare Western Access project. During the planning period, annual growth averaged 3.8 percent. Debt service payments include principle and interest on current debt and assume no future bond issuances. Local government highway operations expenditures were estimated from the local highway operations expenditures reported to the 2007 Census of Governments. Local expenditures were adjusted to the current year using the rate of change in the U.S. Census of Governments Illinois Local Government Payroll data for highway. CMAP used a 2 percent annual inflation factor to forecast local operating expenditures to 2040.

Transit operations and administrative expenditures

Forecast: $113.3 billion	Forecast assumptions for GO TO 2040 update
Includes operating and administrative costs for the RTA, CTA, Metra, Pace, and Pace ADA. As a counterpart to state revenues provided for this purpose, includes principal and interest payments on SCIP bonds. Also includes the portion attributable to interest payments for other RTA debt service obligations.	Operating expenditures were estimated using linear trendlines of 2007-15 actual and planned expenditure data, totaling $101.8 billion, with average annual growth of 2.7 percent. SCIP bond principal payments totaling $1.3 billion were included. The interest portion of debt service payments totaled $10.1 billion.

Highway capital expenditures

Forecast: $100.8 billion	Forecast assumptions for GO TO 2040 update
Capital maintenance costs for the interstate system, state highways, Illinois Tollway highways, and local roads.	Capital expenditures for the highway system are based on assumptions for unit costs and maintenance cycles. These assumptions are then applied to the inventory of highway assets in the region. CMAP staff met with a group of highway implementers representing state and county departments of transportation to determine unit cost and lifecycle assumptions. The assumptions were also reviewed by several municipal governments. Expenditures were inflated 3 percent annually.

Transit capital expenditures

Forecast: $31.0 billion	Forecast assumptions for GO TO 2040 update
Capital maintenance costs for the CTA, Metra, Pace, and Pace ADA.	In consultation with the RTA, transit capital costs were determined from the RTA's preliminary five-year capital budget for 2014-18. From that budget, an average annual capital expenditure was calculated. Expenditures were inflated 3 percent annually.

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FY14-0104

CMAP

GO TO 2040
UPDATE APPENDIX

Socioeconomic Forecast Update Overview



October 2014

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Introduction

In October 2010, CMAP released its 2040 forecast of population, households, and employment in conjunction with the publication of GO TO 2040. Base-year (2010) figures that served as the forecast foundation were derived from mid-decade estimates due to the unavailability of 2010 U.S. Census or state employment data. As 2010 data became available, it was apparent that these initial estimates for population and employment were high in many locations. As such, any adjustment of 2010 activity could impact the 2040 forecast, both in terms of regional total and sub-regional distribution. This document describes the process involved in developing the 2040 forecast update, which was undertaken in compliance with federal regulations and primarily addresses this overestimation issue in the original GO TO 2040 forecasts.

It should be noted that this adjusted forecast does not revisit original forecast methodology or assumptions; rather, it starts with the GO TO 2040 forecast as a starting point, and then:

- Corrects for the base-year error by applying the forecasted increase to the new (actual) 2010 base.
- Takes advantage of new datasets to estimate growth capacity and re-allocate forecast activity in a manner consistent with the planning principles outlined in GO TO 2040.

Table 1. Revised 2040 forecast totals for the region, counties, and the City of Chicago

	Population in Households				Households				Employment			
	2010	2040	CHANGE	GROWTH	2010	2040	CHANGE	GROWTH	2010	2040	CHANGE	GROWTH
Cook	5,104,393	5,960,242	855,849	16.8%	1,966,356	2,304,045	337,689	17.2%	2,379,923	2,814,972	435,049	18.3%
DuPage	904,784	1,104,089	199,305	22.0%	337,132	412,100	74,968	22.2%	608,709	768,282	159,573	26.2%
Kane	508,482	789,295	280,813	55.2%	170,479	265,774	95,295	55.9%	186,768	340,509	153,741	82.3%
Kendall	114,528	228,530	114,002	99.5%	38,022	74,382	36,360	95.6%	22,066	71,830	49,764	225.5%
Lake	682,753	896,341	213,588	31.3%	241,712	318,170	76,458	31.6%	314,717	401,748	87,031	27.7%
McHenry	307,113	508,918	201,805	65.7%	109,199	179,215	70,016	64.1%	88,947	153,389	64,442	72.4%
Will	669,013	1,175,218	506,205	75.7%	225,256	393,148	167,892	74.5%	201,854	437,110	235,256	116.5%
REGION	*8,291,066*	*10,662,633*	*2,371,567*	*28.6%*	*3,088,156*	*3,946,835*	*858,679*	*27.8%*	*3,802,984*	*4,987,839*	*1,184,855*	*31.2%*
Chicago *	2,654,078	3,054,654	400,576	15.1%	1,052,891	1,220,388	167,497	15.9%	1,221,758	1,458,527	236,769	19.4%

**Includes O'Hare portion in DuPage County.*

Sources: U.S. Bureau of the Census (2010 Population & Households); Illinois Department of Employment Security (2010 Employment); CMAP (2040 Projections)

About Forecast Geography

This document makes frequent reference to the "subzone," which is the foundation geography for this forecast and for all CMAP travel modeling activities. For most of the CMAP region, the subzone is based on the Public Land Survey System quarter-section (a regular grid of ½-mile squares or 160 acres). In downtown Chicago (the Central Business District) subzone size is the quarter-quarter section (40 acres).

Original (2010) Forecast

The 2040 forecast of population, households, and employment released in 2010 for the GO TO 2040 plan is the foundation of this update. The process used to develop the forecast is described in detail in the document *Socioeconomic Inventory Validation and Forecasting Method*, available on the CMAP website's Population Forecast web page. A brief summary of the process is provided as follows.

Base-Year (2010) Conditions

Population and household data were based on the latest-available (2007) population estimates at the township level published by the U.S. Census Bureau. Totals were annualized forward to 2010, and disaggregated to the subzone level, allocating growth based on a set of regional accessibility indicators. Since the Census estimate for the City of Chicago was for the city as a whole, its total was apportioned to Community Areas based on government and private-sector reports of real estate activity.

Employment estimates were based on Employment and Wages (ES-202) data provided by the Illinois Department of Employment Security (IDES), which contains employer address, number of employees, and North American Industrial Classification System classification. Employer locations were then summarized to the subzone level. Employment growth to 2010 was annualized based on external regional economic forecasts.

2040 Forecast

A reference scenario of 2040 population and employment was generated based on an extrapolation of the previously (2030 Regional Transportation Plan) adopted forecast. An "access product" was calculated based on each subzone's land value and accessibility to regional markets. This access product was then manipulated through mathematical representation of policies articulated in GO TO 2040 (i.e. brownfield redevelopment, open space protection) to alter the land value and/or accessibility of a subzone, thus changing its desirability and potential for future development. Forecasted urban activity was then re-allocated to match the revised set of assumptions.

Forecast Update

The remainder of this document describes the steps undertaken to generate the revised forecast.

Preliminary Retail Adjustment

After the release of the GO TO 2040 forecast, corrections were made to the retail portion of overall employment. Retail employment is both measured and forecasted as a subset of total employment because it serves two purposes in travel demand modeling: as the "work" end of home-to-work trips for retail workers and as an input for generating estimates of non-work-based trips by measuring the level of retail activity in a subzone.

Generally speaking, the spatial relationship between residential areas and retail centers is greater than that between residential areas and non-retail employment centers, such as office campuses and industrial parks. A new model was developed that determined current retail potential for a subzone based on the 2010 distribution and density of households and retail employment throughout the region. This retail potential model was then applied to the forecast 2040 distribution of households to predict areas of increased retail demand.

Since the purpose of this exercise was to re-allocate forecasted retail employment to better conform with predicted residential distribution, the regional total for 2040 employment remained unchanged.

Establishing a New Regional Forecast Total

The first step in the revision process was to correct the regional forecast for 2040 in terms of the new base-year total. The table below depicts the magnitude of the base-year change:

Table 2. Comparison of estimated 2010 base to actual households (U.S. Census) and employment (IDES)

	Households			Employment		
County	GO TO 2040 Estimate	Census 2010	% Over	GO TO 2040 Estimate	IDES 2010	% Over
Cook	1,970,820	1,966,356	0.2%	2,551,082	2,379,923	7.2%
DuPage	340,061	337,132	0.9%	628,469	608,709	3.2%
Kane	179,702	170,479	5.4%	224,546	186,768	20.2%
Kendall	39,849	38,022	4.8%	26,765	22,066	21.3%
Lake	250,472	241,712	3.6%	384,259	314,717	22.1%
McHenry	114,421	109,199	4.8%	123,513	88,947	38.9%
Will	245,509	225,256	9.0%	229,489	201,854	13.7%
TOTAL	3,140,834	3,088,156	1.7%	4,168,122	3,802,984	9.6%

Sources: U.S. Bureau of the Census (2010 Households); Illinois Department of Employment Security (2010 Employment); CMAP (Household and Employment Estimates)

The new forecast total was established by applying the original forecast increase in households and employment to the corrected 2010 base, or:

$$2040_Updated = 2040_Original - (2010_Estimate - 2010_Actual)$$

This approach was applied at the subzone level, generating an initial corrected forecast that adjusted for the new 2010 data. Subsequent corrections were applied to any areas where the 2010 total exceeded the forecast. These revised subzone totals were then summarized to the region level to establish the new regional forecast total.

Capacity Estimation

The next step was to account for local conditions and make an estimate of total activity (household and employment) capacity in a manner consistent with the planning strategies put forth in GO TO 2040, particularly the encouragement of infill development and the preservation of open space. This was accomplished by utilizing additional datasets, such as:

- *2010 Land Use Inventory (draft)*, for a more accurate depiction of existing conditions and land availability
- *Green Infrastructure Vision (GIV 2.0)*, to aid in articulating open space preservation goals
- *Northeastern Illinois Development Database (NDD)*, for an accurate accounting of near-term growth where development was underway or imminent

Capacity (expressed as potential households and jobs that a subzone could support) was estimated as a factor of several considerations:

- Existing (2010) population and employment
- Proximity to transit
- Mixed-use redevelopment potential
- Increased residential density assumptions (via redevelopment)
- Correction for recession-affected employment
- NDD developments identified as committed or under construction
- Capacity for "available" (vacant or agricultural) land
- Green infrastructure

Reallocation of Forecast Activity

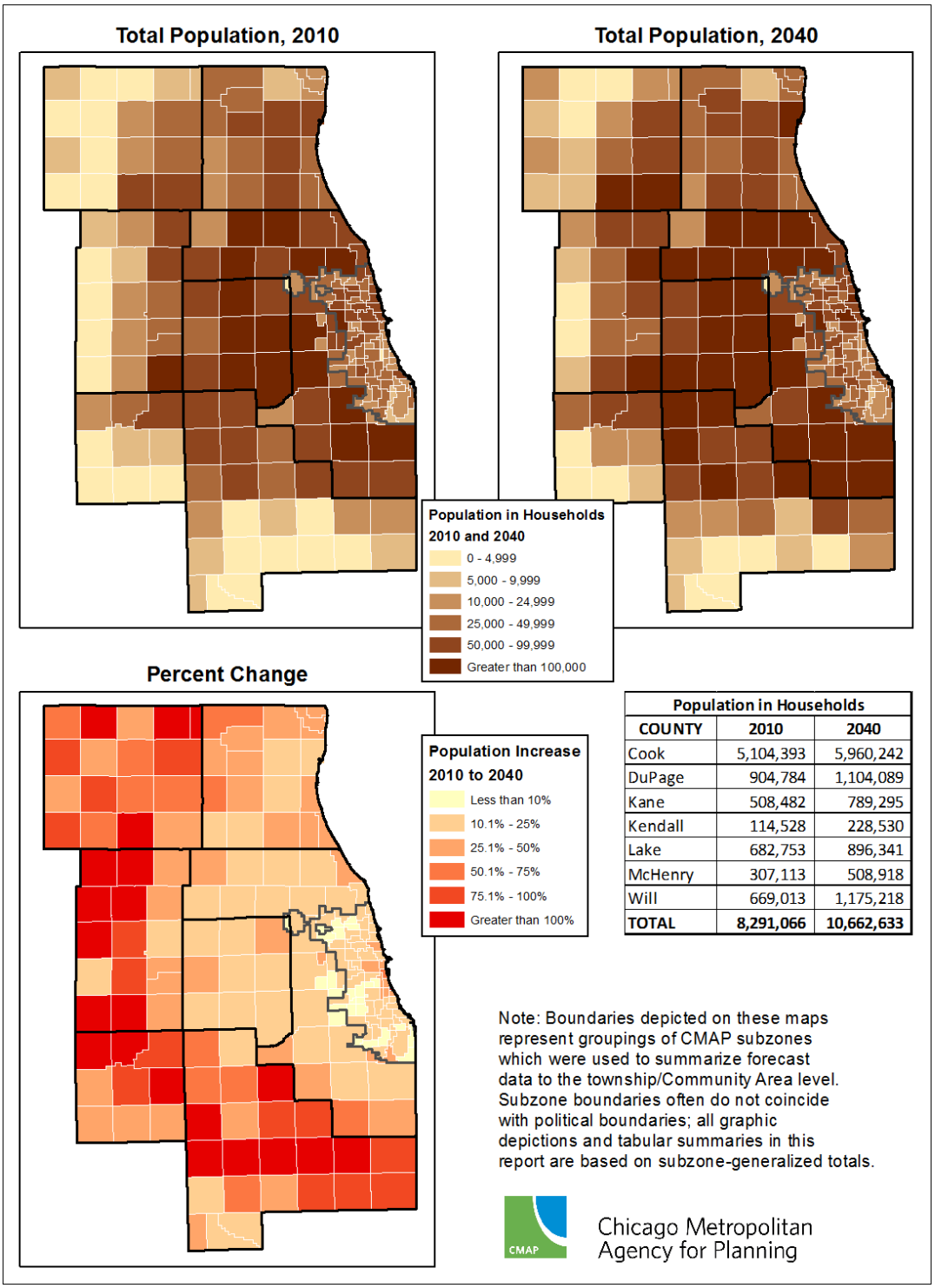
Subzone capacity was compared to the base-corrected household and employment forecast totals. Subzones with forecast activity exceeding estimated capacity were lowered to at-capacity levels, with the excess shifted to nearby subzones with available capacity, so as to not contradict the goals of GO TO 2040 or to imply a change in planning assumptions.
The results of the reallocation process were then reviewed by CMAP's Local Technical Assistance (LTA) staff. LTA project managers compared reallocation results at the subzone

level to project assumptions, and made corrections in areas where there was a noticeable discrepancy between the modeled output and LTA project recommendations.

Household Size Adjustment

Household size assumptions were modified to correct for the GO TO 2040 base-year overestimate. This adjustment was made by holding household size for 2040 constant at the subzone level to Census 2010 rates. To ensure that rapidly-growing areas (transitioning from rural to suburban) did not automatically inherit base-year characteristics, low-density (<100 households per square mile) subzones were assigned a "smoothed" forecasted household size based on the average household size of nearby suburban-density subzones. This contributed to an additional net lowering of projected regional population growth.

Figure 1. Updated forecast: population living in households by township and Chicago Community Area

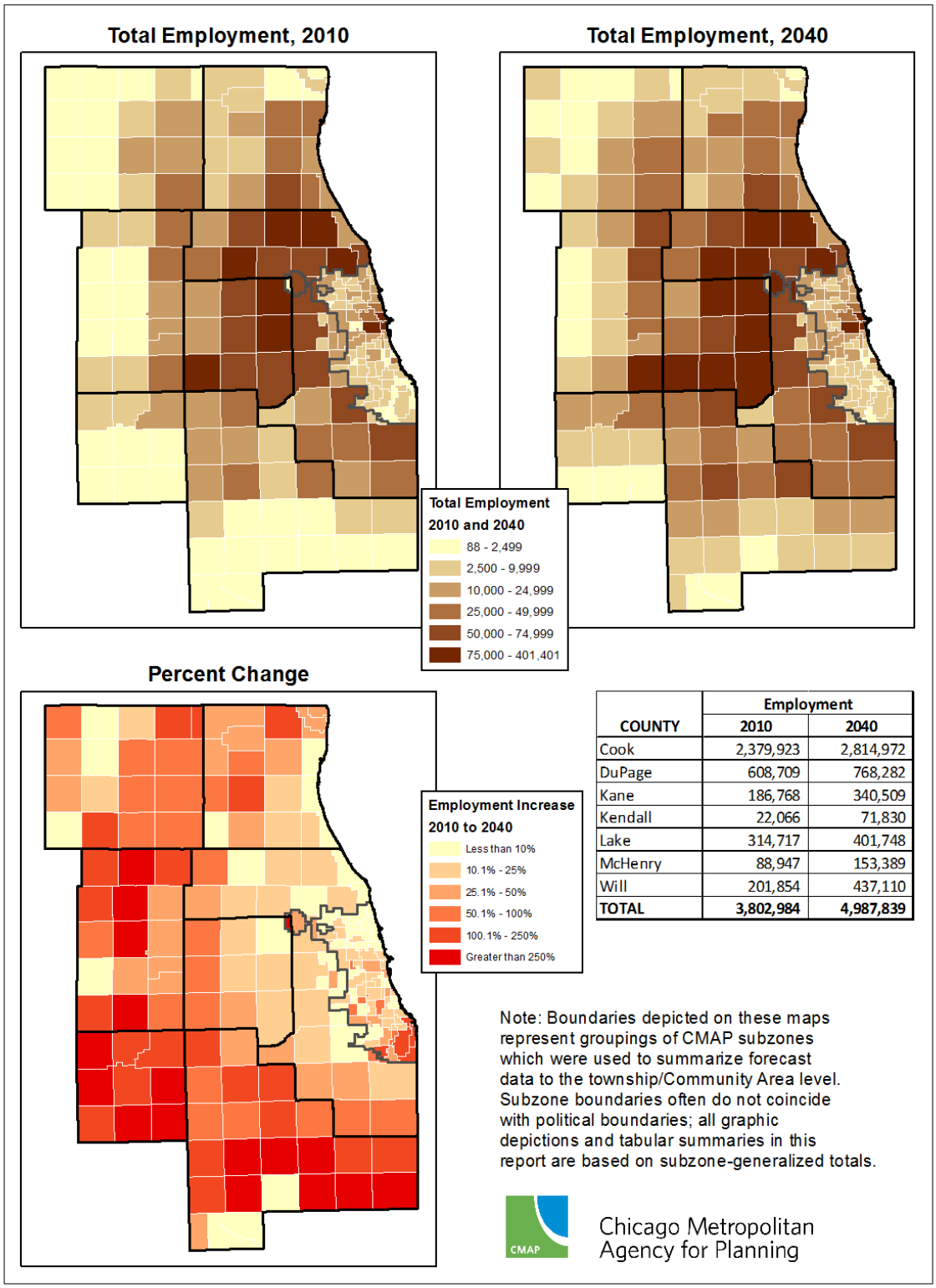


Population in Households		
COUNTY	2010	2040
Cook	5,104,393	5,960,242
DuPage	904,784	1,104,089
Kane	508,482	789,295
Kendall	114,528	228,530
Lake	682,753	896,341
McHenry	307,113	508,918
Will	669,013	1,175,218
TOTAL	**8,291,066**	**10,662,633**

Note: Boundaries depicted on these maps represent groupings of CMAP subzones which were used to summarize forecast data to the township/Community Area level. Subzone boundaries often do not coincide with political boundaries; all graphic depictions and tabular summaries in this report are based on subzone-generalized totals.

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Figure 2. Updated forecast: total employment by township and Chicago Community Area



COUNTY	Employment 2010	Employment 2040
Cook	2,379,923	2,814,972
DuPage	608,709	768,282
Kane	186,768	340,509
Kendall	22,066	71,830
Lake	314,717	401,748
McHenry	88,947	153,389
Will	201,854	437,110
TOTAL	**3,802,984**	**4,987,839**



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GO TO 2040
UPDATE APPENDIX

Implementation Action Areas



October 2014

GO TO 2040 Update Appendix: Implementation Action Areas

The GO TO 2040 comprehensive regional plan included a series of detailed action area tables to guide implementation of the plan's recommendations. The plan update process allowed CMAP and stakeholders to enhance the alignment of GO TO 2040 recommendations with responsible parties to reflect progress, restructuring of federal programs, and other variables since the plan was originally adopted in October 2010. CMAP staff conducted significant outreach through the agency's Working Committees to update the implementation action area tables, and relevant materials are archived at www.cmap.illinois.gov/about/2040/update.

This process was undertaken over several months between late 2013 and early 2014 by CMAP and partners in a series of phases:

- Identification of implementation examples. This effort helped inform Moving Forward 2013, CMAP's third annual GO TO 2040 implementation report, which was released in early 2014.
- Classification of each implementation action area into categories: retain, revise, complete, or delete.
- Red-lined text edits to specific action areas, including the addition of select new implementation actions.

Many text revisions were relatively minor — updates to reflect legislation and programmatic changes, removal of dated information, and slight rewording to improve readability. There were also a smaller number of more substantive edits, including the removal of actions that were completed over the past four years and the addition of new actions. These new actions reflect the evolution of CMAP's stance of certain policy issues, as well as the emergence of new policy issues.

Highlights of more substantive changes include:

- **Manage and Conserve Water and Energy Resources**: Updates reflect the implementation and completion of the Energy Impact Illinois program, as well as ongoing implementation of recent initiatives.
- **Reform State and Local Tax Policy**: Original GO TO 2040 implementation actions called on the region to convene a task force to consider various policy issues. That recommendation was met through CMAP's Regional Tax Policy Task Force, which issued its report in January 2012, and the new implementation actions for the recommendation area grow out of the Task Force's deliberations.
- **Improve Access to Information**: Edits reflect CMAP's experience with the MetroPulse website and the evolution of CMAP's work with The Chicago Community Trust to develop regional indicators and distribute data to communities.
- **Invest Strategically in Transportation**: Recommendations related to congestion pricing were revised to acknowledge the completion of recent studies and to emphasize the implementation of congestion pricing on new and, eventually, existing expressway capacity.
- **Create a More Efficient Freight Network**: The section on federal freight policy has been revised and expanded to reflect progress made under the 2012 federal transportation authorization bill.

This Appendix presents the final GO TO 2040 update implementation action areas. A brief narrative introduces each section and highlights significant changes from the original GO TO 2040 plan. New actions introduced through the update process are indicated with an asterisk (*). A list of acronyms is on page 34.

Livable Communities

Achieve Greater Livability through Land Use and Housing

Most implementation action areas from GO TO 2040 were retained in whole, while several were updated to reflect the current status of various projects and programs. For example, GO TO 2040 originally called for CMAP and the Regional Transportation Authority (RTA) to coordinate their technical assistance and planning programs. That recommendation was implemented between CMAP's Local Technical Assistance (LTA) program and the RTA's Community Planning Program. The relevant implementation action text was revised to support the ongoing implementation of this joint effort. To keep the text relevant over the planning period, revisions were made to remove or broaden references to specific programs and technologies that tend to change over time. Edits were also made to ensure that text matched implementation actions also found in other GO TO 2040 sections, such as text related to increased emphasis on transit-oriented development around bus and arterial rapid transit services.

Implementation action area #1: Provide funding and financial incentives

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Align funding and technical assistance for planning and ordinance updates	Federal (HUD, EDA, NOAA), State (IDOT, DCEO, IHDA, Attorney General), RTA, CMAP, counties, municipalities, philanthropic	CMAP and RTA should continue coordination on the Community Planning and LTA programs, which fund local plans and ordinance updates that are consistent with GO TO 2040. Supplement the current program with funding sources from philanthropic or other public and private sources as appropriate. In particular, funding from environmental, housing, and economic development sources should also be included within this streamlined program. Also, broaden coordination to include IDOT.
Implement, expand, and continue the Sustainable Communities Initiative program or similar federal programs with similar goals	Federal (HUD, U.S. DOT, U.S. EPA, DOE, EDA)	The federal government should apply the principles of the Sustainable Communities Initiative across other federal programs as well. Its administering departments (HUD, U.S. DOT, and U.S. EPA) should also commit sufficient funds in future years to make it a significant funding source for plan implementation, not just plan development. Federal agencies should also align federally-required planning efforts, such as HUD Consolidated Plans, with GO TO 2040 priorities, and federal investment should be geared to implement planning efforts that are consistent with the principles of the Sustainable Communities Initiative.
Develop regional infrastructure funding programs for plan implementation	State (IDOT, IHDA), RTA, CMAP, counties, COGs, nonprofits	Create a pilot program meant to focus infrastructure funds to implement local comprehensive plans, modeled on programs in the Atlanta and San Francisco regions. Investigate transportation funds currently programmed by the state (STP) and by CMAP (CMAQ, TAP) for this purpose, as well as non-transportation sources. Retain the current programming of local STP funds, but encourage programmers to consider livability in their funding decisions.

Implementation action area #2: Provide technical assistance and build local capacity

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Continually review status of local plans	RTA, CMAP, counties, municipalities	Conduct a survey of municipal decision makers every two years. Use its findings to target planning technical assistance. This could include comprehensive planning assistance to communities that do not have current plans, and assistance with implementation to those that do. Also use results to identify missing or underemphasized elements of local comprehensive plans, such as housing affordability or water conservation. In addition, RTA should continue to track implementation of past plans funded through the Community Planning program, and devote resources to their implementation.
Create model ordinances and codes	CMAP, counties, municipalities	Develop sample ordinances or codes in areas relevant to GO TO 2040 that can be adapted by local governments. Examples include water conservation ordinances, housing rehabilitation codes, and parking regulations. At the same time that model ordinances are under development, work with a few case study communities to ensure that they can be adapted to work locally. CMAP should also promote best planning practices through publications highlighting local approaches to these issues.
Research and explore alternative land use regulation systems	CMAP, counties, municipalities, nonprofits	Research alternative systems such as SmartCode and form-based codes that address structure, form, and placement over conventional use-based, Euclidean zoning approaches. Coordinate with communities that have adopted alternative land use regulatory systems, assess performance, and provide resources and training for other communities interested in these methods.
Analyze ordinance outcomes	CMAP, counties, municipalities, nonprofits	In partnership with interested communities, CMAP should review existing ordinances to quantitatively analyze their impacts (in terms of stormwater runoff, local fiscal impacts, resulting housing cost, contributions to greenhouse gas emissions, and others).
Provide assistance in planning for affordable housing needs	CMAP, counties, municipalities, nonprofits	In partnership with interested communities, research local housing supply and demand and identify appropriate housing strategies. Provide direct technical assistance, in collaboration with other regional civic organizations, to communities seeking to develop a balanced supply of housing through locally-appropriate strategies such as community land trusts, land banking, housing preservation, employer assisted housing, inclusionary zoning, removal of regulatory barriers, strategies for vacant or foreclosed properties, furthering fair housing goals, or community acceptance strategies. Support local work through regionally-sponsored research such as the "Homes for a Changing Region" reports, the "Home Grown" best practices summary, or similar efforts.
Use and enhance existing technical assistance software tools	CMAP, counties, municipalities, nonprofits	Strategically deploy innovative software and on-line applications for outreach and other planning activities. Develop and update an on-line "case study library" of best planning practices by local governments, to be continually updated and improved as technical assistance activities continue.
Target technical assistance to communities demonstrating interest in furthering GO TO 2040	CMAP, RTA, counties, municipalities, nonprofits	Create menu of assistance "offerings" consistent with GO TO 2040, and clearly evaluate requests for assistance based upon conformance with these plan objectives. Proactively identify opportunities to provide community assistance.
Sponsor Planning Commissioner workshops	CMAP, counties, municipalities, nonprofits	Provide Planning Commissioner Workshops throughout the region. Workshops will cover such issues as the importance of updating comprehensive plans, consistency of local ordinances with comprehensive planning policy, making defensible land use decisions, roles of planning commissions and zoning boards of appeals, and placing local land use decisions within a regional context. These also can include special sessions on topics of interest, such as transit-supportive land use, energy conservation, or parking regulation, to name a few.

Implementation action area #3: Support intergovernmental collaboration

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Encourage formation of formal collaborative planning efforts	CMAP, RTA, counties, COGs, municipalities	Encourage COGs and counties to lead formation of issue-specific collaborative planning groups to address issues such as housing, transportation, economic development, land use, water and related environmental issues, or others. Provide technical assistance to existing collaborative groups in research and mapping, developing model ordinances and overlay districts, seeking funding, interacting with state and federal agencies, and entering into intergovernmental agreements.
Form collaborative groups to address affordable housing across communities	Counties, COGs, municipalities, nonprofits, developers, other housing stakeholders	Encourage the formation of collaborative groups to address affordable housing across communities. These can be broad (such as the Chicago Southland Housing and Community Development Collaborative) or specifically targeted to a specific housing issue (such as the Preservation Compact). These groups should include a broad array of housing industry stakeholders and should explore various funding mechanisms to produce strategies that are nimble and specific to the current housing market.
Prioritize funding to communities engaging in intergovernmental planning	Federal (HUD, U.S. DOT, U.S. EPA), State (IHDA, IDOT, DCEO)	Provide financial incentives for involvement in collaborative groups by prioritizing funding to communities that apply for funding jointly and develop programs across municipal borders. Selection criteria in funding programs should recognize and reward intergovernmental applicants.
Facilitate communication between communities facing similar challenges	CMAP, counties, COGs, municipalities	Support initiatives by COGs or counties that bring municipalities together in coordinated planning activities and information-sharing. CMAP should work with staff of the counties and COGs to help coordinate these efforts. CMAP should also identify communities sharing similar features facing similar planning challenges, and provide a facilitated environment to bring them together to work on solutions and share ideas collaboratively.

Implementation action area #4: Link transit, land use, and housing

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Identify and exploit additional opportunities for transit-oriented development	CMAP, RTA, CTA, Metra, Pace, counties, municipalities nonprofits	Many communities have embraced TOD as a strategy to revitalize their downtowns, and plans for many of the most obvious locations for TOD have already been prepared. CMAP and other stakeholders should identify other potential opportunities for application of TOD strategies and initiate pilot TOD projects in areas where TOD is more difficult (i.e., locations with difficult land assembly, bus-based TOD, etc.). Opportunities for the application of TOD principles around planned ART or BRT services can be an immediate focus.
Use livability principles to plan for land use in development near transit, specifically for major capital projects and BRT	Counties, municipalities	Counties and municipalities should pursue opportunities for more dense development which mixes uses and housing types within "location efficient" areas near transit services. Counties and municipalities can increase density by providing density bonuses (in exchange for affordable units), creating transit overlay districts, or using form-based codes to address community fit. This can occur both for existing transit services and areas where transit expansion is planned, and applies to both rail and bus service. Counties and municipalities should specifically pursue supportive land use planning in areas near transit major capital projects and BRT.
Promote housing affordability near transit	Counties, municipalities	Proximity to transit services often increases land value, making it more difficult to provide a range of housing options. Counties and municipalities should analyze housing needs near transit services, and can provide a variety of incentives to developers to bring down development costs in exchange for affordable units. These tools include land donations, density bonuses, reduced minimum parking requirements, permit fee waivers, land trusts and expedited permitting processes. These should be explored, considered, and adapted to specific local situations.
Target housing programs to rehabilitation in areas with transit access	Federal (HUD), State (IHDA), counties, municipalities	Affordable housing grant programs should give high priority to preserving the existing affordable housing stock, particularly in TODs.
Require supportive land use planning before new transit investment is made	RTA, CTA, Metra, Pace	Consider supportive land use when making investment and programming decisions. The service boards should prioritize investments (new service in particular) in areas that have or are planning for land use and local infrastructure that supports transit.
Update guidelines for transit-supportive land use	RTA, CTA, Metra, Pace	Update materials produced by the RTA and transit service boards concerning land use planning and small-scale infrastructure investments that support transit. These materials should include additional topics such as housing affordability that go beyond the density and design issues which are currently included.

Manage and Conserve Water and Energy Resources

Following the implementation and completion of the Energy Impact Illinois program, the plan's energy policy implementation actions were substantially revised to emphasize the ongoing implementation of recent initiatives, including the deletion of an energy-related implementation action that was no longer relevant. Other deletions in this area include an action related to the Green Project Reserve, which was consolidated with a previous action, and an action related to the use of franchise agreement funding to support retrofit and rebate programs. The second action was deemed to no longer be reasonable. A new implementation action encourages the incorporation of energy usage and greenhouse gas emissions into local planning efforts. This area also includes technical changes and corrections.

Implementation action area #1: Implementing energy and water retrofit programs

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Administer and provide a financial framework for ongoing retrofit programs	CMAP, Elevate Energy, Delta Institute, Community Investment Corporation, local lending institutions	Maintain administration of single-family residential and multifamily financing programs, developed between 2010-13 through the $25 million Better Buildings Neighborhood Program grant funded by the U.S. Department of Energy.
Increase access to a trained workforce	State, trade associations, community colleges, WIBs	Support ongoing development of a regional training center for certified efficiency work. Support ongoing establishment of consistent standards and certifications for workers and contractors and create a network to match building owners with certified contractors. Partner with workforce agencies to create a "central broker" to match trained job-seekers to businesses seeking certified workers.
Increase access to information concerning retrofits	CMAP, Elevate Energy	Maintain regional informational website[1] for connecting building owners to qualified contractors, utility/nonprofit energy efficiency incentives, and financing products.

1 See **www.energyimpactillinois.org**.

Implementation action area #2: Integrating land use planning and resource conservation

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Create model codes/ ordinances and support use of existing models	CMAP	Assist communities in amending or adopting codes for water conservation by providing ordinance language and related resources. Assist implementation by making available guidance for model review processes.
Accelerate use of efficient appliances/fixtures through green code adoption	Federal, State, municipalities	Utilize Energy Star Portfolio Manager/Energy Performance Indicator or other performance indicators for energy efficiency review in commercial and residential buildings. Support federal efforts to improve energy efficiency standards in products such as appliances and fixtures. Adopt appliance and fixture codes where possible to an efficiency level greater than federal or state requirements, such as those offered through the US Green Building Council's Leadership in Energy and Environmental Design (LEED) standards.
Provide technical assistance to local governments	State (DCEO, IDNR), CMAP	Encourage incorporation of sustainability plans or codes in local planning practices during energy-related grant award processes by prioritizing funding to communities that have taken these initiatives. Allocate funding for the development of green codes. CMAP should support local multijurisdictional efforts, along with IDNR and permittees, during the transition period brought on by regulatory changes.
Promote rainwater harvesting for nonpotable indoor uses	State, counties, municipalities, nonprofits	Local governments should ensure that existing regulations do not prohibit the indoor use of rainwater. Collaborate in executing informational/demonstrational efforts for the implementation of rainwater harvesting. Support amendment of local ordinances and codes accordingly.
Increase commitment to water efficiency by promoting water-loss reduction, water conservation, and reuse programs and projects throughout the CMAP region	State (IDNR), CMAP, local multijurisdictional efforts, municipal-run community water suppliers	Advise and guide IDNR to update its annual water audit form to follow the International Water Association and American Water Works Association standard water balance protocol to help permittees reduce water loss. Work with IDNR, local multijurisdictional efforts, and community water suppliers to develop conservation and efficiency plans.
Protect sensitive aquifer recharge areas (SARAs)	CMAP, counties, municipalities	CMAP should assist local governments with prioritization of SARAs for protection as well as code and ordinance revisions to ensure their protection.
Promote and practice the integration of resource conservation in land use planning	State (DCEO), CMAP, local governments	Use planning grant programs to assist communities in incorporating resource conservation in local comprehensive planning. Encourage communities to refrain from assuming constraint-free future water supplies for projected population growth in comprehensive plans.
Adopt policies to encourage attainment of zero water footprints/water neutrality for large scale projects	Municipalities, water utilities, corporate and industrial entities	Water utilities should require large-scale projects to seek water neutrality. Project sponsors should work with utilities to set an annual water budget following an audit that identifies internal water saving mechanisms and external offsets if the budget is exceeded. CMAP should provide baseline or case study information to increase awareness of the concept and promote its applicability in the region.
Implement urban and community forestry programs	Counties, municipalities, park districts, nonprofits	Adopt minimum standards for tree coverage in development projects along with tree preservation and maintenance regulations. Undertake these programs through park districts in public sites. Incentives should be provided for residents to plant trees, such as discounted sales and/or planting assistance. Land-use change should be guided in part by an urban forestry program that strives to maintain woodlots and other tree cover during development.
Use green infrastructure practices to help manage stormwater in new development and redevelopment	Counties, municipalities	Create incentives and remove barriers in code/ordinance language to ensure that stormwater management using green infrastructure is integrated in the planning and design phase of development projects. Use infill or redevelopment as opportunities to promote retrofits with green infrastructure during (re)development. Require maintenance plans in the stormwater management permitting process that specify maintenance activities and indicate responsible parties. These plans should be transferrable with property deeds. Take advantage of the IEPA-administered Clean Water State Revolving Fund (CWSRF) Green Project Reserve to finance the implementation of green infrastructure.
Implement green infrastructure retrofits	Counties, municipalities, homeowner's associations, property owners	Local governments should create incentives for implementing green infrastructure retrofits (e.g., stormwater utility program). Watershed plans for developed areas should identify potential green infrastructure retrofits, such as rain gardens, green streets, parking lot bioretention, and so forth. These plans should be used to help secure capital funding for retrofits.

Implementation action area #3: Pricing

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Utilize full cost pricing to incentivize more efficient water use, fund conservation programs, and fund both short- and long-term capital projects in addition to operations and maintenance	Illinois Commerce Commission, CMAP, municipalities, utilities	Municipalities should decouple water utility budgets from the municipal general revenue fund and ensure that revenues collected from water billing meet capital and operations and maintenance (O&M) budgets. Utilities should implement metering and appropriate bill designs. Utilities should ensure that bills reflect the full cost of service for treatment and delivery of water. CMAP should offer technical assistance on conservation pricing and rate-setting.
Institute stormwater utility program	Counties, municipalities	Local governments with stormwater management responsibilities should charge dedicated user fees to property owners to cover the costs of maintaining stormwater infrastructure. Such fees should be directly linked to the amount of impervious area on a site. With these revenues in hand, local governments should consider taking maintenance responsibility for stormwater infrastructure on private property, as property owners (e.g., homeowner's association) may not be willing or able to do so.

Implementation action area #4: Funding

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Use the Clean Water State Revolving Fund's (CWSRF) Green Project Reserve as a means for financing water and energy efficiency programs	State (IEPA), counties, municipalities	Local governments should take advantage of the IEPA-administered CWSRF to finance the implementation of water efficiency programs, including water conservation, reuse, and water-loss reduction). Local governments should also take advantage of the CWSRF to finance the implementation of energy efficiency projects.
Implement innovative energy efficiency financing mechanisms, including Energy Performance Contracting	State (DCEO), counties, municipalities, utilities	Research and review options for counties and municipalities to move forward with energy efficiency upgrades. One option through Energy Service Companies (ESCOs) offers cost sharing or loans for property owners for improvements to be paid by consequent cost savings resulting from the installation of energy efficient equipment and fixtures. ESCOs provide guarantees that cost savings will be attained; if not, they pay the difference. DCEO also has an extensive local government-focused program and plays a key role in this area.
Pursue innovative financing mechanisms for retrofits	State (General Assembly, IFA), counties, municipalities, utilities, lenders	Explore the use of PACE financing, Green Loan Programs, New Market Tax Credits, Energy Efficiency Ratings Incentives, revolving loan funds and loan pools, etc. for funding energy and water efficiency programs. Form partnerships required to implement these programs with utilities, lending institutions and contractors.
Establish comprehensive energy and climate change policy	Federal (Congress)	Address greenhouse gas emissions economy-wide by such actions as improving the carbon content of fuels, reducing industrial emissions, and limiting emissions from electricity generation, as well as establishing policies to promote energy conservation and renewable energy. The federal government should have a strong role in this area.
***Incorporate energy usage and greenhouse gas emissions indexing into comprehensive and sustainability local planning**	CMAP, counties, municipalities	As part of their comprehensive and sustainability planning efforts, counties and municipalities should index their energy usage and associated greenhouse gas emissions to a specific base year, as well as set goals to achieve a percentage savings over time. Local government can take advantage of various energy efficiency, renewable energy, or "smart grid" programs available through local utilities, nonprofits, or other units of government.

Implementation action area #5: Local governments as early adopters of sustainable practices

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Implement green infrastructure demonstration projects	Counties, forest preserve and conservation districts, municipalities, park districts	Local governments in the region should implement green infrastructure demonstration projects with regular performance monitoring to further evaluate the applicability of such measures to local conditions. They should utilize available staff and technical expertise/resources to construct and maintain green infrastructure facilities and perform seasonal monitoring, modifying designs to adapt to local conditions as necessary. Local governments should partner with developers in establishing demonstration projects by offering financial assistance/cost share with construction costs.
Utilize green infrastructure practices in all public improvement projects	State (IDOT, IDNR), counties, forest preserve and conservation districts, municipalities, school and park districts	All governmental bodies that undertake construction activities should implement policies that require the use of site-appropriate green infrastructure practices for stormwater management.
Consolidate community water systems to achieve economies of scale and potential energy efficiencies	Municipal-run community water systems	Local governments should investigate coordinating or consolidating water utilities to enhance cost-effectiveness and lower financial risks. The expansion of existing water supply plants should be emphasized over the development of smaller plants for individual utilities. A common funding stream for plant expansion could be obtained by tapping into collective resources.
Utilize renewable energy generation in water utilities	Municipalities, utilities	Municipal utilities should seek to employ alternative energy sources, such as solar, wind, anaerobic digestion, or other distributed generation technologies to generate all or part of the power required for utility operations. Unused power can be sold back to the grid.
Develop energy and water efficiency and conservation strategies	Counties, municipalities	Communities should develop a baseline analysis of energy and water use, broadly identify potential efficiency and conservation measures, and analyze the feasibility of implementing them, including the availability of financing. This strategy should be used as an input to local comprehensive planning and as a guide to implementation. CMAP can support local governments through one-on-one technical assistance, and also by working through appropriate state and local agencies.

Expand and Improve Parks and Open Space

Edits to this area include the addition of a new implementation action to support the update of the Regional Greenways and Trails Plan, as well as the deletion of implementation actions related to state conservation funding programs that were completed following GO TO 2040's adoption. Other edits reflect updates to funding and incentive programs, along with various technical corrections and clarifications. Revisions to Green Infrastructure Vision (GIV) implementation actions emphasize the need to refine it over time and to clarify the role of governments in limiting development, including infrastructure expansion within the green infrastructure network. Revisions also clarify the role of preserving agricultural land as a component of or complement to the green infrastructure network.

Implementation action area #1: Coordinate open space investment to create a connected regional green infrastructure network

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Prioritize direct land protection within the green infrastructure network	Federal, State (IDNR), forest preserve and conservation districts, land trusts	The forest preserve and conservation districts should adopt and periodically update acquisition plans. These acquisition plans should set targets that are consistent with the overall objective of preserving 150,000 acres of land, two-thirds of it within the green infrastructure network. The plans should be oriented toward protecting the areas most important from a natural resources perspective. Other things being equal, a parcel within the GIV boundaries should have substantially higher priority for protection or restoration than a parcel outside it. Furthermore, direct state acquisitions should take into account whether an acquisition opportunity is within the green infrastructure network.
Include green infrastructure connectivity in open space grant programs	State (IDNR), philanthropic	A replenished Open Land Trust program should have a specific set-aside, or at least a set number of points in a score-based system, to help fill out the green infrastructure network. Natural Areas Acquisition Fund (NAAF) should continue to be used as it is to acquire the most important natural areas. Almost all of the candidate properties for the NAAF are likely within the GIV, but location within the GIV per se should not be a criterion. Open Space Lands Acquisition and Development (OSLAD) criteria should be revised to assign points for connectivity with other parks and protected open space. Private foundations that fund open space preservation should make preservation of the green infrastructure network part of their prioritization metrics.
Prioritize development of greenway trails with Transportation Alternatives/ Enhancement funds	State (IDOT), CMAP, counties, municipalities	The new federal Transportation Alternatives Program can be used for a number of eligible activities to support non-motorized transportation. CMAP is responsible for programming some of these funds and should continue to prioritize the development of multi-use, off-street bicycle trails. The state continues to administer its Illinois Transportation Enhancement Program, which should also prioritize the development of greenway trails.
***Update Regional Greenways and Trails Plan**	CMAP, COGs	The Regional Greenways and Trails Plan was first developed in 1992 and was last updated in 2009. Given that significant progress has been made on constructing the trails in that plan and changed conditions may suggest alternate routes for some regional trails, CMAP should undertake an update to that plan so that it may continue to guide decisions in programming transportation funds.
Refine the Green Infrastructure Vision further	State (IDNR, INHS), CMAP, CW	The GIV provides a broad, qualitative identification of the lands that are most important to protect and restore. In 2011-12, CMAP collaborated with Chicago Wilderness to refine the Green Infrastructure Vision ("GIV 2.0") using the services of the national leader in green infrastructure planning. A number of scientific issues remain, however. The GIV should be revisited on a regular basis and improved with successive versions to be sure it reflects regional priorities and that it can be used effectively to help guide action. Additional emphasis should be placed on already-developed areas of the region, including the City of Chicago, and on the potential contributions of urban forestry. Finally, it is of the utmost importance that resources be identified through fine-scale land cover mapping to provide the best possible information for local development and infrastructure planning.

Implementation action area #2: Invest in the establishment of new parks in developed areas

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Foster cooperation between park districts and school districts in dense areas to share use of open space	Municipalities, park districts, school districts, forest preserve and conservation districts	Develop inter-local agreement between the districts, followed by a planning study to determine land and facilities that could be used jointly to meet education and recreational needs, and then by specific improvements to meet identified needs.
Use innovative financing and delivery mechanisms to meet the need for more park space	Counties, municipalities, park districts	Redevelopment can be a major opportunity to provide more park space for a community. Codes can be altered to incentivize developers to provide open space during redevelopment by providing density bonuses, making reinvestment in existing communities more attractive. Furthermore, local governments can ask developers to provide connections to greenways or even trail segments as part of redevelopment. When appropriate, they could also fund park improvements through tax increment financing, considering that parks are known to have a positive effect on the value of nearby properties.
Review land-cash donation ordinances	Counties, municipalities, park districts	Older communities should review their subdivision codes or land-cash donation ordinances to make sure open space donation requirements or in-lieu fees apply during redevelopment, that they are at least 10 acres per 1,000 people (or at least 4 acres per 1,000 in dense areas), and that in-lieu fee values reflect current land values. Municipalities should work closely with park districts in this regard; higher donation requirements coupled with higher allowable densities will tend to encourage compact development. Communities expecting new growth should review their ordinances to ensure they provide rules on land donation to ensure land is well-located. It is also in the public interest to allow developers to donate land with natural resource values, such as woods, wetlands, and floodplains; park districts should strongly consider accepting these lands as part of the donation and manage them as passive recreational open space.
Encourage volunteerism and non-traditional staffing	Forest preserve and conservation districts, park districts	Park and forest preserve districts should actively encourage the creation of conservancies and partner with them to reduce the cost burden of maintenance and park programming while giving more "ownership" to users.
Protect sensitive aquifer recharge areas (SARAs)	CMAP, counties, municipalities	CMAP should assist local governments with prioritization of SARAs for protection as well as code and ordinance revisions to ensure their protection.
Encourage the integration of resource conservation in land use planning	State (DCEO), CMAP	Use planning grant and technical assistance programs to aid communities in incorporating resource conservation in local comprehensive planning and continue to provide other tools, resources, and assistance such as model ordinances to communities.
Implement "urban greening" projects	Counties, municipalities, park districts	Although it does not provide recreational opportunities for the most part, providing more extensive landscaping, tree cover, etc. does make developed areas more attractive and hence more livable. It can help increase access to open space and connect people with nature. Municipalities should build such practices into local infrastructure projects they undertake, such as street and sidewalk reconstruction. They should also review the potential to include requirements for them in new development through local ordinances.
Implement urban farms and community gardens	Municipalities, park districts	In some cases, it will be more appropriate to utilize available urban land for food production,[2] rather than for recreational parks. This will depend on local interests and the current availability of either type of land. Urban farming and community gardening have become increasingly important, as they satisfy a consumer preference for locally grown food, reduce food transportation costs, and provide a number of other benefits.

2 See the GO TO 2040 recommendation section "Promote Sustainable Local Food."

Implementation action area #3: Harmonize actions by state and local government with natural resource protection

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Adopt progressive conservation design ordinances	Counties, municipalities	The most important thing a local government can do to protect open space is to plan for livability.[3] This will reduce overall land consumption. Some development will continue to occur within the green infrastructure network, however. Regardless of whether or not new development occurs in the Green Infrastructure Network, local governments should require or at least encourage conservation design, resulting in the legal protection of a significant portion of the site through a conservation easement. The protected areas should be fully accessible to the public and linked to any offsite trails. Conservation design should produce site yields equal to or greater than allowable with the underlying zoning, so that gross density does not change. Local governments should adopt a conservation design ordinance based from the Conservation Design Resource Manual[4] to make it a by-right form of development. Some consideration should be given to having conservation design requirements apply automatically on sites containing important natural resources, as identified in a local comprehensive plan. A funding source and requirements for the management of common open space must be part of the development approval process.
Emphasize the protection of the green infrastructure network in local comprehensive plans	Counties, municipalities	As part of its comprehensive plan, a municipality should (in collaboration with the park district) specifically identify areas preferred to serve as parks, greenways, and natural areas. These areas should be zoned as such in accordance with the municipality's comprehensive plan.
Protect natural resources in transportation corridors and focus compensatory mitigation into the green infrastructure network	Federal (U.S. ACE), State (IDOT, Tollway), CMAP, forest preserve and conservation districts	One way of maximizing resources for preservation and restoration within the green infrastructure network is to stipulate that compensatory wetland mitigation required under federal or local ordinances occur within that network, but still focused within the watershed where the impact occurred. Requiring mitigation in this predefined area could help resolve the problem that entities required to do mitigation are often pressed to find a land management agency willing to take ownership and management responsibilities for the wetlands. It remains important to adhere to a sequence of avoiding and minimizing wetland impacts before utilizing compensatory mitigation. Furthermore, transportation agencies should use advanced design techniques to protect resources in project corridors, such as those spelled out in the I-LAST (Illinois – Livable and Sustainable Transportation) manual developed by IDOT, the Federal Highway Administration's INVEST system, or the Greenroads rating system.
Limit urban infrastructure expansion within the green infrastructure network	State (IEPA, IDOT), CMAP, municipalities	State and local governments fund and construct infrastructure such as roads and sewers, which play a role in supporting and encouraging land development. As such, local governments and the state should attend to whether these investments will negatively impact the regional green infrastructure network identified in the GIV.

3 See the GO TO 2040 section "Achieve Greater Livability through Land Use and Housing."

4 Northeastern Illinois Planning Commission and Chicago Wilderness, http://chicagowilderness.org/files/1413/3087/0449/Conservation_Design_Resource_Manual.pdf.

Implementation action area #4: Increase funding to achieve the level of park provision and land conservation

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Secure additional dedicated state open space funding	State (IDNR), nonprofits	State funding for land acquisition, recreational facility development, and state park operations have declined significantly in the past few years. While a state capital bill was passed in 2009, more significant and stable funding is needed to replenish the state's Open Land Trust account. A set-aside specifically for acquisitions within the GIV and for parks programming in northeastern Illinois would be ideal. The Illinois General Assembly created a $2 motor vehicle registration surcharge to support IDNR's conservation efforts, effective January 2013. However, it did not provide much money for additional conservation — the funds are mostly for IDNR operations — and did not replenish the Open Land Trust account.
Increase involvement by private landowners and land trusts in conservation activities	State (General Assembly), Federal (Congress)	Private land conservation activities must play an increasingly important role in northeastern Illinois, but the state should provide incentives to encourage this, such as a state income tax credit for the donation of a conservation easement.[5] A conservation easement tax credit in Illinois would incentivize permanent protection of important lands while keeping them in private ownership. Federal tax incentives should be strengthened and extended. These actions could help encourage people to donate easements.
Build capacity in private conservation organizations	Land Trust Alliance, CW, Openlands, and others	To help them fulfill their important role in regional conservation, additional technical and administrative capacity needs to be built up at land trusts. This could entail training in real estate instruments, finance, and land management, among other areas.
Support direct federal investment in open space	Federal (Congress, U.S. Forest Service)	Some of the biggest hubs or "macrosites" in the region are based on land protected by the federal government. Direct federal investment in open space in the region is an important form of funding that could be expanded; the federal government should take on a more significant role in open space protection in the region. This could happen through the transfer of appropriate surplus federal property for open space uses, as happened at Midewin National Tallgrass Prairie and Fort Sheridan. It could also occur through the formation of national wildlife refuges, such as the new Hackmatack National Wildlife Refuge. Organizations in the region should support these opportunities as they arise.
Increase funding for federal open space grant programs	Federal (Congress)	The federal Urban Park and Recreation Recovery (UPARR) program has not been funded since 2002. It is the only federal program specifically for constructing and rehabilitating local parks, and has been in place for more than three decades. The state portion of the Land and Water Conservation Fund has seen very limited budgetary authorization in recent years.

5 As an example, the state currently reduces real estate taxes on qualifying land enrolled in an Illinois Nature Preserves Commission program.

Implementation action area #5: Treat management needs as an important part of landscape preservation

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Restore open space within the green infrastructure network to natural land cover and hydrology and commit to long-term management	Forest preserve and conservation districts, land trusts, State (IDNR), utilities	From an environmental viewpoint, the central purposes of protecting the green infrastructure network are to protect water resources and to preserve biodiversity within the region. Ecosystem restoration, which often depends on at least partial reversal of hydrologic modifications, must be a major activity within the green infrastructure network. Local park sites are successfully being redesigned to include smaller green infrastructure practices for stormwater management; this is an important role they can play in the future in addition to providing recreation opportunities. Lands that are not protected open space per se are also candidates for management as green infrastructure. For instance, utility companies should make additional effort to put right-of-way into natural land cover.
Devise and commit to a system to prioritize restoration needs based on regional criteria	State (INHS, IDNR), CMAP, forest preserve and conservation districts, nonprofits	It is not yet clear which areas are most important for restoration from a region-wide standpoint. CW or other partners, such as the Illinois Natural History Survey (INHS), should develop or simply adapt a system to rank natural areas by the viability and importance of restoring them. Restoration projects by organizations in the region should then be based on these priorities, as should external funding for restoration projects. Standardization of collection and sharing of data on restoration success should be encouraged as part of this system.
Consider preservation of agricultural land as a component of and/or a complementary land use to the green infrastructure network	Counties, forest preserve and conservation districts, land trusts	Although the long-term goal is to restore land within the green infrastructure network to natural land cover, it is important to consider and preserve farmland as a part of, a complementary land use to, or an important buffer to the green infrastructure network. Agricultural operations taking place on preserved agricultural land should be done in accordance with a conservation plan approved by the forest preserve, conservation district, or land trust. Some agricultural operations, such as food production, organic, biologically-based, and other sustainable operations provide benefits that are consistent with and complementary to land and water conservation goals, and should be considered as desirable uses in or adjacent to the green infrastructure network.
Support efforts to provide adequate operating budgets for implementing agencies	State (General Assembly), CMAP, nonprofits	Re-evaluate statutory restrictions on the ability of park districts and forest preserve and conservation districts to raise property taxes to manage lands they acquire. Consider inclusion of funds for management in open space referenda. Estimate financial needs for restoration work in the region.

Promote Sustainable Local Food

A number of technical corrections and clarifications were made to this GO TO 2040 recommendation section. Additionally, a former action related to fresh food financing was completed following GO TO 2040's adoption and thus deleted from the plan update. A new action was added referring to local food production in the region's non-urban areas, filling a gap in the original implementation actions.

Implementation action area #1: Facilitate sustainable local food production

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Support urban agriculture as a source of local food and a productive use of vacant or underutilized land	Federal (USDA, U.S. EPA), State (Dept. of Agriculture, IDPH, IEPA), counties, municipalities, nonprofits	Urban agriculture can be a productive use of vacant or underutilized urban land. Local governments should simplify and incentivize the conversion of vacant and underutilized lots, spaces, and rooftops into agricultural uses, and allow local food production in residential areas as well as on parcels designated for institutional (e.g., schools and hospitals) and nonprofit use (e.g., churches). Research groups should support this by developing an inventory of underutilized publicly owned land that could be appropriate for urban agriculture. Brownfield remediation funding can and should be used to support community gardens and farmers' markets.
***Support food production in non-urban areas as a regional source of local food**	Federal (USDA), State (Dept. of Agriculture), counties, municipalities, nonprofits, and educational institutions	Food production in the rural and peri-urban areas of the region holds much promise for meeting a significant share of regional food demand. Local governments should encourage and support the use of agricultural land for local food production. Counties should lead the effort to encourage more local food production in the peri-urban and rural areas and to remove barriers to local food production in unincorporated areas, such as access to land and infrastructure.
Continue and expand farmland protection programs	Counties, forest preserve and conservation districts, municipalities, park districts, land trusts	The region's local governments should maintain and improve their current farmland protection programs and develop new programs where needed. Kane County's Farmland Protection Program can serve as a model for the region. Focused on the goal of preserving land, their program provides equal opportunity to applicants regardless of crop selection. Counties and municipalities should work together to remove barriers to local food production on their respective lands and encourage inter-jurisdictional business opportunities. Where appropriate, agriculture should be supported as part of preserved open space such as forest preserves, park districts, or land trusts, and can also be protected by municipalities and counties through the use of conservation design techniques that preserve a portion of a development as farmland. The state should also permit counties to hold referenda to raise revenue for agricultural preservation.
Encourage revisions of state and federal policy to support local food production and processing	Federal (USDA), State (IDPH)	Farm and food policies at the state and federal level (including public health and food safety regulations) should be reassessed to accommodate local and small farm operations and processors. Most federal incentives have been geared to encourage large industrial farming practices, and current state and federal regulations can inhibit local and small farm production and processing. Recent state and federal policy changes to recognize the importance of local food should continue and be strengthened.
Support local food production through institutional support and procurement processes	State and local agencies and institutions, wholesale farmers, University of Illinois Extension	In line with the 2009 Local Food, Farms, and Jobs Act, a procurement process for state and local institutions that favors local foods (such as schools, hospitals, and other government facilities) could bolster the local food economy by creating a stable demand for local food. Sharing of best practice information between participating institutions is also recommended.

Implementation action area #2: Increase access to safe, fresh, affordable, and healthy foods

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Increase community access to fresh food through demonstration programs	Federal (USDA), State (DCEO), counties, municipalities, philanthropic, private investors, banking institutions	Support and expand various demonstration programs for providing better food access in food deserts, such as farmers' markets, farm carts and stands, fresh food delivery trucks, food cooperatives, on-site school programs, community-supported agriculture, and other alternative retail options and direct sales from community vegetable gardens. On-site school farms could also be used to increase access and develop a local food curriculum. Funding should be identified to implement these programs. These programs also can be supported by examining zoning, health, and licensing regulations to ensure that they do not create barriers to local access to fresh food.
Link hunger assistance programs to local foods	Federal (USDA), State (Dept. of Agriculture), public health organizations, food pantries, individual farmers' markets, restaurants, and grocers	A partnership between hunger assistance and local food production can benefit both parties. Food pantries can work with local food producers to increase their quantities of fresh food. Additionally farmers' markets and other alternative local food outlets should accept Supplemental Nutrition Assistance Program (SNAP) benefits and conduct outreach to SNAP recipients to utilize these locations to purchase food. To support this effort, Illinois passed the Farmers' Market Technology Improvement Program Act in 2010, which establishes a fund to provide financial assistance for equipment (such as electronic benefit transfer [EBT] card readers) and transaction fees to facilitate the use of SNAP benefits at farmers' markets and other alternative retail locations. Resources such as grants and loans should be provided to support the fund and the other efforts listed above.

Implementation action area #3: Increase data, research, training, and information sharing

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Build regional nonprofit capacity for local foods systems	Nonprofits, philanthropic	Identify and support a regional food entity (nonprofit). The entity should be represented by a variety of members (economic, environmental, transportation, agricultural, public health, etc.) to analyze and support food policy issues from a comprehensive perspective and coordinate federal grant and loan programs. This entity should coordinate with the activities of the Illinois Food, Farms, and Jobs Council. It should also host summits and informative meetings for local officials and policymakers, including health departments, community organizations, and environmental groups.
Improve data collection and research on local food production, distribution, processing, sales, and other data needs	Federal (USDA), State (Dept. of Agriculture, DCEO), CMAP, counties, nonprofits, universities, philanthropic	The region needs improved data on the production, distribution, sales, and other data related to local food and specialty crops. Also, infrastructure needs for the transportation, storage, processing, and distribution of food (such as regional distribution hubs or refrigerated storage facilities, for example) should be identified and analyzed. CMAP should work with neighboring metropolitan planning organizations like the Northwest Indiana Regional Planning Commission and the Southwest Michigan Regional Planning Council to accelerate effective planning, and regional food systems development.
Provide training and information sharing	Universities, community colleges, other education and training providers, nonprofits, philanthropic, local businesses and restaurants	Local food training and technical assistance programs for farmers and laborers should be provided to assist in the transition to local food production. These should be linked with workforce development programs. Sustainable and conservation oriented farming techniques should be particular focuses. Also, information sharing between practitioners on a variety of local food topics, including food waste reduction, processing, and reuse, should be encouraged. Develop comprehensive information resources to develop and connect the value chain between farmers, distributors, retailers, producers and consumers, such as the University of Illinois MarketMaker website.[6] Universities and community colleges should offer food related courses to cover a variety of topics from nutrition to distribution. Businesses and restaurants can also support local food by purchasing from local food farms/vendors and providing information to customers about food origin (such as menu and product labeling).
Provide technical assistance to incorporate local food systems in comprehensive plans and ordinances	CMAP, counties, municipalities, nonprofits	Assist government officials and planners to incorporate local foods and agricultural protection into comprehensive plans and ordinances. Local food could also be integrated into economic development plans. Technical assistance should accommodate the full spectrum of local food production from community gardens to commercial farm operations, and could include activities such as removing barriers to local food production, distribution, and sales; allowing season-extending structures; or designating certain zones for permitted small-scale food production.

6 University of Illinois MarketMaker website, 2010. See **http://www.marketmaker.uiuc.edu/**.

Human Capital

Improve Education and Workforce Development

Text on data transparency initiatives was revised to reflect the current status of those programs. Additionally, edits removed or broadened references to specific initiatives, many of which have evolved or terminated since the adoption of GO TO 2040. Such edits help focus attention on the policy recommendations themselves. The action on assessment reports for cross-system coordination were also edited to remove references to specific industrial sectors (some of which have been analyzed since GO TO 2040's adoption) and to note potential opportunities to deliver these assessments.

Implementation action area #1: Improve coordination between education, workforce development, and economic development

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Prepare assessment reports on cross-system coordination	Nonprofits, philanthropic	Complete these assessments as an independent report, or continue to include aspects of a cross-system assessment in related reports. For example, the CMAP cluster drill-down reports describe current coordination efforts and ways to expand upon them. Additionally, this work can also be incorporated into local planning projects. These assessments should identify and convene economic development, education, and workforce leaders in each industry, and determine areas of duplication or gaps. They should also summarize the conclusions with recommendations for next steps, including setting of common goals and pursuit of pilot programs to improve coordination.
Expand on successful workforce development coordination programs	State (DCEO), community colleges, WIBs, economic development organizations	Build on successful efforts that foster collaboration, reduce duplication, and increase accessibility for employers and workers throughout the region. Partner with the private sector and economic development organizations to develop education and training programs that are responsive to today's economy.
Strengthen role of workforce intermediaries — including community colleges, universities, proprietary schools, universities, apprenticeship programs, vocational programs, community-based organizations, Workforce Investment Boards and Workforce Investment Act affiliates	Community colleges, nonprofits, other education, workforce and economic development groups	Expand programs that have succeeded at individual education institutions and training providers to be applied broadly across the region. Improve communication between education institutions and training providers through regional forums that also involve economic development groups. Increase the profile of workforce intermediaries as a critical link in the education and workforce development system.
Collect, compile, and publicize career pathways analyses	State (DCEO, ISBE, ICCB, IDES), community colleges, nonprofits, philanthropic	Identify existing analyses of career pathways, or programs of education and training that prepare students for future employment in a certain field. Compile these and make them available to education institutions, workforce service providers, and employers. Update this compilation frequently to reduce duplication, revise based on advances in the industry, and prepare new career pathways to eliminate any gaps in coverage of new or expanding industries.

Implementation action area #2: Data and information systems

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Launch and continually improve Regional Economic and Workforce Indicators	CMAP	Collect and analyze data on economic trends, innovation, clusters, and workforce. This data and information should be housed at CMAP and disseminated via the CMAP website. The site will illustrate metrics and include in-depth analysis of the data and ongoing discussion of relevant policy issues.
Identify additional data sources concerning education and workforce, including existing data and newly developed or innovative data measures	State (IDES, ISBE, ICCB, DCEO), CMAP, higher education institutions and community colleges	Analyze existing education and workforce information and data sources, including CWICstats, Illinois Department of Employment Security (IDES), Illinois State Board of Education (ISBE), DCEO, and the Illinois Community College Board (ICCB), among other sources. Identify barriers to making new data sources publicly available on the Regional Indicators Project website and determine incentives or mechanisms needed to overcome these barriers.
Expand and advance efforts that work to integrate multiple education and workforce data systems	CMAP, State (IDES, DCEO), WIBs, education institutions, workforce providers	The region continues to need reliable data, analysis, and information on the workforce development system and its outcomes. Continue to expand and support CWICstats (Chicagoland Workforce Information Council at Chapin Hall) to analyze and link data in order to study students and training participants as they move through the public education system and the public workforce development system. Continue to develop the Integrated Workforce Information System (IWIS), an integrated management information system that will collect information across programs and organizations on all those being served by the workforce development system in Chicago and Cook County, including those whose services are supported by public or private funds.
Expand and develop the Illinois Longitudinal Data System to include workforce and labor market data	State (ISBE, DCEO), early childhood educators, higher education institutions, workforce providers	Implement the ILDS to track student performance over their educational careers, including data beyond academic achievement. Expand this to coordinate with early childhood education, higher education, and workforce development data systems.
Refine and expand use of school readiness measurement tools to improve early childhood education programs	State (ISBE), early childhood educators	Continue to develop and scale up measures of school readiness for students entering kindergarten. Use this to evaluate the effectiveness of various early childhood education programs at preparing students for success in school. Link this assessment with the Student Information System described above.

Implementation action area #3: Improve delivery of workforce development services

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Increase the flexibility and federal funding for workforce development and increase flexibility of State discretionary workforce funds	Federal, State (DCEO), WIBs, workforce providers	Modify the requirements of WIA funding to allow workforce boards to exercise more flexibility in how these funds are used. Permit differences in how WIA funds are used between regions to reflect their different economic profiles and related training needs.
Investigate the use of other funding sources for workforce development	Nonprofit, philanthropic	Explore the use of more flexible funding sources such as CDBGs to be used more extensively for workforce development. Create a region-wide documentation of existing public funding streams to allow the development of specific recommendations for funding changes.
Monitor impact of more flexible funding and communicate outcomes	Federal, workforce providers	The outcomes of modified policies and funding streams should be result in better matches in workforce skills and business needs. Routine and regular monitoring of effectiveness in meeting regional goals will be an ongoing activity.
Strengthen community-focused provision of workforce services	State (DCEO, Governor's Office), community-based organizations, business community, WIBs, other workforce funders	Continue offering workforce development services through community-based organizations, in conjunction with other services. Evaluate local community-focused programs, determine which approaches are most effective, and promote further use of these programs.

Support Economic Innovation

Edits to this recommendation section removed or broadened references to specific initiatives, many of which became irrelevant in years following GO TO 2040's adoption. Such edits help to focus attention on the policy recommendations themselves. The implementation actions related to drill-down analyses were revised to remove references to specific industries (some of which were analyzed since the adoption of GO TO 2040) and to acknowledge the need to take a subregional perspective in future reports. Growing from CMAP's work in cluster analysis, a new implementation action was added to highlight the need to reorient economic development strategies to the region's key drivers of economic growth.

Implementation action area #1: Improve data and information systems

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Evaluate the success of state innovation programs and financial incentives	State (DCEO, and other relevant state agencies)	The history and impacts of state programs and incentives for economic development and innovation should be evaluated. Such an evaluation can inform the expansion or restoration of successful programs, identify gaps in existing programs, and improve responsiveness to emerging economic trends. There is evidence that many of these state programs have been quite successful — these successes need to be better analyzed, documented, and publicized to inform future state policies and programs.
Collect and analyze data relative to innovative business starts and closures in the region	CMAP, WBC, State (IDES), Illinois Science and Technology Coalition	Currently there is very limited information about how innovations translate into larger economic effects, such as jobs and business starts. CMAP and other regional entities should measure the number of new innovation start-up firms and jobs created. This will provide the region with a means of tracking emerging industries and technologies, the growth in new firms, as well as their longevity. This information should also have useful research consequences beyond the study of innovation.
Collect and analyze other pertinent data related to innovation outcomes	CMAP, WBC, Chicagoland Chamber of Commerce, Illinois Science and Technology Coalition, CMRC, State (IDES), additional outside experts	CMAP and other regional partners can serve a vital role as a central repository for the collection of data related to innovation. CMAP should also consider how to best measure success through this data — other groups have created weighted measures of a variety of variables — an "innovation index" — which can work to measure future success.
Research and redesign technology transfer evaluation criteria	State (DCEO), Illinois Science and Technology Coalition, technology transfer programs at universities and other institutions	The region needs to increase technology commercialization and bridge the gap between the region's basic research assets and the private market. There is some evidence that innovators are changing their products to be responsive to the criteria by which technology transfer programs are judged. This is likely inefficient. Alternative metrics that better reward commercialization of new innovations should be explored. Applied research should be carried out by interviewing tech transfer officials, scientists, engineers, investors, and manufacturers, and researching other evaluation metrics.

Implementation action area #2: Nurture the region's industry clusters

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Form coalitions around the region's vital industry clusters to organize regional strategies and better position the region to compete in the global marketplace	State (DCEO), CMAP, local governments, nonprofits (Chicagoland Chamber, CMC, MEGA, WBC), Chicago Fed, workforce boards, philanthropic	The region should use its various clusters of regional specialization as an overarching organizing framework for future coordination, collaboration, and proactive initiatives, including organizing around potential state and federal funding. The region should implement strategies to support key clusters, such as the recommendations identified in CMAP's cluster drill-down reports to foster innovation, meet workforce needs, and prioritize infrastructure investments. Specifically, public/private coalitions can develop strategies to attract businesses and skilled workers and articulate a common regional direction.
Perform "drill down" analyses on established and emerging industry clusters	CMAP, Chicago Fed, regional leaders or coalitions around industry clusters	Industry clusters have been researched extensively, but many gaps, practical linkages and pertinent policy responses remain poorly understood. CMAP should continue developing drill-down analyses to understand key drivers of the economy and how the region can foster future growth. Analyses will present data specific to these clusters; identify infrastructure, workforce, and innovation needs; present strategies for coordination and communication; and make policy recommendations. Future reports should include sub-regional analyses that examine a smaller geography and unique opportunities.
***Reorient economic development strategies toward key drivers of regional economic vitality**	State (General Assembly, Governor, DCEO), local governments, economic development organizations	State and regional economic development policies and practices should be reoriented to better compete in the highly competitive global marketplace. Specifically, strategic plans should set clear investment priorities. Programs and services should be more coordinated and streamlined to improve the experience for businesses and workers. Information and data about these efforts should be accessible and include transparent, routine evaluation. These actions will enable the state and region to develop a more outward-facing strategy to attract and retain businesses and workers, as well as compete nationally and globally.

Implementation action area #3:
Increase the commercialization of research, target investment decisions, and pursue new financing opportunities

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Bolster or reinstitute successful State programs which assist entrepreneurs and create linkages between researchers and the private sector	State (General Assembly, DCEO)	State elected officials should bolster or reinstitute state programs with a track record of success in assisting entrepreneurs with critical business startup and marketing needs, locating pre-seed and early stage financing, furthering technical or managerial skills, and assisting with new product development and marketing. For example, the state-funded programs like IEN and ITEC provided entrepreneurs with important businesses development support to put together documentation for venture capital or "angel" investors, apply for federal SBIR money, apply for a patent, or put together a business plan.
Re-institute the Illinois Innovation Challenge Matching Grant program	State (General Assembly, DCEO)	Some version of the Innovation Challenge Matching Grant program should be reinstated to provide matching funding for federal SBIR and STTR recipients. SBIR and STTR are federal programs funding small businesses working with universities.
Explore the creation of a major new venture capital fund, at the regional or mega-regional level	State (Governor's office, DCEO), the business community, the Chicago Fed, nonprofits, I2A fund, philanthropic	A new venture capital fund should be created to help investors and entrepreneurs create and grow profitable businesses in the metropolitan Chicago region and potentially beyond. The fund should be managed and operated by a private firm, but exploration should be done first by government, civic organizations, foundations, and the private sector. The fund should be targeted toward clusters of regional specialization. A range of private and public revenue sources should contribute to such a fund, and philanthropic organizations can play a large role.
Implement a more robust national innovation policy	Federal (Congress)	Provide more incentives for public/private collaboration around innovation. Provide federal funds that can be leveraged with private resources. Provide competitive funding for regional approaches around specific industry clusters.

Implementation action area #4: Create a culture of innovation

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Research, compile, and publicize examples of successful innovation	State (DCEO), nonprofits (Chicagoland Chamber, CMC, MEGA, WBC, Illinois Science and Technology Coalition) philanthropic, private sector, universities	Innovation success stories should be collected and publicized. Commonalities of these experiences should be emphasized, and the role of experimentation and perseverance must be taught so that workers, entrepreneurs, and sources of funding see experimentation as an important stepping stone to innovation and growth.
Expand and link innovation related training	Nonprofits (Chicagoland Chamber, MEGA, WBC), universities	There are multiple meeting places, forums, and educational programs that support innovative thinking in the region. These programs should be expanded to reach wider audiences. Educational programs, conferences, and innovation competitions should also be linked so that budding innovators and investors can interact across fields and disciplines to share experiences and foster further innovative thinking.
Reorient philanthropic giving toward innovation	Philanthropic	The region's foundations are a strong asset and to date have funded extensive efforts in education, arts and culture, and human services. Focusing more on the regional economy and innovation makes sense on many levels for foundations, as these are truly the catalytic investments which can help the region sustain a high level of prosperity and vitality. Foundations can work to support those groups working to organize regional initiatives and policy around a "cluster approach."
Identify opportunities for state and local regulatory reform and modernize local ordinances	State (DCEO), municipalities, nonprofits (Chicagoland Chamber, MEGA, WBC), the business community	Review and implement reforms in existing state and local regulations, especially in areas of rapidly changing technology and changes in federal regulation. Convene innovative companies to learn about potentially limiting local regulations or ordinances. Provide model ordinances that contain language about up-to-date regulation and how to keep it updated. Review validation, information sharing, and technical assistance programs for new technology development and implementation. Recommend updates as appropriate.

Efficient Governance

Reform State and Local Tax Policy

All original implementation actions in this recommendation section were completed through the Regional Tax Policy Task Force, which issued its final report to the CMAP Board in January 2012. The new implementation actions build on findings of the Task Force and reflect CMAP's recent research efforts in this area.

ACTION	LEAD IMPLEMENTERS	SPECIFICS
***Play a leadership role in facilitating a regional perspective on tax policy**	CMAP	CMAP should take an active role in defining a regional perspective, backed by rigorous research and analysis, with respect to tax policy issues and appropriate changes in tax law that are in the best interests of the region as a whole, as well as the governments that are an integral part of the region and the residents and businesses that pay taxes.
***Address tax policy issues in a manner that encourages effective local land use decisions and triggers sustainable economic activity**	State	The State of Illinois should enact tax policy reforms that benefit the region by encouraging decisions that make effective use of land and generating sustainable economic development. As an example, new approaches to disbursing state sales tax revenue to local governments could enhance both the efficiency and the equity of the system for residents, businesses, and local governments.
***Implement tax policy reforms that encourage efficient and modern approaches to governance**	State	The tax system should reflect the region's demographics and needs, as well as encourage local governments to consolidate or share services when appropriate. Outmoded aspects of the State's tax system should be reformed. For example, personal property replacement tax revenue is allocated to local governments using a method based on the structure of local taxes and the economy in the late 1970s. Barriers in the tax system that make it difficult for local governments to consolidate or share services should be removed.
***Adopt reforms that improve the transparency of the tax system**	State, counties, townships, municipalities, school districts, special districts	Taxpayers should have access to recent data on tax revenue and rates, as well as how tax revenue is expended. This should include tax expenditures, which are devises like tax exemptions and abatements which reduce the amount of revenue that would otherwise be collected. The State provides some of this data in a publicly-accessible manner, as do many local governments. The State, as well as local governments, should continue to standardize and improve the transparency of taxation and other fiscal data.
***Enact reforms that phase out Cook County property tax assessment classification**	Cook County	Cook County is the only county in the State that assesses commercial and industrial property at a higher percentage of market value than residential property. The higher tax burden on businesses in Cook County creates a discontinuity in taxation within the region, which impedes redevelopment of infill land to strengthen existing communities. The Cook County Board should phase out this regional inconsistency over a period of years in order to allow residential taxpayers to adjust to the increased burden.
***Adopt tax policies that help the region compete more effectively for economic development opportunites**	State	The State of Illinois should enact tax policy changes that reduce economic distortions, broaden the tax base, and lower rates, which would help the region, as well as the State, compete more effectively for economic development opportunities. For example, broadening the state individual income tax base to include federally-taxed retirement income would provide a more stable revenue source as the region's demographics change. Likewise, the sales tax base could be broadened to include additional services as a way to respond to changing consumption patterns, with a focus on lowering the region's high sales tax rates.
***Evaluate state and local economic development incentives**	State, counties, municipalities, other units of local government	State and local governments widely use numerous tax incentives to attract and retain businesses and developments. The impact of these tools should be evaluated for their consistency with GO TO 2040's goals of an efficient, equitable, and transparent tax system, as well as redevelopment goals.

Improve Access to Information

The text in this recommendation section was substantially revised, in part to reflect CMAP's experience with the MetroPulse website and the evolution of CMAP's work with The Chicago Community Trust to develop regional indicators and distribute data to communities. Because good data becomes more accessible every year from institutions and government agencies, MetroPulse will henceforth narrow its focus to select indicators for monitoring the progress of GO TO 2040 implementation and the Trust's community goals. This revised approach should be more effective for the greatest number of users. The second implementation action area has been revised from "Develop Regional Best Practices" to "Facilitate Data Sharing Among Communities Across the Region," with corresponding deletions and additions of implementation actions.

Additionally, the third implementation action area from GO TO 2040, "Provide Direct Technical Assistance and Conduct Data Sharing Pilot Programs," has been deleted. The technology for visualizing and distributing data over the web is constantly changing and evolving. Each county and municipality will have different goals, indicators, and targets to monitor. As an authoritative source of data and information, CMAP will continue to remain active and engaged in this topic. However, prescribing a method to provide technical assistance or creating pilot programs are not effective strategies for increasing access to information across the region, given the diverse needs of our communities. CMAP will also continue to encourage the distribution of public data on-line by posting original data created by the agency, updating community data snapshots, and periodically refreshing regional indicators data to monitor the implementation of GO TO 2040.

Implementation action area #1: Launch the regional indicators project's metropulse website

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Launch the Regional Indicators Project's MetroPulse website	CMAP, The Chicago Community Trust	In collaboration with the Trust, CMAP will update the website that tracks indicators of regional and community quality of life, with emphasis on the indicators used for tracking GO TO 2040 implementation. This website will continue to include Community Data Snapshots describing each of the region's municipalities and City of Chicago Community Areas.
Continually update indicators and other public data that CMAP makes available through its website	CMAP, The Chicago Community Trust	CMAP and the Trust are committed to updating these data on-line at least every two years. This effort will include the creation and distribution of community data snapshots describing all of the region's municipalities and City of Chicago Community Areas. It will also include creating and updating infographics and analyses that describe progress toward plan implementation.
Conduct outreach activities around regional indicators and Community Data Snapshots through CMAP's Local Technical Assistance program	CMAP, The Chicago Community Trust	Community Data Snapshots will be updated every two years and will evolve in tandem with data used to inform the Existing Conditions Reports, which are interim deliverables for Local Technical Assistance projects. CMAP will distribute Snapshots to communities as part of project implementation activities to update data contained in these reports.
Develop annual GO TO 2040 Implementation Reports	CMAP	CMAP will develop annual "Moving Forward: GO TO 2040 Implementation Reports" that describe actions taken by the agency and others to implement GO TO 2040. Every other year, these reports will alternate between qualitative and quantitative focus. Those years with a quantitative focus will update indicators as new data become available, introduce better data as appropriate, and provide analysis to show progress in plan implementation.

Implementation action area #2: Facilitate data sharing among communities across the region

ACTION	LEAD IMPLEMENTERS	SPECIFICS
***Commit to increasing access to information through data sharing and transparency**	State (various agencies), counties, municipalities	Some agencies have taken the lead in recent years to make data available on-line in a publicly-available format. State, county, and municipal agencies should follow this example and post all administrative data on-line in either database or spreadsheet file formats.
Increase the number of datasets that governments in the region share with the public	Federal, State, CMAP, counties, municipalities, The Chicago Community Trust	Develop a guide describing best practices for municipalities and other local governments to make their data public via the web. Emphasize simple, replicable tools that do not require substantial investment of public resources. Investigate the potential of creating a regional repository for aggregating local data, to maximize efficiency of municipal efforts in this regard and to give the public a single destination to find such data. Explore building on the MetroPulse Community Data Snapshots in partnership with units of local government. Build awareness among local officials and residents (e.g., through training sessions) regarding the importance and availability of public data to enhance decision making.
Create and maintain a web directory of data resources relevant to GO TO 2040 implementation	Federal, State, CMAP, counties, municipalities, The Chicago Community Trust	The new MetroPulse content should also include a well-maintained directory of data resources by topic. CMAP will organize this directory according to subject area, so communities can have direct access both to data available on-line and to subject matter experts available to help them interpret these data. Such experts include organizations with regional expertise as well as state and federal agencies.

Pursue Coordinated Investments

Many of the edits in this recommendation section are technical corrections and clarifications or rewording to improve readability. Updates reflect programmatic changes since the adoption of GO TO 2040. The implementation action "Identify linkages and opportunities for regional collaboration around federal and state funding sources; engage local governments on these issues" was deleted. That action referred to the region's response to the federal stimulus bill in 2009 and as such is no longer active. Additionally, references to specific external research programs have been deleted or broadened — such edits help to focus attention on the policy recommendations, rather than specific examples that may become irrelevant over time.

Implementation action area #1: Take a regional approach to federal and state investment

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Realign current programmatic and review responsibilities, both in transportation and non-transportation areas, to support GO TO 2040	CMAP	CMAP should, as far as possible, realign its current programmatic and review responsibilities to support GO TO 2040. These responsibilities now include staffing project selection committees and selecting criteria for the allocation of Unified Work Program (UWP), Congestion, Mitigation and Air Quality Improvement (CMAQ), and Transportation Alternatives Program (TAP) funds; oversight and monitoring of the Surface Transportation Program (STP); and an advisory role in reviewing water quality management plan amendments (the Facility Planning Area [FPA] process) and in reviewing Developments of Regional Importance (DRIs).
Continue to lead regional efforts in implementing federal and state investments	CMAP	CMAP should seek a greater role in leading regional responses to some funding opportunities and, where appropriate, drive more efficient, effective, and collaborative programming decisions.
Incentivize regional decision-making and empower regional institutions	Federal (U.S. DOT, U.S. EPA, HUD, EDA, DOE), State (IDOT, IHDA, DCEO)	Through challenge grants or similar mechanisms, incentivize regions to create partnerships across state and local governments, business and civic organizations, and other groups for strategic implementation or capital investment activities. Strategies could include: energy efficiency retrofit projects, brownfield remediation, mixed-use development, transit-oriented development, regional workforce initiatives, or congestion pricing initiatives.
Support a more robust investment in comprehensive planning	Federal (U.S. DOT, U.S. EPA, HUD, EDA, DOE), State (IDOT, IHDA, DCEO)	Currently, MPOs receive only transportation planning funds from the U.S. DOT. If comprehensive planning is truly a high priority of the federal government, it requires involvement from other agencies, like U.S. EPA and HUD, in providing MPOs and regional planning agencies additional funds to do comprehensive planning and implementation. The State of Illinois mandates regional comprehensive planning, but has not sufficiently appropriated funds toward this purpose.

Implementation action area #2: Reform state and federal policies and programs

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Harmonize state and federal grant and program requirements to support livable communities	Federal (U.S. DOT, U.S. EPA, HUD, EDA, DOE), State (IDOT, IHDA, DCEO)	As federal agencies have begun to coordinate policies, initiatives, and grant programs (specifically, U.S. DOT, U.S. EPA, and HUD) to remove barriers to creating more livable, sustainable communities, state agencies should similarly coordinate policies and programs. Achieving "livable communities" requires prioritizing comprehensive investments in capital improvement projects like brownfield remediation and providing for affordable housing near public transit.
Modify certain apportionment formulas, project selection criteria, and grant requirements that may cause unintended outcomes	Federal (U.S. DOT, U.S. EPA, HUD, EDA, DOE), State (IDOT, IHDA, DCEO)	GO TO 2040 includes a number of recommendations that call for revisions to funding formulas and/or project selection criteria. Some examples include the end of the "55/45" split for state transportation dollars and the need for criteria for green infrastructure connectivity in open space grant programs. These examples and others mentioned in the plan need to be addressed by state and federal agencies to achieve more optimal and transparent policy outcomes.
Focus metropolitan policy analysis and outreach on improving and empowering existing regional institutions	Nonprofits, philanthropic	A number of research organizations provide decision makers with public policy ideas, and have made the case for regional investments and the importance of comprehensive planning. The importance of empowering existing regional institutions, especially MPOs, should be further prioritized in these discussions. Research organizations should focus more energy analyzing and advocating for improving and empowering these institutions through federal legislation.

Implementation action area #3: Support efforts to consolidate local services

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Analyze the fiscal, efficiency, and other consequences of sharing or consolidating local services	Metropolitan Mayors Caucus, COGs, municipalities	MMC recently completed a report specifically addressing these types of issues in relation to fire and police services. The Caucus should continue these efforts and make specific recommendations.
Analyze the effects of consolidating local governments	Counties, COGs, municipalities	It is important to analyze the costs and benefits of consolidation, and this effort should be undertaken by COGs or counties, who are well-placed to coordinate local efforts. CMAP should support and participate in such efforts as needed.

Regional Mobility

Invest Strategically in Transportation

In addition to technical corrections and clarifications, along with updates to reflect the current status of funding programs, the edits to this recommendation section include more substantial revisions. Chief among them are changes to the congestion pricing section, which has been revised to directly call for the implementation of congestion pricing on new and, eventually, existing expressway capacity. Correspondingly, former actions that focused solely on congestion pricing studies and pilot projects have been deleted. This section includes new implementation actions to establish a regionally-imposed transportation user fee and pass legislation to allow value capture as a funding option for transportation capital projects. It removes the former implementation calling for the public-private partnerships enabling legislation, which was passed by the General Assembly and signed into law after the adoption of GO TO 2040.

Implementation action area #1: Find cost and investment efficiencies

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Prioritize maintenance and modernization projects when making investment decisions	State (IDOT, Tollway), RTA, CTA, Metra, Pace, counties, municipalities	Investments that maintain and modernize the transportation system should be prioritized over major expansion projects. This focus should serve as a policy backdrop for transportation investment decisions on both the highway and transit side. Furthermore, research and planning staffs from implementing agencies should conduct more in-depth studies on the impacts of cost-effective maintenance and modernization strategies, including the procurement of more state-of-the-art buses and trains. In addition to more proactive maintenance practices, other modernization strategies include traveler information systems, bicycling and pedestrian improvements, better pavement materials, signal timing, and other intelligent transportation system (ITS) improvements. Projects of all types should take a multimodal approach, seeking to improve conditions for all travelers, including bicyclists and pedestrians.
Develop and utilize transparent evaluation criteria for the selection of projects, particularly ones adding capacity	State (IDOT, Tollway), CMAP, RTA, Metra, Pace, CTA, counties, municipalities	Well-defined criteria are needed for the selection of projects, particularly for new facilities or projects that add capacity to existing facilities. Performance-based funding will help make the process of allocating state and federal funds more transparent for the general public and allow for the most crucial improvements and projects to be completed first with the finite resources available. CMAP should work with implementing agencies to develop and implement these performance measures.
Ensure that the region's transportation projects are based on the above performance measures and align with the priorities of GO TO 2040	CMAP	CMAP has an important role to play in terms of whether or not finances should be allocated to transportation projects based on the above performance criteria, and whether the projects satisfy the direction of the long range plan, GO TO 2040. Changes and amendments to the TIP are the process by which such decisions can be made. CMAP staff should use criteria to measure the performance of projects, particularly larger, capacity-adding projects, in the TIP and make recommendations on action to the CMAP Board and MPO Policy Committee, who hold final say on whether or not projects should be included.
Improve decision making models used for evaluating transportation projects	CMAP	CMAP should continue to lead in developing analytical tools and techniques for project evaluation. As the agency coordinates comprehensive regional planning, the quantitative models employed to make these evaluations should be upgraded toward integrated models with transportation, land use, and economic components.
Identify methods and technologies to improve operational efficiency of the transit agencies	RTA, CTA, Pace, Metra	The RTA and service boards should focus their efforts on addressing the system's fiscal health, particularly pursuing strategies for improving operating efficiencies and ending the continual cost increases that have compromised the integrity of the system.
Revise federal requirements for funding the engineering of major transit capital projects	Federal (U.S. DOT)	FTA regulations concerning use of funds for engineering of transit projects are stricter than those governing highway projects, and should be changed to create a "level playing field."
Develop regional infrastructure funding programs for plan implementation	State (IDOT, IHDA), RTA CMAP, counties, COGs, nonprofits	Create a pilot program meant to focus infrastructure funds to implement local comprehensive plans, modeled on programs in Atlanta and San Francisco. Investigate transportation funds currently programmed by the state (STP) and by CMAP (CMAQ, TAP) for this purpose, as well as non-transportation sources. Retain the current programming of local STP funds, but encourage programmers to consider livability in their funding decisions.
End the "55/45" split for Illinois transportation dollars and make investment decisions based on metrics of need	IDOT	Northeastern Illinois continues to be plagued by a non-statutory funding split which allocates 55 percent of road funding to downstate districts and 45 percent to northeastern Illinois. Transparent, performance-driven criteria should be used to drive investments rather than an arbitrary split.
Revise the process of state capital program funding in Illinois	State (General Assembly)	Adequate funding for transportation capital improvements should be included as part of the annual budgetary process. The current reliance on infrequent "state capital program" bills creates inconsistent funding levels that complicate long-term planning for transportation. Furthermore, project selection should be based upon performance criteria rather than on earmarks.

Implementation action area #2: Increase motor fuel taxes in the short term, and institute a replacement in the long term

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Implement an eight-cent increase of the state's motor fuel tax and index it to inflation	State (General Assembly)	This would require an act of the Illinois General Assembly and the Governor. An increase in the state's MFT presents the best option for short-term increase in revenues for transportation funding. The tax should be indexed to the rate of inflation to combat the decrease in purchasing power that occurs over time. A portion of these proceeds should be devoted to funding transit capital.
Implement an increase of the federal motor fuel tax and index it to inflation rate	Federal (Congress)	This would require an act of the U.S. Congress and the President. The federal MFT was last increased in 1993. Index the tax to the rate of inflation.
Address the need for a potential gas tax replacement revenue mechanisms, particularly "pay-as-you-drive" fees like a vehicle miles traveled fee	Federal (U.S. DOT), State (IDOT), CMAP	As the fuel efficiency of automobiles increases along with the use of non-petroleum based fuels, there will be a long-term need to replace the MFT. Such a replacement could take the form of a VMT fee. Existing technologies can be used to implement a VMT fee while protecting drivers' privacy.
***Establish a regionally-imposed transportation user fee**	State (General Assembly)	CMAP's Regional Tax Policy Task Force recommended that the region pursue regional revenue sources for regional needs. Other than the RTA sales tax, which primarily provides funding for transit operations, the region does not have a region-wide dedicated source of funding to provide for capital transportation investments.

Implementation action area #3: Implement congestion pricing

ACTION	LEAD IMPLEMENTERS	SPECIFICS
***Toll and congestion price all new expressway capacity**	State (IDOT, Tollway)	Given scarce transportation resources and the need to focus on maintenance and modernization of the existing system, all new expressway capacity added to the region should be tolled and congestion priced.
***Toll and congestion price existing expressway capacity**	State (IDOT, Tollway)	Given scarce transportation resources and the need to better manage congestion, existing expressway capacity in the region should be tolled and congestion priced.
Fund supportive transit projects with revenues generated from congestion pricing	State (IDOT, Tollway), RTA, Metra, Pace, CTA	To alleviate potential equity issues created by the higher fees on road segments, there will be a need to increase transit service in the congestion-priced corridors. Congestion pricing revenues will be used to fund the increased service.
Fund arterial improvements with revenues generated from congestion pricing	State (IDOT, Tollway), counties, municipalities	Congestion pricing can cause increased traffic diversion onto parallel arterials in local communities. The increased traffic may cause unintended congestion problems for local users of the arterials and infrastructure solutions maybe required. Congestion pricing revenues will be used to fund the mitigation solutions.

Implementation action area #4: Implement pricing for parking

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Conduct detailed studies on potential parking pricing projects	CMAP, municipalities	Identify potential locations/areas where pricing for parking could be implemented and study the potential effects.
Implement parking pricing, including variable pricing projects	Municipalities	In almost all cases, local governments have authority over parking and would be the implementer and collect the generated fees. In compact, walkable retail districts or downtowns, on-street parking, as close to a business as possible, is the most convenient type of parking for potential customers, and using pricing to keep these spots available for short-term use should be a high priority.
Encourage subregional planning studies to include a parking pricing component	CMAP, RTA	The use of both on- and off-street parking should be analyzed as part of any subregional planning study that considers transportation. This may include studies at a variety of planning levels, including corridors, downtown business districts, or even industrial/office parks.

Implementation action area #5: Find other innovative finance mechanisms

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Provide objective analysis of potential projects and innovative strategies	CMAP	As the regional planning agency, CMAP can provide objective analysis on potential projects and the different financing models available to state, local, and private agencies. A strong focus should be placed on finding innovative finance mechanisms for major capital projects.
Evaluate public-private partnerships in project development	State (IDOT, Tollway), CMAP, RTA, counties, municipalities	Based upon the analysis of potential projects and financing strategies, agencies should consider the use of PPPs on a project-by-project basis. The public interest must be adequately protected in any PPP agreement.
Conduct detailed value capture studies	State (IDOT, Tollway), CMAP, RTA, CTA, Metra, Pace, counties, municipalities	To generate new funding for transit, the region needs to consider different value capture techniques on potential new or expanded transportation infrastructure projects. The increased revenues can be used to help meet a project's capital costs.
***Pass legislation to allow value capture for transportation capital investments**	State (General Assembly)	State legislation is needed to establish some sort of value capture district to support transportation capital investments. Current laws do not provide for the multijurisdictional, long-term (30-35 years) districts needed for transportation value capture, and limit value capture in other ways. Accommodation of overlapping tax districts is required.

Increase Commitment to Public Transit

Edits to this recommendation section include technical corrections and clarifications, along with updates to reflect changes in funding programs or progress made since the adoption of GO TO 2040. For example, federal law revised the eligibility requirements of the Capital Investment Program for transit (including the New Starts, Small Starts, and Core Capacity Improvements programs), partially completing one of the original implementation actions. The edits also removed references to specific projects that had been previously included in various implementation actions. Such edits help to focus attention on the policy recommendations themselves. Additionally, the edits consolidated three previous implementation actions regarding the use of livability principles in land use planning into a single implementation action.

Implementation action area #1: Improve the fiscal health of transit

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Strengthen RTA efforts on financial oversight	RTA, CTA, Metra, Pace	The RTA is charged with the financial oversight of the transit system. In collaboration with the service boards, the RTA should focus its efforts on addressing the system's fiscal health, including increasing efficiencies and limiting cost increases moving forward.
Direct a portion of congestion/parking pricing revenues to transit	State (IDOT, Tollway), RTA, counties, municipalities	Congestion pricing and parking pricing are recommended within GO TO 2040. The revenues from these sources should be used in part for supportive transit service. For example, revenues from congestion pricing should be used to support increased transit service in the same corridor as the priced facility, or to improve connections to service in the corridor.
Use other innovative funding sources	State (IDOT, Tollway), CMAP, RTA, CTA, Metra, Pace, counties, municipalities	The reliance of the transit system on sales tax has contributed to its past funding crises. CMAP, in conjunction with potential funding partners, should investigate innovative funding sources such as value capture, or increasing the state gas tax and allocating a portion of the receipts to transit, in addition to the pricing strategies described above.
Revise federal requirements for funding the engineering of major transit capital projects	Federal (U.S. DOT)	FTA regulations concerning use of funds for engineering of transit projects are stricter than those governing highway projects, and should be changed to create a "level playing field."

Implementation action area #2: Modernize the region's transit system

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Focus investments on maintenance and modernization	RTA, CTA, Metra, Pace	Continue to make the maintenance of the system at a safe and adequate level the top priority when making investment decisions. The transit service boards should also pursue opportunities to modernize and upgrade the system as part of routine maintenance to bring the system to a world-class level.
Adopt best practices in new technologies	State (IDOT), RTA, CTA, Metra, Pace, counties, municipalities	Use technological improvements to make the system more efficient. The use of transit signal priority systems, ART concepts, and traffic signal coordination in general is supported, particularly when integrated for robust corridor management. Advanced scheduling and operations practices should also be used to improve the efficiency of demand-responsive services. Coordination with agencies that maintain roadways — namely, IDOT, counties, and municipalities — will be necessary to achieve some of these improvements.
Widely implement traveler information systems	RTA, CTA, Metra, Pace	Pursue the widespread implementation of traveler information systems, which can give real-time arrival information, assist in trip planning, inform commuters about parking availability, and serve other purposes. These can include signs at stations, websites and social media, station announcements, and other technologies.
Consider user-centered design in vehicle purchases and station design	RTA, CTA, Metra, Pace	Invest in improvements that make transit more attractive to potential users. State-of-the-art vehicles, clean and attractive stations, safe and convenient pedestrian access, inclusion of public art or other aesthetic features, and the overall appearance of transit all have an impact on transit use.
Establish seamless coordination between modes	RTA, CTA, Metra, Pace, counties, municipalities	Coordinate services and fares between the service boards, including pursuit of a universal fare payment system. Also, coordination with bicycle and pedestrian facilities and car-sharing services, which are often used by transit riders, can link transit seamlessly with other modes.

Implementation action area #3: Pursue high-priority projects

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Prioritize among potential bus service increases, extensions, and new service using regionally consistent criteria	RTA, CTA, Metra, Pace	Pursue bus expansion projects in areas where they are most likely to succeed. Expansions should be prioritized in part based on supportive local land use planning and infrastructure investment. The recommendations made above concerning technology and user perception apply here as well. Potential transit markets should be tested with bus-based concepts such as ART or BRT before investing in rail infrastructure.
Include transit components as part of major highway capital projects	State (IDOT, Tollway), RTA, CDOT, CTA, Metra, Pace	Include planning for transit (including bus-on-shoulder, bus service in managed lanes, or BRT, but also rail in some cases) within highway projects recommended in the plan.
Implement high-priority transit projects	RTA, CDOT, CTA, Metra, Pace	Advance recommended projects through the federal New Starts program or other funding programs.
Conduct detailed studies of prioritized corridors, and continually develop and evaluate major projects	RTA, CDOT, CTA, Metra, Pace	Conduct feasibility studies for projects that showed high potential but are not fully understood, and pursue innovative financing for beneficial unconstrained projects. Identify potential major capital projects through corridor studies, county or COG transportation plans, or other regional efforts. Evaluate and consider these projects during regular updates to the plan.
Improve evaluation measures and decision-making processes	CMAP, RTA, CTA, Metra, Pace	In light of limited funding, it is critically important to be able to evaluate projects against a variety of evaluation measures to make the best long-term decisions. CMAP should work with the RTA to develop improved transportation models that effectively measure the benefits of a variety of types of transit projects.
Increase federal investment in high-speed rail	Federal (U.S. DOT, Congress)	The initial round of funding for high-speed rail assisted with necessary improvements, but a continued federal commitment is necessary to actually implement a functioning system. The region's Congressional representatives should make this a high priority, as should U.S. DOT staff. However, federal funding for high-speed rail should not come at the expense of funding for regional public transit improvements.
Link high-speed rail with regional transit and land use planning	RTA, CDOT, CTA, Metra, Pace, counties, municipalities	Advance the West Loop Transportation Center, which improves the connections between Metra and the CTA, as well as proposed high-speed rail service, and plan for supportive nearby land use. Plan for direct and convenient links between high-speed rail, Metra, and CTA in this location. Also, identify additional station locations within the region and plan for supporting transit services and land use.

Implementation action area #4: Conduct supportive land use planning

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Align funding and technical assistance for planning and ordinance updates	Federal (HUD, EDA, NOAA), State (IDOT, DCEO, IHDA, Attorney General), RTA, CMAP, counties, municipalities, philanthropic	CMAP and RTA should continue coordination on the Community Planning and LTA programs, which fund local plans and ordinance updates that are consistent with GO TO 2040. Supplement the current program with funding sources from philanthropic or other public and private sources as appropriate. In particular, funding from environmental, housing, and economic development sources should also be included within this streamlined program. Also, broaden coordination to include IDOT.
Identify and exploit additional opportunities for transit-oriented development	CMAP, RTA, CTA, Metra, Pace, counties, municipalities, nonprofits	Many communities have embraced TOD as a strategy to revitalize their downtowns, and plans for many of the most obvious locations for TOD have already been prepared. CMAP and other stakeholders should identify other potential opportunities for application of TOD strategies and initiate pilot projects in areas where TOD is more difficult (i.e., locations with difficult land assembly, bus-based TOD, etc.). Opportunities for the application of TOD principles around planned ART or BRT services can be an immediate focus.
Use livability principles to plan for land use in development near transit, specifically for major capital projects and BRT	Counties, municipalities	Counties and municipalities should pursue opportunities for more dense development which mixes uses and housing types within "location efficient" areas near transit services. Counties and municipalities can increase density by providing density bonuses (in exchange for affordable units), creating transit overlay districts, or using form-based codes to address community fit. This can occur both for existing transit services and areas where transit expansion is planned, and applies to both rail and bus service. Counties and municipalities should specifically pursue supportive land use planning in areas near transit major capital projects and BRT.
Promote housing affordability near transit	Counties, municipalities	Proximity to transit services often increases land value, making it more difficult to provide a range of housing options. Counties and municipalities should analyze housing needs near transit services, and can provide a variety of incentives to developers to bring down development costs in exchange for affordable units. These tools include land donations, density bonuses, reduced minimum parking requirements, permit fee waivers, land trusts, and expedited permitting processes. These should be explored, considered, and adapted to specific local situations.
Require supportive land use planning before new transit investment is made	RTA, CTA, Metra, Pace	Consider supportive land use when making investment and programming decisions. The service boards should prioritize investments (new service in particular) in areas that have or are planning for land use and local infrastructure that supports transit.
Update guidelines for transit-supportive land use	RTA, CTA, Metra, Pace	Update materials produced by the RTA and transit service boards concerning land use planning and small-scale infrastructure investments that support transit. These materials should include additional topics such as housing affordability that go beyond the density and design issues which are currently included.

Create a More Efficient Freight Network

As in other recommendation sections, the edits here include technical corrections and clarifications. More substantive edits occurred in the first implementation action, which calls for a national vision for freight. Moving Ahead for Progress in the 21st Century (MAP-21), the federal transportation authorization law, made strides in recognizing and promoting the significance of freight and completed some of the implementation actions previously included in GO TO 2040. The edits provide new implementation actions that build upon MAP-21's groundwork.

Implementation action area #1: Create a national vision and federal program for freight

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Support the implementation of a national freight policy and freight networks	Federal (Congress, U.S. DOT)	MAP-21 established a method to formulate a national freight policy, as well as a National Freight Network and a Primary Freight Network. Support the development and implementation of these efforts.
*** Expand federal policy to include a truly multimodal freight network**	Federal (Congress, U.S. DOT)	MAP-21 defines the National Freight Network and Primary Freight Network as highway systems. Work to expand these networks to include other modes critical to goods movement and to expand the highway network beyond the 27,000-mile cap established in MAP-21.
***Provide dedicated, performance-based funding for freight improvements**	Federal (Congress, U.S. DOT)	MAP-21 fails to provide dedicated funding for a national freight program. Dedicate funds to that purpose from freight user fees and allocate these funds using performance criteria.
***Provide an engaged role for MPOs in freight planning and project selection**	Federal (Congress, U.S. DOT)	MPOs should be directly involved in the state freight planning process. They should also have a key decision-making role in the prioritization and selection of freight projects for funding.

Implementation action area #2: CREATE rail system improvements

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Build a larger national coalition to support the CREATE Program	Federal (Congress, U.S. DOT), State (General Assembly, IDOT), Amtrak, Metra, CMAP, municipalities, freight railroads	To heighten the status of the CREATE program at the federal level, its importance and benefits need to be communicated to stakeholders (elected officials, other MPOs, business community, public) throughout the country in order to gain broader endorsement, support, and funding.
Secure funding to complete the CREATE Program	Federal (Congress, U.S. DOT), State (General Assembly, IDOT), Amtrak, Metra, CMAP, municipalities, freight railroads	Identify funding sources to complete the implementation of the CREATE Program. Funding sources that should be explored include, but are not limited to, local, state, and federal grants; bond or loan opportunities; freight railroads; and other private sources.
Prioritize and implement the CREATE Program	Federal (U.S. DOT), State (IDOT), Amtrak, Metra, City of Chicago, freight railroads	Prioritize the remaining projects based on criteria that factor in project readiness, available funding resources, and public benefit, and aggressively work to implement all remaining projects.
Develop the next phase of rail improvements	State (IDOT), Amtrak, Metra, CMAP, municipalities, freight railroads	Develop a "CREATE II" program to ensure the regional rail system has the capacity to efficiently handle future traffic loads and intermodal transfers. CREATE II should seek to improve operating speeds and reduce congestion on all major mainline routes traversing the Chicago region and also increase terminal capacity.

Implementation action area #3:
Regional trucking improvements: truckways, truck routes, delivery time management, and restrictions

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Identify opportunities for dedicated truck corridor systems	State (IDOT, Tollway), Freight Authority, CMAP, counties, municipalities	Identify appropriate facilities and corridors for truckways or truck-only lanes, in order to improve safety and increase efficiencies by separating large trucks and passenger vehicles. Provide an alternative for freight to avoid certain corridors due to peak-period passenger vehicle congestion. Engage freight-industry stakeholders and communities in early discussions.
Implement dedicated and managed truckways	State (IDOT, Tollway), Freight Authority, CMAP, counties, municipalities	Preserve right-of-way in potential corridors. Engage in feasibility studies and, if appropriate, preliminary engineering and construction. Provide freight-appropriate designs, including pavement design, geometrics, sight distance, and lane widths. Engage PPPs, as appropriate.
Manage the transportation system to reduce peak-period congestion through congestion pricing	State (IDOT, Tollway), CMAP	Analyze, evaluate, and institute congestion pricing on selected road segments.
Catalog and update the region's truck routes	State (IDOT), CMAP, counties, municipalities	Analyze and map existing truck routes. Identify the gaps and inconsistencies in the current routes. Coordinate a logical and efficient system to update and implement a regional network of truck routes.
Address delivery times and parking restrictions	Counties, municipalities	Assess local delivery times and parking restrictions. Make changes where possible to reduce peak-period truck travel.

Implementation action area #4: Organization and public policy

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Explore the establishment of a governance structure, such as a Freight Authority, to identify issues, guide investments and advocate on behalf of the region	State (IDOT, Tollway), CMAP, counties, municipalities, freight carriers	Analyze and plan to establish a Freight Authority, preferably within an existing agency, to serve as an oversight agency for coordinating freight issues and investments in the Chicago region. The Authority should bring together the public and private sectors, working together toward accomplishing goals of mutual interest and benefit to the region. In its oversight capacity, the proposed body would have the authority to collect revenue (such as user fees or tolls) and issue bonds. The agency's oversight responsibilities would include all freight modes, as well as freight-related economic development opportunities within the region.
Conduct further study to implement user fees	Federal (Congress, U.S. DOT), State (IDOT, Tollway), CMAP, counties, municipalities, freight carriers	The largest hurdle to implementing improvements for freight is identifying funding and securing a revenue stream. The region should actively study various methods to collect user fees as a potential revenue source for freight improvements.

Implementation action area #5: Integrating freight needs and financing into infrastructure prioritization

ACTION	LEAD IMPLEMENTERS	SPECIFICS
Include freight-related performance measures in the project evaluation process	State (IDOT, Tollway), CMAP, counties, municipalities	Develop measures that take into account freight needs and deficiencies in evaluating potential transportation improvements. This performance-based approach will provide a more transparent and quantitative means of project evaluation, and instill more accountability into the project selection process.
Enhance freight modeling capacity	CMAP	Develop more robust modeling tools that will better predict the impacts of changes in national and global freight systems on local and regional freight movements. Also, facilitate a better understanding of regional freight movements and their impacts on the transportation network as well as nearby land use.

Acronym and Abbreviation List

ART	Arterial Rapid Transit
BRT	Bus Rapid Transit
CDBG	Community Development Block Grant
CDOT	Chicago Department of Transportation
Chicago Fed	Federal Reserve Bank of Chicago
Chicagoland Chamber	Chicagoland Chamber of Commerce
CMAP	Chicago Metropolitan Agency for Planning
CMAQ	Congestion Mitigation and Air Quality Improvement Program
CMC	Chicago Manufacturing Center
CMRC	Chicago Manufacturing Renaissance Council
COG	Council of Government
CREATE	Chicago Region Environmental and Transportation Efficiency Program
CTA	Chicago Transit Authority
CW	Chicago Wilderness
CWIC	Chicago Workforce Investment Council
CWSRF	Clean Water State Revolving Fund
DCEO	Illinois Department of Commerce and Economic Opportunity
DOE	U.S. Department of Energy
DRI	Development of Regional Importance
EBT	Electronic Balance Transfer
EDA	U.S. Economic Development Administration
ESCO	Energy Service Companies
FPA	Facility Planning Area
GIV	Green Infrastructure Vision
HUD	U.S. Department of Housing and Urban Development
I2A	Illinois Innovation Accelerator Fund
ICCB	Illinois Community College Board
IDES	Illinois Department of Employment Security
IDNR	Illinois Department of Natural Resources
IDOT	Illinois Department of Transportation
IDPH	Illinois Department of Public Health
IEN	Illinois Entrepreneurship Network
IEPA	Illinois Environmental Protection Agency
IFA	Illinois Finance Authority
IHDA	Illinois Housing Development Authority
I-LAST	Illinois – Livable and Sustainable Transportation
ILDS	Illinois Longitudinal Data System
INHS	Illinois Natural History Survey
INVEST	Infrastructure Voluntary Evaluation Sustainability Tool
ISBE	Illinois State Board of Education
ITEC	Illinois Technology Enterprise Centers
ITS	Intelligent Transportation System
IWIS	Integrated Workforce Information System
LEED	Leadership in Energy and Environmental Design
LTA	Local Technical Assistance Program
MAP-21	Moving Ahead for Progress in the 21st Century
MEGA	Metropolitan Economic Growth Alliance
MFT	Motor Fuel Tax
MMC	Metropolitan Mayors Caucus
MPO	Metropolitan Planning Organization
NAAF	Natural Areas Acquisition Fund
NOAA	National Oceanic and Atmospheric Administration
OSLAD	Open Space Lands Acquisition and Development
PACE	Property Assessed Clean Energy
PPP	Public-Private Partnership
RTA	Regional Transportation Authority
SARA	Sensitive Aquifer Recharge Area
SBIR	Small Business Innovation Research
SNAP	Supplemental Nutrition Assistance Program
STP	Surface Transportation Program
STTR	Small Business Technology Transfer
TAP	Transportation Alternatives Program
TIP	Transportation Improvement Program
TOD	Transit-Oriented Development
Tollway	Illinois State Toll Highway Authority
UPARR	Urban Park and Recreation Recovery
U.S. ACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
U.S. DOT	U.S. Department of Transportation
U.S. EPA	U.S. Environmental Protection Agency
USGBC	U.S. Green Building Council
UWP	Unified Work Program
VMT	Vehicle Miles Traveled
WBC	World Business Chicago
WIA	Workforce Investment Act
WIB	Workforce Investment Board



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CMAP

GO TO 2040
UPDATE APPENDIX

Indicator Methodology



Updated January 2015

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1. Introduction

GO TO 2040 includes a set of performance measures under each recommendation area, which are intended to serve as benchmarks for monitoring the progress of plan implementation. Indicator target values for the years 2015 and 2040 were specified in the plan as a way to quantify actual plan progress and to track how well the region is doing in achieving its goals. These targets should be considered aspirational goals based on the overarching themes of the plan – the region should strive for livable communities, a competitive regional economy, efficient governance, and a world-class transportation system. In preparation for the GO TO 2040 plan update, staff at the Chicago Metropolitan Agency for Planning (CMAP) undertook an indicator review process to collect updated data and identify improvements in the plan performance measures. This report documents the indicator review process and identifies all of the performance measures to be used in the plan update.

1.1 Indicator Review Process

CMAP has revised some of the performance measures included in the plan update to better match the agency's policy needs and the data available. Experience gained over the first few years of implementing the plan, as well as the knowledge staff developed in further analyzing the indicators, informed the selection of indicators for the plan update. The indicator review process proceeded in three phases, which are briefly described.

Phase 1: Assessment of the GO TO 2040 indicators.

CMAP staff conducted an objective evaluation of each of the plan indicators for the express purpose of determining if it could be improved upon for the plan update. Questions were asked about the measure itself, including:

- Is this a reasonable measure of what the plan hopes to achieve?
- Is this measure understandable to a non-planner?

Questions were also asked about the data supporting each of the indicators:

- Are there any concerns about the quality of the underlying data?
- What level of effort is required to update the indicator and is it a reproducible measure?
- Can the data be updated with sufficient frequency to serve as a reliable benchmark for measuring plan progress?
- Are there alternative data sets available that could be used to support the indicator?

As the performance measures are intended to track the progress of plan implementation, *a guiding principle during the assessment was the need for indicators to be based on actual measured values and not be reliant upon modeled or estimated figures*. Each GO TO 2040 indicator was considered on its own merits. While some indicators had easily identified improvements that could be made, an effort was also made to balance the data availability and capacity to maintain the indicator in determining the most appropriate measure to serve the needs of the plan update.

Phase 2: Development of proposed indicators for the plan update.

Based on the results of the indicator assessment, CMAP staff developed a list of proposed indicators for the plan update. The 28 indicators fall into three groups:

- Eight original indicators currently in GO TO 2040 that are continuing unchanged.
- Ten original indicators that are being modified from their GO TO 2040 version.
- Ten new indicators that mostly address the recommendation areas in GO TO 2040 that did not identify specific indicators (Improve Education and Workforce Development, Support Economic Innovation, and Reform State and Local Tax Policy).

The plan performance measures are intended to provide the means to objectively evaluate the progress of plan implementation. To foster this evaluation there should be indicator continuity across plan updates, to the extent possible. Therefore the decision to modify plan indicators was not taken lightly, however meeting any of the following criteria was considered an improvement to an existing indicator:

- Observed data exist that can be used to replace an indicator currently reliant on modeled data.
- Modifying an existing indicator would result in a more meaningful measure or one more easily understood by a non-planner.
- An alternative dataset is available that is released with greater frequency to create a more robust set of indicator values.
- Modifying the existing indicator would result in a significant reduction in the level of effort to maintain it without a proportional reduction in its meaningfulness.
- Modifying the existing indicator would increase its relevance to plan recommendations.

The set of proposed indicators for the plan update was presented to CMAP's various Working Committees to obtain input on the indicators related to their areas of expertise and to receive

public comment. The indicators were also presented to the CMAP Board and the MPO Policy Committee for discussion.

Phase 3: Development of new and revised indicator target values.

Following identification of the indicators to be included in the plan update, the final step in the review process was to identify short- and long-term target values for the performance measures. Including target values in the plan is essential, as they provide a benchmark against which implementation of specific goals in the plan can be quantified. The first task in developing targets was collecting the available data updates for the performance measures. For the continuing indicators, this provides a basis to determine how the region performs in meeting the short-term goals established in GO TO 2040. For the new and modified indicators being introduced, collecting the current conditions is essential for establishing baseline values and for understanding the current context of the measure.

The following summary describes the procedures used to develop indicator target values for the plan update:

- New or modified indicators:
    - Baseline conditions of the indicator were established.
    - A short-term target for the year 2020 and a long-term target for the year 2040 were developed.
    - No 2015 targets were established for these indicators, as it makes little sense to develop a one-year target for a long-range plan.
- Indicators continuing from GO TO 2040:
    - When available, updated current conditions were calculated.
    - The original short-term target value from GO TO 2040 (2015) is included in the plan update to track progress against the updated current conditions. When necessary, a revised 2015 target was developed.
    - A new short-term target value was developed for the year 2020 so that there would continue to be a quantifiable short-term goal to aim for after 2015.

More detailed descriptions of the indicators and the methods used to develop target values are included in the body of this document.

1.2 Document Layout

The remainder of the report is divided into sections that correspond to the 12 recommendation areas of GO TO 2040. Each section includes a discussion of all of the indicators in the plan

update that relate to the recommendation area in order to give the reader a holistic view of how progress is to be measured. When appropriate, it is noted which performance measures are new and which have been modified from their original version.

Visualizations of the indicator target values are included with each of the performance measures. They have three main components:

- Baseline values – These represent the original values reported in GO TO 2040 as current conditions (for continuing indicators only).
- Current conditions – These values are the most current ones available for each indicator.
- Targets values – These include the 2015 targets for continuing indicators and targets for 2020 and 2040 for all performance measures.

This report also includes several appendices:

- *Appendix A* – This discusses a set of secondary kindred indicators that will supplement the information provided by the plan performance measures. It is envisioned that the kindred indicators may be used in the narrative of the plan update and in the annual GO TO 2040 Moving Forward implementation reports to tell a more complete story of progress, as well as address data gaps in the plan performance measures.
- *Appendix B* – This documents the analysis used to develop the Regional Government Transparency Index score.
- *Appendix C* – This appendix provides a discussion of the analysis methodology used to develop the Access to Transit Index.

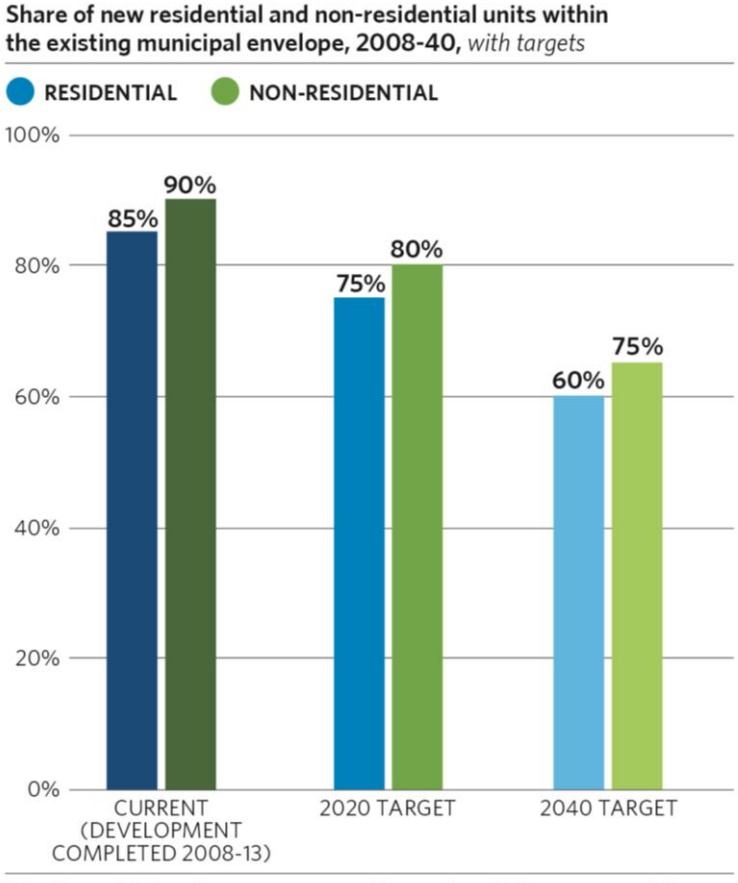
2. Achieve Greater Livability through Land Use and Housing

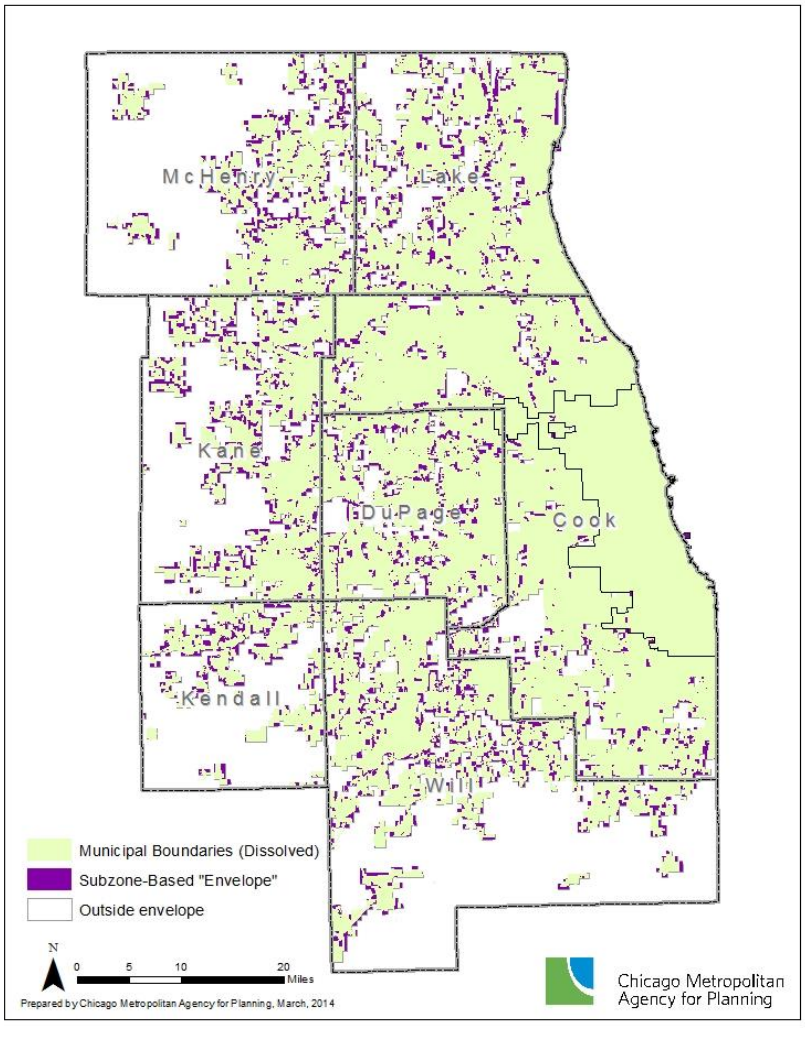
This recommendation area has two indicators, both of which have been modified from the original versions included in GO TO 2040.

2.1 Share of New Development Occurring within the Existing Municipal Envelope

Indicator:	This indicator uses the Northeastern Illinois Development Database (NDD) to measure the percentage of infill development that occurred within the 2010 municipal envelope (discussed below) over the life of the plan. This measure addresses a critical element of GO TO 2040 – encouraging development in existing communities where supporting infrastructure to support it is already in place. Both residential and non-residential development will be tracked. The non-residential category covers a wide range of uses including office, retail, hotel, manufacturing, and warehousing, among others. For this indicator, the term "development" is used in a general sense to include both new development and redevelopment of existing uses. The NDD tracks all significant development and redevelopment in the seven-county region. Developments must meet one of the following criteria to be included in the NDD: • Consume at least once acre of land, OR • Consist of at least ten residential units, OR • Consist of at least 10,000 square feet of non-residential space. The NDD covers new construction, renovations with a change in land use (e.g., commercial to residential), and expansions of existing uses (e.g., school additions). In general, if a development results in a change of population or employment, it is included in the NDD. The database does not include individual homes that may meet the above criteria unless they are part of a larger development, renovations where there is no change in land use, or condominium conversion of existing rental buildings.
Targets:	*Note: This indicator is modified significantly from the GO TO 2040 version, thus it will not have a 2015 target value.* Due to the disparate nature of residential and non-residential development, separate target values and units of measurement will be used to track the progress of each type of development. Reporting

	residential development in terms of units and non-residential development in terms of square footage is the industry standard; there is no simple method to develop an equivalency between the two. In both cases, the units being reported are more meaningful than a general areal measurement such as acres, which are two-dimensional and do not necessarily reflect the intensity of use (particularly when developments are vertical in nature). **<u>Residential Development</u>** 2020: 75 percent of new residential units located within the existing municipal envelope. 2040: 60 percent of new residential units located within the existing municipal envelope. **<u>Non-Residential Development</u>** 2020: 80 percent of new non-residential square footage located within the existing municipal envelope. 2040: 65 percent of new non-residential square footage located within the existing municipal envelope.

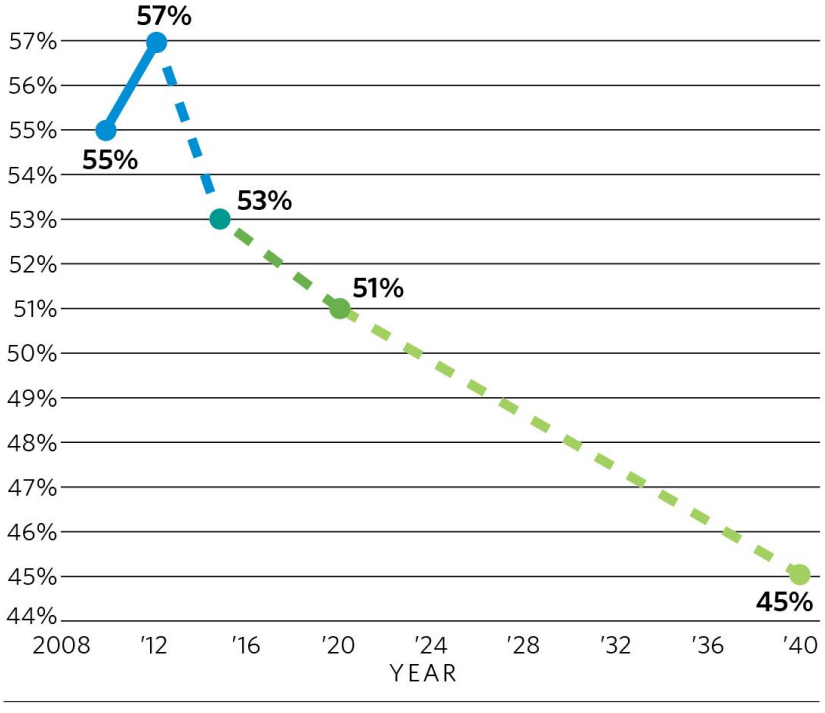
	 Note: The municipal envelop serves as a reasonable proxy for capturing areas near existing municipal boundaries that may have existing infrastructure in place to support development and will be held constant over the life of the plan, as a way to measure infill development. Source: Chicago Metropolitan Agency for Planning analysis.
Methodology:	The indicator will track the share of new residential units and the share of new non-residential square footage that occur within the existing municipal envelope over the life of the plan. While the initial concept called for measuring development within or near existing municipal boundaries, no specific threshold of "near" was defined. Rather than use an arbitrary distance from existing municipal boundaries to define the infill area, an alternative method was used to create the existing municipal envelope. Using the dissolved 2010 municipal boundaries as a basis, the municipal envelope was created by "rasterizing" the polygons to CMAP's subzone system; i.e., converting them to the subzone grid. Subzones are quarter-section sized geographies that CMAP uses for household and employment forecasting; generally they are one-half mile square throughout the region. A subzone was included in the municipal envelope if at least 30 percent of its area was comprised of area within the 2010 municipal boundary polygon. The following map

	shows the 2010 municipal boundaries (light green) compared to the additional areas added to the municipal envelope (shown in purple) due to the subzone conversion. The 2010 municipal boundaries cover an area of 2,171 square miles, while the municipal envelope covers 2,403 square miles -- an increase in total area of 11 percent. The municipal envelop serves as a reasonable proxy for capturing areas near existing municipal boundaries. Comparison of Municipal Boundaries and Subzone-Based "Envelope"  The municipal envelope will be held constant over the life of the plan as a way to measure infill development using a control geography representing areas with existing infrastructure in place.
Original GO TO 2040 Indicator:	The original indicator was a parcel-based analysis of the number of acres of land within existing municipal boundaries that are available for redevelopment. These are parcels that were deemed vacant or

	"underutilized" commercial and residential properties. The underutilized definition was based on the ratio of the improvement value of the parcel to the land value -- residential parcels are underutilized if the ratio is less than 1.0 and commercial parcels are included if their ratio is under 0.5. Parcel data were obtained from the county assessors.
Rationale for Change:	While the "underutilized" land indicator tracked the potential for infill development, the NDD tracks actual developments occurring in the region. Replacing the indicator of available land with one tracking actual infill development is a better way to measure plan implementation progress of this recommendation area.

2.2 Percentage of Income Spent on Housing and Transportation by Moderate- and Low-Income Residents

Indicator:	This measure estimates the share of household income spent on housing and transportation costs for moderate- and low-income households. For analysis purposes, these are households with an annual income ranging from $20,000 to $49,999; this is consistent with the data analyzed in the original GO TO 2040 measure. Data are from the Consumer Expenditure Survey (CES), which is conducted annually by the U.S. Bureau of Labor Statistics (BLS). The survey collects information on household income and expenditures, including those for housing and transportation. Data are reported for the Chicago Metropolitan Statistical Area (MSA).
Targets:	2015: 53 percent of income spent on housing and transportation by moderate- and low-income residents. 2020: 51 percent of income spent on housing and transportation by moderate- and low-income residents. 2040: 45 percent of income spent on housing and transportation by moderate- and low-income residents.

	Percentage of income spent on housing and transportation by moderate- and low-income residents, 2010-40, *with targets*  Source: Chicago Metropolitan Agency for Planning analysis of the U.S. Bureau of Labor Statistics Consumer Expenditure Survey. A look at the most recent data available (2012) shows that the region lost some ground on this measure between 2010-12 -- the share of income spent on housing and transportation by low- and moderate-income households in the region increased from 55 percent to 57 percent.
Methodology:	The 2015 and 2040 targets are unchanged from GO TO 2040. Even though the data source being used to measure progress has changed, the 2010 baseline value using the CES data is the same as the one calculated using the Center for Neighborhood Technology's H+T Index (see the follow description). The 2020 target was developed by continuing a straight-line decrease in the share of household income spent on housing and transportation costs by moderate- and low-income residents.
Original GO TO 2040 Indicator:	The original GO TO 2040 measure used the Center for Neighborhood Technology's Housing + Transportation (H+T) Affordability Index to estimate the share of household income spent on housing and transportation costs. The housing component is derived from U.S. Census data, while the transportation component is estimated using a multidimensional regression analysis that requires a number of

	transportation and Census-based data inputs. The H+T index has been calculated using 2000 Census data and updated with data from the 2005-09 American Community Survey.
Rationale for Change:	As the CES data are released annually, they will allow for creation of a more robust dataset that can be used to track plan implementation progress in this area. Additionally, the CES public use microdata allow for a more–detailed investigation of this topic, such as the breakdown of cost by household income range.

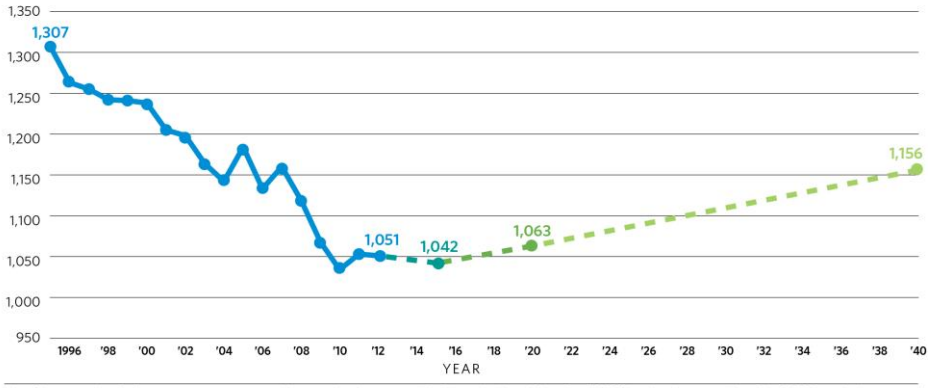
3. Manage and Conserve Water and Energy Resources

The water-related indicators have been modified from their original versions.

3.1 Public Supply Water Demand

Indicator:	This indicator focuses on public supply water demand provided by the Illinois State Water Survey at the University of Illinois at Urbana-Champaign and reported in millions of gallons of water used daily. Public supply water refers to water that is withdrawn, treated, and delivered to residential, industrial, commercial, governmental, and institutional users via public water supply systems. Data will be reported for the seven-county CMAP region only.
Targets:	This indicator will have two sets of targets -- one measuring total daily water demand and one measuring daily demand on a per capita basis. Per capita measurement allows for an examination of water conservation as an increase in total demand due to population or industrial growth can mask gains in conservation. At the same time, it is important to examine total demand because potable water is a finite resource and growth in our region is expected to increase the demand for water in 2040 above the current level of consumption. 2015: 1,042 million gallons of water used daily 123 gallons of water used daily per capita 2020: 1,063 million gallons of water used daily 120 gallons of water used daily per capita 2040: 1,156 million gallons of water used daily 109 gallons of water used daily per capita

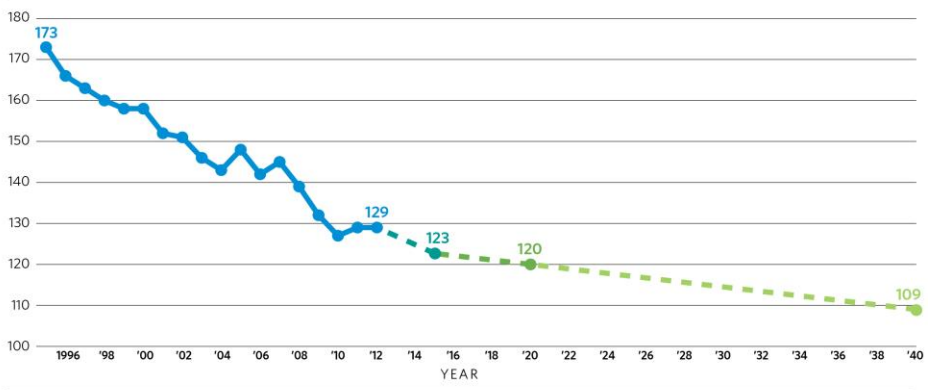
Millions of gallons of water used daily, 1995-40, *with targets*



Note: The target values for future years are consistent with the original analysis prepared by Dziegielewski and Chowdhury (2008), but have been revised to reflect CMAP's updated socioeconomic forecast.

Sources: Illinois State Water Survey (1995-2012); Dziegielewski and Chowdhury, 2008 (Regional Water Demand Scenarios for Northeastern Illinois: 2005-2050) for future years.

Gallons of water used daily per capita, 1995-40, *with targets*

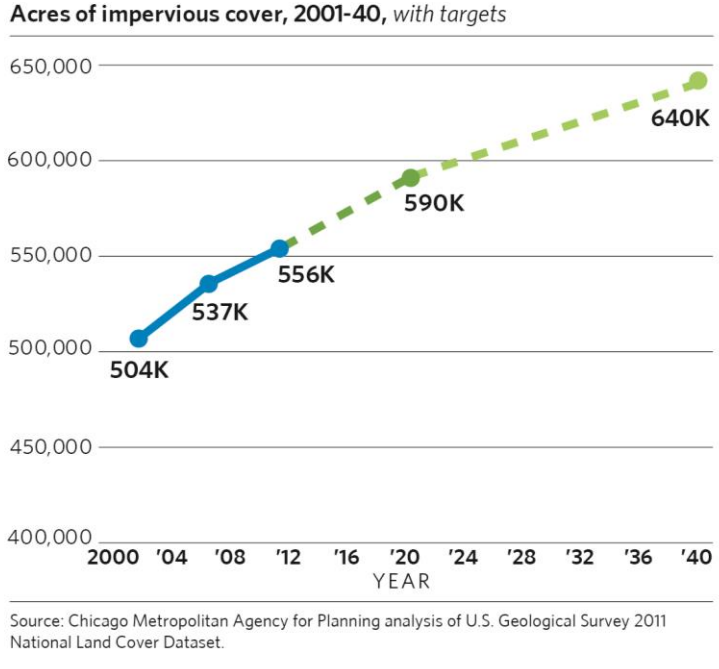


Water demand sources: Illinois State Water Survey (1995-2012); Dziegielewski and Chowdhury, 2008 (Regional Water Demand Scenarios for Northeastern Illinois: 2005-50) for future years.

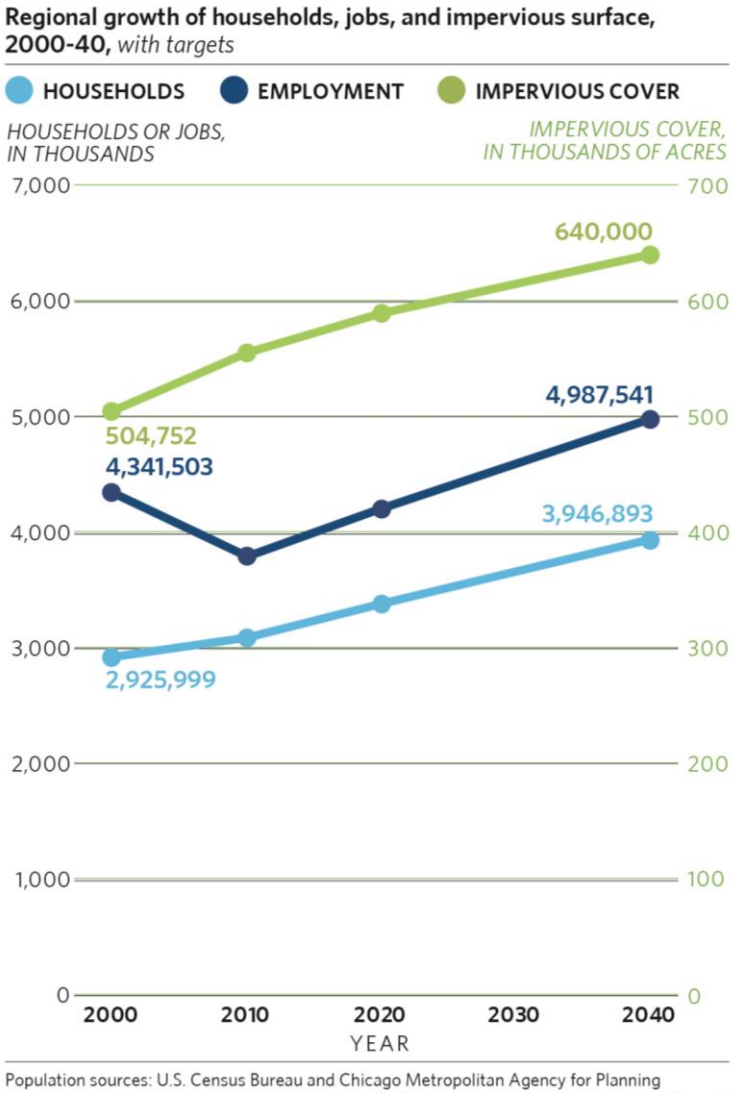
Population sources: U.S. Census Bureau and Chicago Metropolitan Agency for Planning socioeconomic forecast.

Methodology:	Target values for per capita water demand are taken from the technical analysis (Regional Water Demand Scenarios for Northeastern Illinois: 2005-2050) conducted to support Water 2050: Northeastern Illinois Water Supply/Demand Plan. Values represent the forecasts for Public Supply water demand for the seven CMAP counties from the "Less Resource Intensive" scenario of the water plan. The future water scenarios included in Water 2050 were developed by researchers at the Department of Geography and Environmental Resources, Southern Illinois University. Target values for total daily water demand are based on the methodology used in the technical analysis but have been revised to reflect CMAP's updated socio-economic forecast. To remain consistent with the original analysis methodology, the per capita public supply water demand rates developed for the years 2015, 2020, and 2040 were applied to CMAP's revised population forecasts to develop updated daily water demand values. These per capita values are based on the population served by the public supply water systems and not the entire population of the region, as a small portion of the region's population (less than four percent) receives water from private wells and is termed self-supplied domestic sources. For consistency, the historic values of per capita public supply water demand are estimated by removing the same share of the regional population served by self-supplied domestic systems from the population served.
Original GO TO 2040 Indicator:	The GO TO 2040 indicator measured millions of gallons of water used daily, comprised of five sectors: public supply; self-supplied industrial and commercial; self-supplied domestic; irrigation and agriculture; and power generation. These values were drawn from the "Less Resource Intensive" scenario of Water 2050 and applied to the 11-county regional water supply planning area, not just the CMAP region.
Rationale for Change:	Public supply water demand comprises 80 percent of total water demand in the 11-county water supply planning region. Modifying the indicator would reduce the effort needed to track this measure without greatly decreasing its usefulness. Limiting this measure to the seven-county CMAP region will makes its geographic scope comparable to the other plan indicators. Maintaining the indicator as used in GO TO 2040 would require continued consultant support.

3.2 Acres of Impervious Area

Indicator:	This measures the total number of acres of impervious surfaces in the region; it is the entire amount of hard surface (such as buildings, sidewalks and streets) in the landscape. Imperviousness is an important environmental indicator because it is negatively associated with various measures of the biological health and physical integrity of surface waters. The source for this data is the National Land Cover Dataset, a raster dataset with 16 land cover classifications that is published approximately every five years by the USGS.
Targets:	*Note: This indicator is modified significantly from the GO TO 2040 version, thus it will not have a 2015 target value.* 2020: 590,000 acres of impervious cover 2040: 640,000 acres of impervious cover  Source: Chicago Metropolitan Agency for Planning analysis of U.S. Geological Survey 2011 National Land Cover Dataset.
Methodology:	The following chart tracks the increase in households and jobs expected in the region between 2000-40 (measured on the left axis) based on CMAP's socioeconomic forecast for 2040. These values are plotted against the expected increase in impervious area in the region (measured using the scale on the right axis). The anticipated growth rate of impervious area between 2010-40 is roughly one-half that of the increase in households and jobs in the region during the same 30-year period; this reflects the fact that the rate of growth in imperviousness

declines as development density increases.



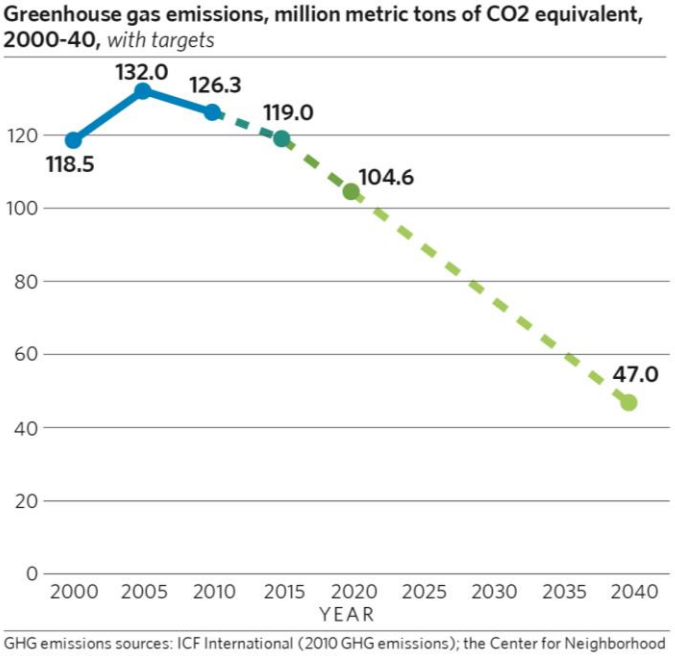
Population sources: U.S. Census Bureau and Chicago Metropolitan Agency for Planning socio-economic forecast. Employment sources: Illinois Department of Employment Security and Chicago Metropolitan Agency for Planning socio-economic forecast. Impervious cover source: U.S. Geological Survey National Land Cover Dataset.

The 2020 target for impervious surfaces reflects that growth in impervious cover in the region should be no more than 60 percent of the rate of household and job growth experienced by 2020. The 2040 target reflects that the growth in impervious cover should be no more than 50 percent of the growth in households and jobs over that same period. Note that the USGS introduced an improved methodology for measuring impervious cover with the release of the 2011 National Land Cover Dataset. Using this new methodology, the USGS also released revised impervious cover data for the years 2001 and 2006; these values are used in the chart above.

Original GO TO 2040 Indicator:	The original GO TO 2040 measure ("Acres of Connected Impervious Area") assumed all impervious surfaces in the region, as measured by the National Land Cover Dataset, were connected.
Rationale for Change:	The source dataset allows for the measurement of total impervious acres, but cannot distinguish between connected and unconnected areas. Making this change would allow the indicator to continue measuring total impervious area in the region, while keeping the underlying analysis and source data the same. It represents a more accurate depiction of the information.

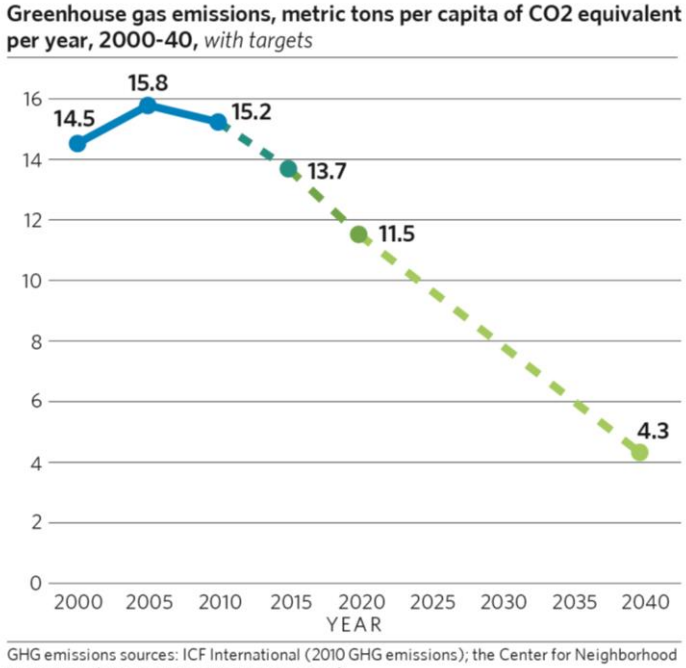
3.3 Greenhouse Gas Emissions

Indicator:	This indicator measures the total of greenhouse gas (GHG) emissions produced in the CMAP region and serves as a proxy for energy consumption. GHG emissions are calculated for a number of different sectors, with the two largest contributors being building energy (i.e., electricity and natural gas) and transportation, which together comprise nearly 90 percent of GHG emissions. Emissions are reported in million metric tons of carbon dioxide equivalent ($MMTCO_2e$).
Targets:	As with water demand, this indicator includes two sets of targets: one measuring total emissions and one measuring them on a per capita basis. 2015: 119 $MMTCO_2e$ 13.7 metric tons of CO_2 equivalent per capita 2020: 105 $MMTCO_2e$ 11.5 metric tons of CO_2 equivalent per capita 2040: 47 $MMTCO_2e$ 4.3 metric tons of CO_2 equivalent per capita



GHG emissions sources: ICF International (2010 GHG emissions); the Center for Neighborhood Technology (GHG emissions for all other years).

Population sources: 2010 U.S. Census and Chicago Metropolitan Agency for Planning socio-economic forecast.



GHG emissions sources: ICF International (2010 GHG emissions); the Center for Neighborhood Technology (GHG emissions for all other years).

Population sources: 2010 U.S. Census and Chicago Metropolitan Agency for Planning socio-economic forecast.

The most recent analysis (reflecting data for 2010) shows a decrease in overall GHG emissions from the base year value in 2005.

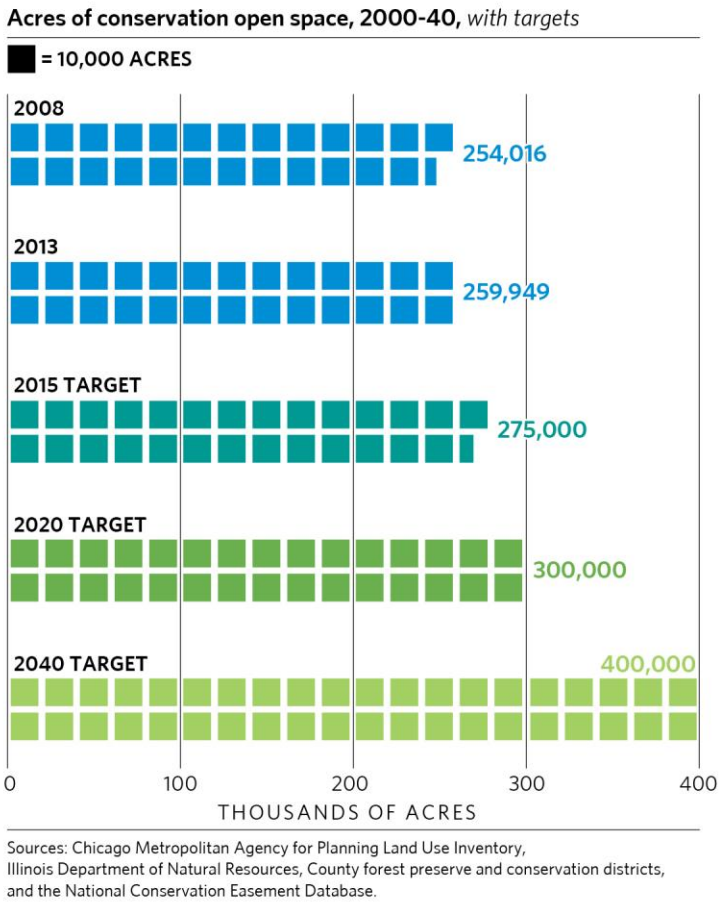
Methodology:	The 2015 and 2040 targets are unchanged from GO TO 2040. The 2020 target was developed by continuing a straight-line decrease in $MMTCO_2e$ in the region.

4. Expand and Improve Parks and Open Space

No changes are proposed for the parks and open space indicators.

4.1 Acres of Conservation Open Space

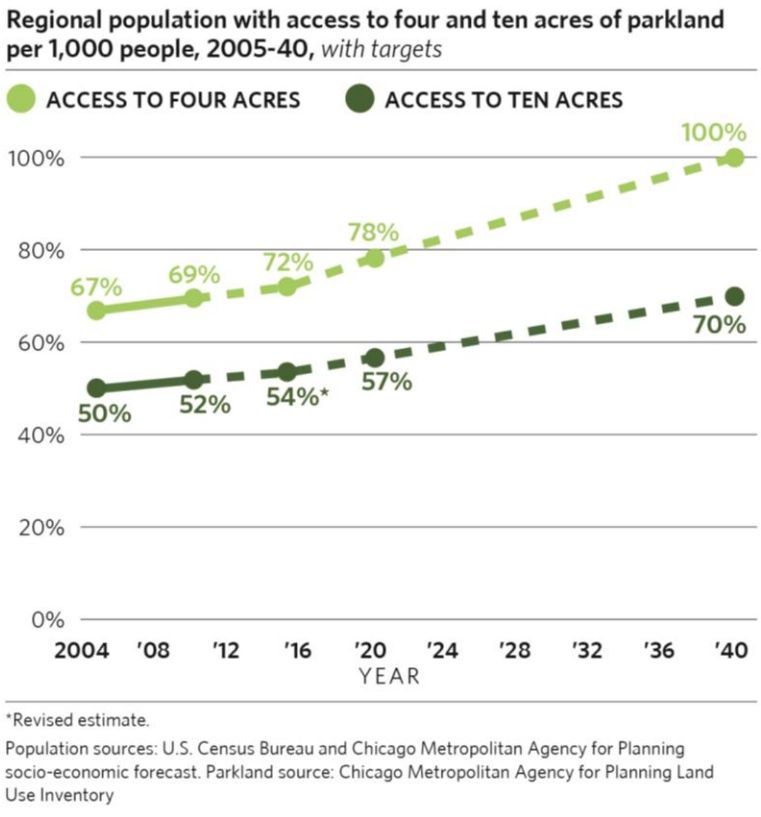
Indicator:	This indicator measures the total number of acres in the region used for conservation (i.e., preserves and natural areas). This measure does not include acres of parkland in the region, land used for golf courses, farm land, or land used for historic preservation. Information on conservation open space is gathered from a number of data sources including the Illinois Department of Natural Resources, county forest preserves or conservation districts, CMAP's Land Use Inventory, and the National Conservation Easement Database.
Targets:	2015: 275,000 acres 2020: 300,000 acres 2040: 400,000 acres

	
Methodology:	The 2015 and 2040 targets are unchanged from GO TO 2040. The 2020 target was developed by continuing a straight-line increase in acres of open space in the region. The current CMAP Land Use inventory, finalized following the adoption of GO TO 2040, is a parcel-based database which is a marked departure from the previous version. As a result of this change, the base year conservation open space value was recalculated based on the updated Land Use Inventory structure in order to ensure that this indicator is measured in a consistent manner.

4.2 Regional Access to Parks per Person in Acres

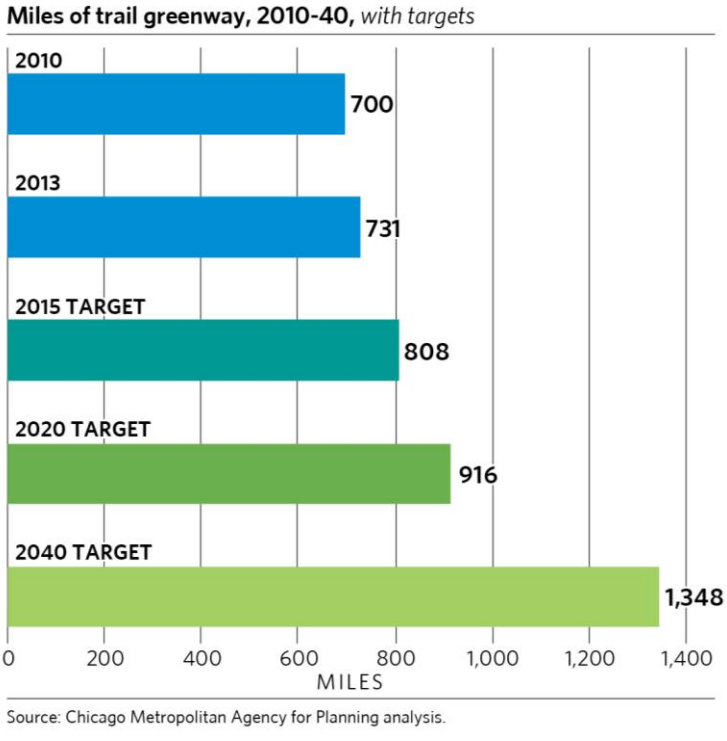
Indicator:	This is an aggregate per capita measure of park accessibility based on proximity to park land. Values are reported as the percentage of the regional population with access to parks at the rates of four acres per 1,000 people (representing the denser parts of the region) and ten acres per 1,000 people (representing less-dense areas). The CMAP Land Use Inventory is the data source for determining park locations; subzone population data are used to calculate the per capita values.

Targets:	The base year values for this indicator reported in GO TO 2040 were developed using the current version of the Land Use Inventory available at the time (2005) and a socioeconomic forecast of population for the year 2010. The 2010 current conditions reported below were developed using the updated 2011 Land Use Inventory and population figures from the 2010 Census. For consistency, the 2005 values were re-calculated using the 2010 Census population – in effect this holds the population constant so that any changes between 2005 and 2010 are due solely to increases in the amount of parkland. Use of the 2010 Census population figures resulted in 2005 values that were slightly higher than those calculated for GO TO 2040. As a result, the 2010 value for the population with access to ten acres of parkland per 1,000 people is 52 percent, which is equal to the original 2015 target for this indicator. Thus the 2015 target for this indicator is revised to 54 percent for the plan update. **<u>Four acres per 1,000 people</u>** 2015: 72 percent of the regional population 2020: 78 percent of the regional population 2040: 100 percent of the regional population **<u>Ten acres per 1,000 people</u>** 2015: 54 percent of the regional population 2020: 57 percent of the regional population 2040: 70 percent of the regional population

	
Methodology:	The 2015 target for the population with access to ten acres of parkland per 1,000 people is modified from its original value, as noted previously. The other 2015 target and the 2040 targets are unchanged from GO TO 2040. The 2020 targets were developed by continuing a straight-line increase in acres of parkland in the region.

4.3 Trail Greenway Mileage

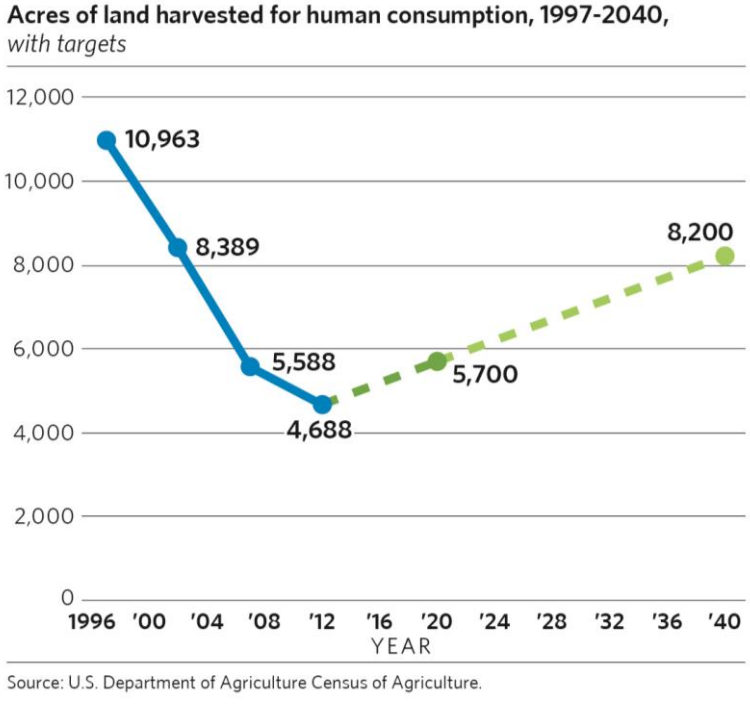
Indicator:	Trail greenways are defined as off-street trails for walking or bicycling that connect parks or conservation areas; they exclude on-street trails. This indicator measures the number of miles of trail greenways in the Northeastern Illinois Regional Greenways and Trails Plan that have been completed or let. This information is maintained by CMAP staff in the Bicycle Information System.
Targets:	2015: 808 miles 2020: 916 miles 2040: 1,348 miles

	 As of 2013, 731 miles of trail greenways have been completed. In addition, another 59 miles of trail greenways have been programmed and will likely be completed by 2015 -- for a total of 790 miles, just a bit under the 2015 target.
Methodology:	The 2015 and 2040 targets are unchanged from GO TO 2040. The 2020 target was developed by continuing a straight-line increase in miles of trail greenways in the region.

5. Promote Sustainable Local Food

Changes are proposed for the two local food indicators drawn from U.S. Census of Agriculture data.

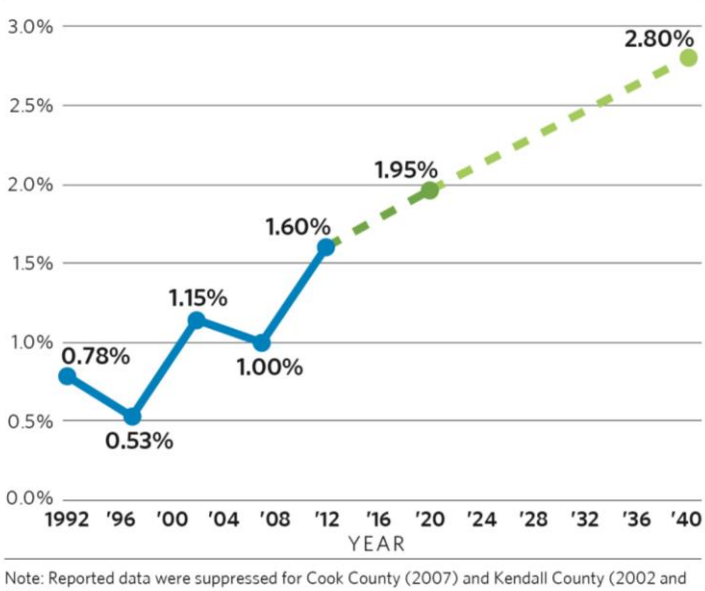
5.1 Acres of Land Harvesting Food for Human Consumption

Indicator:	Data for this indicator come from the U.S. Census of Agriculture. The U.S. Department of Agriculture defines "direct consumption" as the totals found in these categories: orchards, peanuts, potatoes, sweet potatoes, and vegetables. This indicator lists the total number of acres in the region that support food for direct human consumption. This data excludes community gardens and other entities not counted in the Census of Agriculture.
Targets:	*Note: No targets were established for this indicator in GO TO 2040, thus it will not have a 2015 target value.* 2020: 5,700 acres of land harvesting food for human consumption in the region. 2040: 8,200 acres of land harvesting food for human consumption in the region. 

Methodology:	The goal for 2040 calls for a 75-percent increase in the number of acres in the region harvesting food for direct human consumption. This goal is directly tied to the goal for the indicator measuring the market value of agricultural products sold directly to individuals for human consumption in the region. The chart above shows a steady decline in the number of acres in the region used to harvest food for direct human consumption over the last four censuses; achieving the 2040 goal will increase the number of acres used for this purpose to a level comparable to that seen in the year 2002. The 2020 goal reflects a straight-line increase from current conditions.

5.2 Value of Agricultural Products Sold Directly to Individuals for Human Consumption

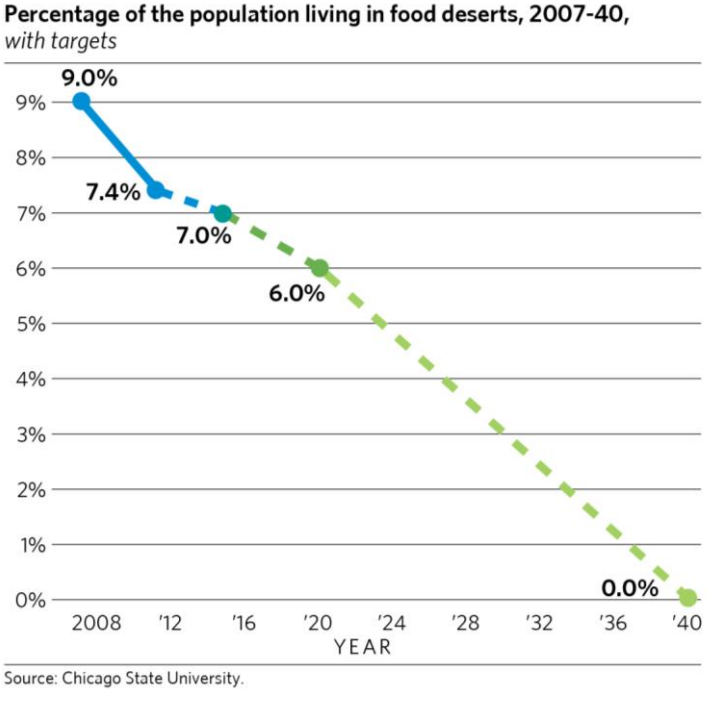
Indicator:	This indicator measures the dollar value of agricultural products produced and sold directly to individuals for human consumption from establishments such as roadside stands, farmers' markets, and pick-your-own sites in the seven-county region. The value excludes non-edible products such as nursery crops, cut flowers, and wool, but does include livestock sales. Data are from the Census of Agriculture conducted every five years and represent the best available data on food grown and consumed locally. This measure is adjusted for inflation to show real (not nominal) value. The values reported by the Census of Agriculture will be converted to 1997 dollars to make them directly comparable across years. Specifically, the Consumer Price Index for "Food at Home" for the Chicago-Gary-Kenosha Consolidated MSA is used to convert the values to real dollars. "Food at Home" is defined by the Bureau of Labor Statistics as "the total expenditures for food at grocery stores (or other food stores) and food prepared by the consumer unit on trips, [excluding] the purchase of nonfood items." Data suppression can be an issue with this indicator; however there is no better data source available. Generally, county data are suppressed (i.e., county totals are not reported) when the actual data of a dominant entity can be ascertained fairly accurately from the aggregate data values that are reported.

Targets:	*Note: No targets were established for this indicator in GO TO 2040, thus it will not have a 2015 target.* While this indicator will track the inflation-adjusted value of agricultural products sold directly to individuals for human consumption, the target values will be measured in a different manner. The targets will reflect the ratio of the market value of agricultural products sold directly to individuals for human consumption to the market value of total agricultural products produced in the region. It will track the share of total agricultural value comprised of agricultural products sold directly for human consumption. 2020: The market value of agricultural products sold for human consumption will comprise 1.95 percent of the total value of agricultural products sold in the region. 2040: The market value of agricultural products sold for human consumption will comprise 2.80 percent of the total value of agricultural products sold in the region. **Market value of agricultural products sold for human consumption as a share of total value of agricultural products in northeastern Illinois, 1992-2040,** *with targets*  Note: Reported data were suppressed for Cook County (2007) and Kendall County (2002 and 2007) due to privacy concerns. Source: Chicago Metropolitan Agency for Planning analysis of U.S. Census of Agriculture data.

Methodology:	Reporting these data in inflation-adjusted values makes comparing the indicator values easier, and accounts for true growth or decline in the value by removing the effects of inflation. Setting target values using inflation-adjusted numbers is a bit more complicated – it requires estimating increases in value as well as future inflation rates. Rather, the targets are presented as normalized values: the target represents the market value of agricultural products sold directly for human consumption divided by the value of total agricultural products sold in the region. Thus the region will be able to track whether the relative importance of agricultural products sold directly for human consumption is increasing in the region. The goal for 2040 calls for a 75-percent increase in the share of total agricultural products sold in the region comprised of products sold for direct human consumption. The current share (as measured from the 2012 Census of Agriculture) is 1.6 percent of the value of total agricultural products sold in the region. The chart above tracks the change in this value since 1992. Aside from a dip in the measure from 1992-97, overall the market value of agricultural products sold for direct human consumption has increased its share of the total value of agricultural products sold in the region between 1992 and 2012 in a fairly linear fashion. Note that the values reported for 2002-07 are artificially low due to the suppression of data for Cook County in 2007, and the suppression of Kendall County data in both years.
Original GO TO 2040 Indicator:	The original indicator reported this value directly from the Census of Agriculture.
Rationale for Change:	Economic comparisons, especially ones that may cover decades of data, should use real dollars as a basis for comparison. Removing the effects of inflation reveals the true growth (or decline) in value.

5.3 Percentage of Population Living in Food Deserts

Indicator:	This indicator measures the percentage of the population that lives in a Census tract where the median household income is below the weighted average median income level for the seven counties ($52,170 for GO TO 2040; $67,329 for the updated analysis) and that has a low accessibility to large supermarkets. For the study, supermarkets are defined as full-service chains, supercenters, and local chains or

	independents with at least five check-out lanes and a full line of groceries[1]. Data collection and analysis were led by Daniel Block of the Fredrick Blum Neighborhood Assistance Center at Chicago State University. This analysis was recently updated to reflect conditions in 2011.
Targets:	2015: 7 percent 2020: 6 percent 2040: 0 percent 
Methodology:	The 2015 and 2040 targets are unchanged from GO TO 2040. The 2020 target was developed by continuing a straight-line decrease in percentage of population living in low food access areas.

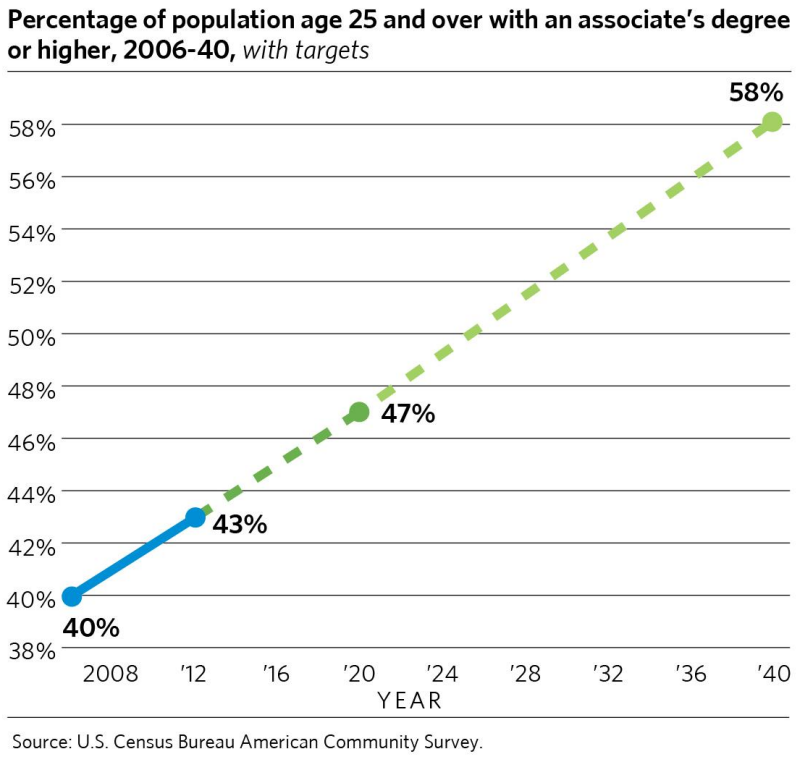
[1] Block, Daniel, Noel Chavez and Judy Birgen. (2008, June 3). *Finding Food in Chicago and the Suburbs: The Report of the Northeastern Illinois Community Food Security Assessment – Report to the Public.* Chicago: Chicago State University Frederick Blum Neighborhood Assistance Center and the University of Illinois-Chicago School of Public Health, Division of Community Health Sciences.

6. Improve Education and Workforce Development

All of the indicators under this recommendation area are new for the GO TO 2040 plan update.

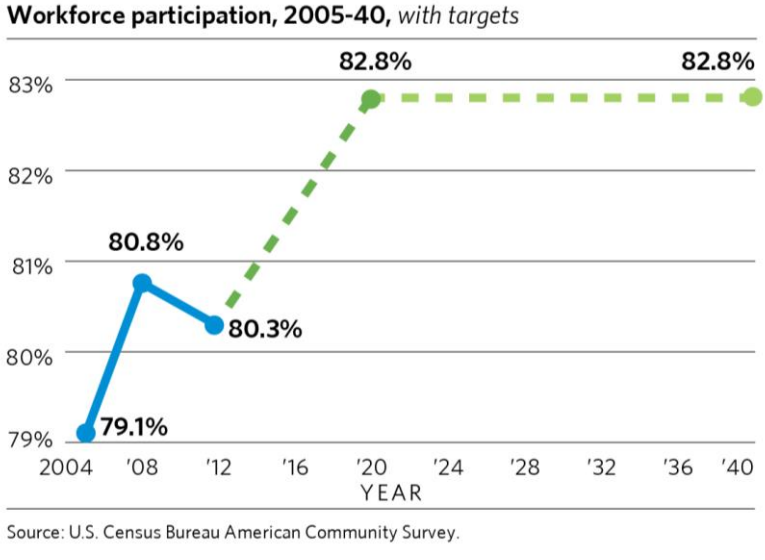
6.1 Population Age 25 and Over with an Associate's Degree or Higher

Indicator:	This measure reports the percentage of the regional population age 25 and over that have obtained an Associate's degree or higher. Data come from the American Community Survey (ACS) and represent the seven-county CMAP region. Educational attainment data are released annually. The inclusion of Associate's degrees in this measure helps to highlight the important role community colleges play in improving education and workforce development, and reflects the significance of "middle-skill" jobs in our regional economy. These are jobs that require more than a high school diploma but less than a Bachelor's degree. The overall level of resident education within metropolitan areas is a useful proximate measure for regional economic prosperity. Higher levels of education are generally associated with lower unemployment rates, a more innovative workforce, and a more economically vibrant region. Many jobs that previously only required a high school education are becoming more complex. Employers now seek workers with advanced skills that can raise productivity and help firms compete in the global marketplace.
Targets:	*Note: This is a new indicator so it will not have a 2015 target value.* 2020: 47 percent of the population in the region age 25 and over with at least an Associate's degree 2040: 58 percent of the population in the region age 25 and over with at least an Associate's degree

	
Methodology:	Currently, about 43 percent of the regional population age 25 and over holds an Associate's degree or higher (this exceeds the national average of 37 percent). Data from the ACS show that both high school completion and higher education levels are on the rise, in the region and nationwide. Since 2006 the proportion of the region's residents holding an Associate Degree or higher has increased by roughly 0.53 percent per year, which is faster than the national average increase of 0.45 percent per year during the same time period. The goal is to maintain the current growth rate in educational attainment as it relates to higher education; this is the basis for the establishment of the 2020 and 2040 targets.

6.2 Workforce Participation

Indicator:	This value represents the percentage of the regional population age 20-64 that is either working or actively looking for work. Data are from the American Community Survey and represent the metropolitan statistical area. There are many caveats to note when analyzing workforce participation statistics. An increase in workforce participation is generally viewed as a positive indicator of regional economic opportunity. Increased workforce

	participation suggests a decrease in the number of discouraged workers (individuals who are able to work but are currently unemployed and have not searched for employment in the last four weeks due to a lack of suitable options or a lack of success through previous job applications). However workforce participation is a complex measure due to the fact that it tracks both the number of employed persons and unemployed persons who are currently looking for work. Thus an increase in unemployment can also register as an increase in workforce participation. Similarly, decreases in workforce participation may be due to an increase in the number of discouraged job seekers, or to an increase in the number of people choosing to retire early or leave the workforce for other reasons. Even with these caveats, an increase in workforce participation is generally indicative of a healthy economy.
Targets:	*Note: This is a new indicator so it will not have a 2015 target value.* 2020: Regional workforce participation rate of 82.8 percent 2040: Maintain the regional workforce participation rate of 82.8 percent  Source: U.S. Census Bureau American Community Survey.
Methodology:	The Chicago region experienced a 1.2 percent increase in its workforce participation rate between 2005-12. While our workforce participation rate trails those in Boston and Washington D.C., it exceeds those of the New York and Los Angeles regions. Workforce participation in the Chicago region has increased by about 0.18 percent per year since 2005. Fluctuations in participation rates over time are very similar among every major metropolitan area, suggesting that this trend is governed by macroeconomic factors.

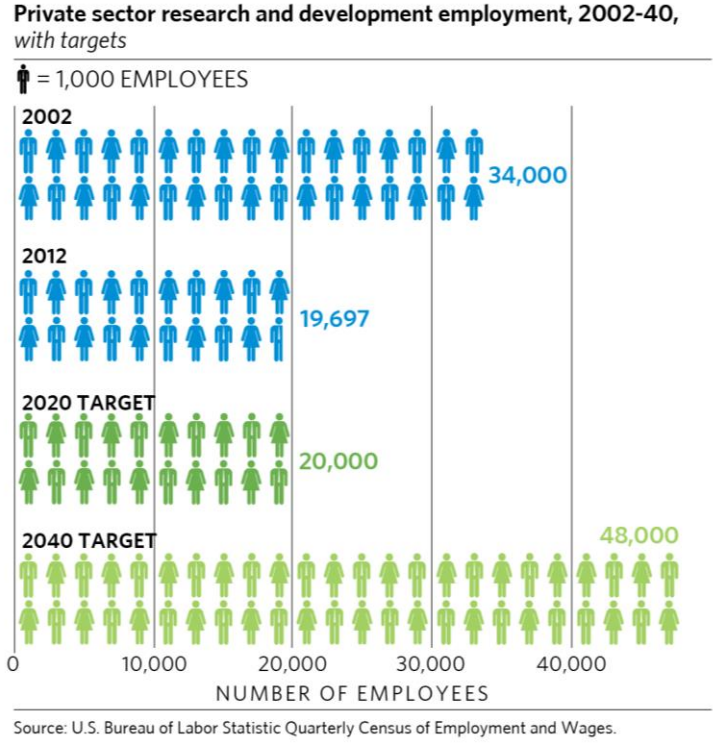
	The goal is to increase the region's workforce participation rate by 0.25 percent per year (up from 0.18 percent/year), thus achieving a rate of 82.8 percent in 2020. This level of workforce participation has been observed in other metro areas. The goal for 2040 is to maintain that workforce participation rate of 82.8 percent -- due to the multitude of factors affecting workforce participation rates and the complexities involved, it is difficult to gauge what an optimal participation rate is or looks like without further economic analysis.

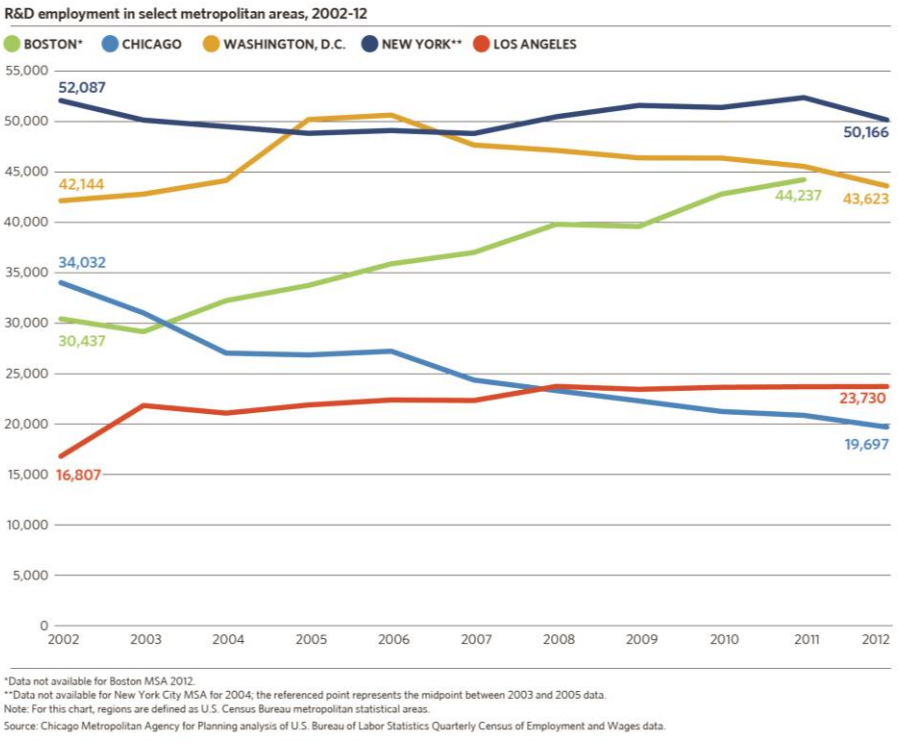
7. Support Economic Innovation

All of the indicators under this recommendation area are new for the GO TO 2040 plan update.

7.1 Private Sector Employment in Research and Development

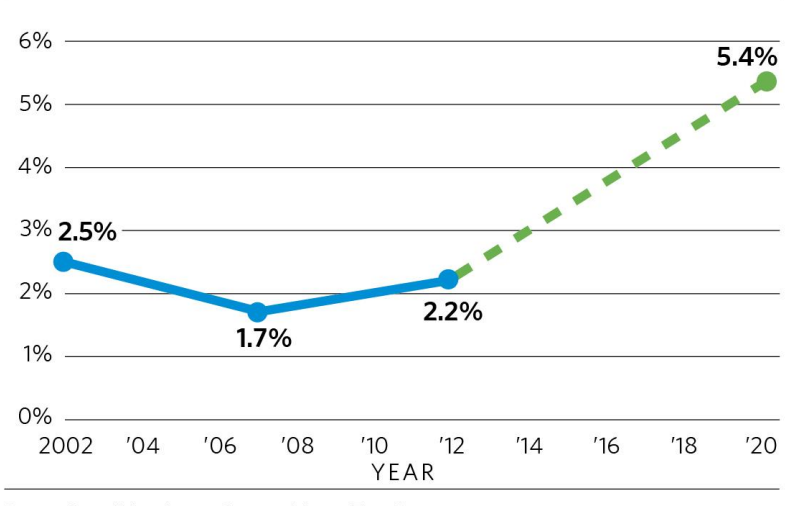
Indicator:	This indicator measures the number of people employed in research and development in the private sector. Data for private R&D employment are from the U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW), which collects and publishes data on jobs and wages by sector. Private R&D employment data presented here are obtained through employment reporting for the Scientific Research and Development Services (NAICS classification number 5417) sector. The data include only filled private sector positions and include both full- and part-time positions. Data are reported for the Chicago MSA and only represent private sector employment for firms whose primary function is research; people employed in research departments of firms classified under other North American Industrial Classification System (NAICS) codes are not counted. Private sector R&D employment is one measure of a region's capacity for innovation; a creative workforce plays an essential role in spurring economic growth.
Targets:	*Note: This is a new indicator so it will not have a 2015 target value.* 2020: 20,000 private sector R&D jobs in the region 2040: 48,000 private sector R&D jobs in the region

	
Methodology:	National trends show large increases in private sector R&D employment, which were up over 19 percent between 2003-12. While our peer metro areas have seen their levels of private sector R&D employment grow or remain at consistent levels, the Chicago region has seen a continual decline in this type of employment – losing more than 14,000 jobs over the last decade. As the region's economy is very diverse, this decline cannot be attributed to just one or two industries – it is likely a larger, cross-sector phenomenon.

	 CMAP's initial goal is to understand why this R&D employment is declining in our region and slow or stop the decline by 2016. The 2020 target reflects an expectation that jobs in this sector will continue to be lost over the next few years at roughly the same rate (around 1,400 jobs per year); then beginning in 2016 the region will start regaining R&D jobs at an annual rate equal to what was lost over the last decade. Continuing this trend achieves the 2040 goal of 48,000 private sector R&D jobs in the region.

7.2 Venture Capital Funding

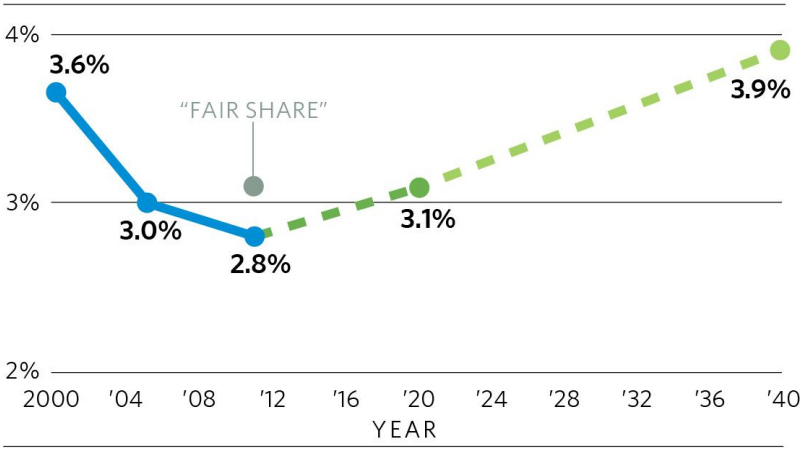
Indicator:	This indicator measures the State of Illinois' share of total U.S. venture capital deals. Innovation in new goods, services, and technologies drives economic growth, but related research, creation, and marketing costs can be substantial. Investors support high-risk, high-growth startup companies through venture capital deals. As a private financial transaction undertaken between two parties, venture capital funding is not tracked by government agencies. Several private organizations track venture capital activity by estimating both the number of deals made and dollar value of deals within various geographies. The data used in this indicator are produced by Thomson Reuters and published by PricewaterhouseCoopers (PWC) and the

	National Venture Capital Association – they represent a "best guess" of venture capital activity by region and state. PWC does not track data specifically for the Chicago region, however most of the VC funding in the state flows to northeastern Illinois. The data behind this indicator focus on the number of VC deals rather than the value of the deals, as one or two high-value deals can significantly skew state and regional data.
Targets:	*Note: This is a new indicator so it does not have a 2015 target value.* 2020: The State of Illinois should account for 5.4 percent of all U.S. venture capital deals 2040: No target will be established at this time **Venture capital funding, share of national deals, 2002-20,** *with targets*  Source: Price Waterhouse Coopers Money Tree Report.
Methodology:	Since the mid-1990s the state of Illinois has accounted for about 2 percent of all VC deals. Trends show that the Midwest (defined as Illinois, Missouri, Indiana, Kentucky, Ohio, Michigan, and western Pennsylvania) is accounting for an increasing proportion of total VC deals; however, Illinois' proportion of deals has remained flat. In 2005 the Midwest accounted for 5.5 percent of all VC deals, by 2012 that proportion increased to 8.1 percent - an average growth of 0.4 percent per year. The goal for 2020 is to increase the number of VC deals in the state such that Illinois' share of total U.S. VC deals accounts for 0.4 percent more per year than the previous year – this is equivalent to the overall growth rate experienced by the Midwest, and mirrors the increases seen by metro regions such as New York and Los Angeles.

	Establishment of a target for 2040 requires a more thorough understanding of the venture capital market, so no long-term target will be established at this time.

7.3 Number of Patents Issued Annually

Indicator:	This indicator measures utility patent output; these are commonly referred to as "patents for invention." According to the U.S. Patent and Trademark Office (USPTO), utility patents may be granted "to anyone who invents or discovers any new or useful process, machine, article of manufacture, or composition of matter, or any new or useful improvement thereof." High levels of patent production generally indicate an innovative region supported by an educated workforce with a strong capacity to conduct research and development. Patent output data are available annually from the USPTO.
Targets:	*Note: This is a new indicator so it does not have a 2015 target value.* While this indicator reports the number of patents issued annually in the region, the target values are measured in a slightly different manner: as the share of total U.S. patents issued in northeastern Illinois. 2020: 3.1 percent of the nation's patents should be issued in northeastern Illinois. This is equivalent to our region's current "fair share" of patents (i.e., a patent output share/population share ratio equal to 1.00). 2040: 3.9 percent of the nation's patents should be issued in northeastern Illinois. This represents the goal of achieving 26 percent more than our region's "fair share" of patent output (i.e., a patent output share/population share ratio equal to 1.26).

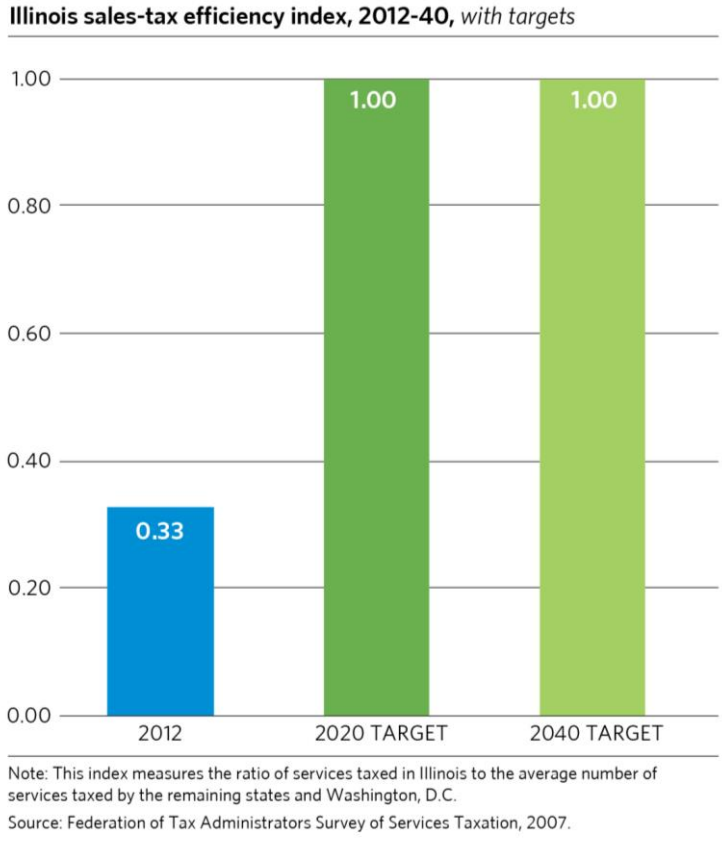
	Northeastern Illinois share of U.S. patents issued annually, 2000-40, *with targets*  Note: The "fair share" dot indicates the proportion of national patent output metropolitan Chicago should produce based on the region's share of the national population. Source: U.S. Patent and Trademark Office.
Methodology:	The vast majority of new patents are issued to residents and businesses in metropolitan areas. Further, in most instances the total number of patents produced in metropolitan areas is correlated with their regional population. In 2011 the Chicago MSA accounted for 3.1 percent of the U.S. population, but only 2.8 percent of total patent output. Thus the region's patent output share divided by its population share ratio equaled 0.90. The region's "fair share" of patents for 2011 was 3.1 percent (equivalent to its population share). The goal for 2020 is for the region to increase its patent output to meet its 2011 "fair share" of patent output – 3.1 percent. The top 25 most populous metro areas account for 40.8 percent of the nation's population and 51.6 percent of the nation's patents. In other words, they produce 26 percent more than their "fair share" of patents. The goal for 2040 is for our region to match the patent output rate of the top 25 metropolitan areas and to have a patent output share that is 26 percent more than the region's share of national population. The 2040 target is for the region to produce 3.9 percent of the nation's patents, a 26 percent increase over the 2020 target.

8. Reform State and Local Tax Policy

All of the indicators under this recommendation area are new for the GO TO 2040 plan update.

8.1 Sales Tax Efficiency Index

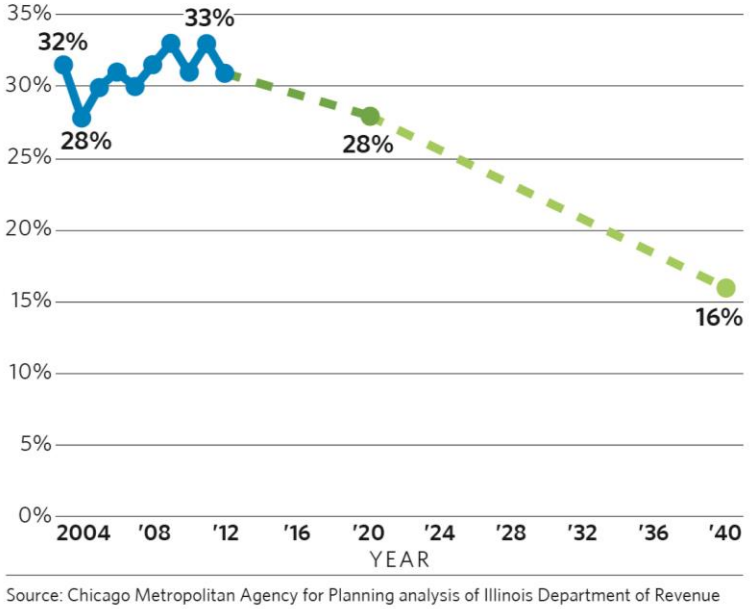
Indicator:	The Sales Tax Efficiency Index compares the number of services included in the sales tax base in Illinois compared to the average number of services taxed by the remaining 49 states and Washington, D.C. The indicator will be the following ratio: $$\frac{\textit{number of services in Illinois sales tax base}}{\textit{weighted average number of services in sales tax bases of 49 states \& D.C.}}$$ The denominator of the index uses the number of services taxed by each locale and weights each by the size of its gross domestic product, thus reflecting the relative importance of each within the national economy. The data source for the number of services included in the sales tax base is the Federation of Tax Administrators Survey of Services Taxation 2007. The source for the gross domestic product values is the U.S. Bureau of Economic Analysis.
Targets:	*Note: This is a new indicator so it will not have a 2015 target value.* 2020: The index value should equal 1.0 2040: The index value should equal 1.0

	
Methodology:	For 2012 the index is: $\frac{17}{52} = 0.33$. This shows that Illinois includes only one-third of the number of services in its sales tax base compared to the "average" state, thus rating it low on sales tax efficiency. The indicator will focus on a target of achieving an index value of 1.0, meaning that the number of services taxed in Illinois is the same as the weighted average of the rest of the country. The 2020 goal for this indicator is to achieve the desired index value of 1.0. The goal for 2040 is to maintain the index value at 1.0.

8.2 Percentage of Municipalities with a Per Capita Sales and Property Tax Base of More than 25 Percent Below the Median

Indicator:	This indicator uses the measure described in a Policy Update[2] dealing with the equity of the tax system. Equity is viewed in terms of municipalities' ability to fund necessary services. The per capita tax

[2] Chicago Metropolitan Agency for Planning. (2013, August 19). *Using Indicators to Chart Progress toward a More Equitable Regional Tax System.* http://www.cmap.illinois.gov/policy-updates/-/blogs/using-indicators-to-chart-progress-toward-a-more-equitable-regional-tax-system

	base value used to measure a community's ability to raise funds is: $$\frac{\textit{municipal retail sales + municipal equalized assessed value for property}}{\textit{municipal population}}$$ The tax base value is normalized by municipal population to provide a common basis for comparison. The median per capita tax base for the region ($42,322 for 2012) was calculated and municipalities were categorized by how far above or below the median value their municipal tax base lies. The tax base information was derived from Illinois Department of Revenue data. Population figures are from the U.S. Census Bureau.
Targets:	*Note: This is a new indicator so it will not have a 2015 target value.* 2020: 28 percent of the region's municipalities will have a per capita sales and property tax base more than 25 percent below the regional median 2040: 16 percent of the region's municipalities will have a per capita sales and property tax base more than 25 percent below the regional median **Percentage of municipalities with a per capita sales and property tax base of more than 25 percent below the median, 2003-40** *with targets*  Source: Chicago Metropolitan Agency for Planning analysis of Illinois Department of Revenue Data and U.S. Census, 2010 decennial Census data.

Methodology:	For 2012, 31 percent of the region's municipalities have per capita tax bases more than 25 percent below the median. This percentage has remained fairly stable over the last decade (as shown in the graphic above). The short-term (2020) target will be to achieve a 10-percent decrease in the number of municipalities with a per capita tax base more than 25 percent below the median. That would reduce the value to 28 percent of municipalities, a number not seen since 2004. The goal for 2040 is to reduce the number of municipalities with per capita tax bases more than 25 percent below the regional median by one-half of its current value, i.e., 16 percent of the municipalities.

8.3 Tax System Transparency Score

Indicator:	This plan indicator uses the measure described in a Policy Update[3] dealing with the transparency of the tax system regarding public access to local taxation and other fiscal data. CMAP developed a transparency scorecard to track the availability of ten categories of tax and finance-related documents on the websites of the seven counties (the categories are listed in the following chart). The scorecard is loosely based on the system once used by the Sunshine Review, an organization that rated governments on transparency and was recently acquired and merged into Ballotpedia. Each county is given one point for each category of materials that is available on their website. The total score for each county is determined and those seven values are averaged to calculate the Tax System Transparency Score for the region.
Targets:	*Note: This is a new indicator so it will not have a 2015 target value.* 2020: A score of 10 out of 10 2040: No target will be established at this time

[3] Chicago Metropolitan Agency for Planning. (2013, Septermber 25). *Using Indicators to Chart Progess toward a More Transparent Regional Tax System.* http://www.cmap.illinois.gov/policy-updates/-/blogs/using-indicators-to-chart-progress-toward-a-more-transparent-regional-tax-system.

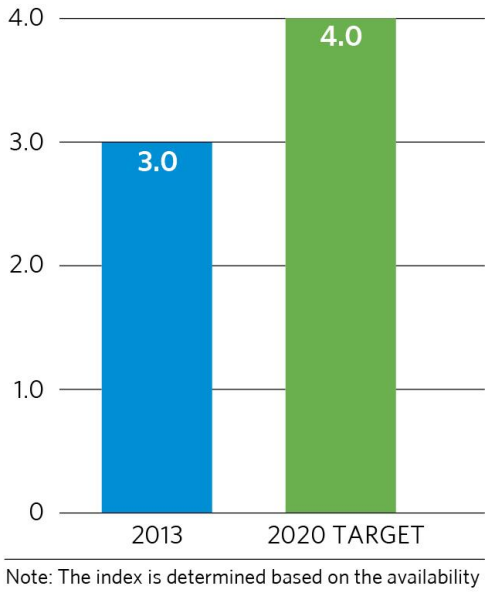
	Tax system transparency score, 2013-20, *with targets*  Note: Transparency score values are determined by the amount of tax and financial information available on county websites. Source: Chicago Metropolitan Agency for Planning analysis of county websites in metropolitan Chicago.
Methodology:	There are no technological barriers to achieving a perfect score of ten for the region by 2020, so it is set as the target. No target is set for 2040 -- if the 2020 target is actually met, it will require revising this measure because a perfect score under this system would be the new norm.

9. Improve Access to Information

A new indicator was developed for this recommendation area for the GO TO 2040 plan update.

9.1 Regional Government Transparency Index

Indicator:	This regional index is calculated as the average of all of the individual category scores (discussed below) determined by examining each of the websites of the seven counties in the CMAP region. This index measures not only the availability of on-line government information, but also the ease with which it can be accessed (as measured by the number of mouse clicks required to reach the information from the county website home page). Additionally, each county can raise their score within a given category by one increment by providing information that is beyond the norm. The intent is to measure access to government information in an objective way. The websites of the seven CMAP counties were examined to determine whether they provide information in the following ten categories: 1. Government Officials and Staff Directory 2. Online resources for access to open meetings & records 3. Document Library 4. Ways to file record requests online (FOIA) 5. Access to budget and financial information 6. Archives of meetings, ordinances, votes 7. Links to public notices 8. Access to e-government applications 9. Public procurements (bids or RFPs) 10. Maps and Data A score was assigned to the information categories for each county based on the following scale: 0 = Information not available on website. 1 = Three or more mouse clicks were required to reach the information from the county homepage, or the website Search function was needed to locate the information. 2 = Two mouse clicks were required to reach the information from the county homepage (or 3+ clicks plus a bonus for supplemental information). 3 = One mouse click was required to reach the information from the county homepage (or two clicks plus a bonus for supplemental information).

	4 = Maximum score possible; requires one mouse click from homepage to reach information plus a bonus for having supplementary information or functionality available.
Targets:	*Note: This is a new indicator so it will not have a 2015 target value.* 2020: A score of 4 out of 4 2040: No target will be established at this time **Regional government transparency index, 2013-20,** *with targets*  Note: The index is determined based on the availability of certain information on a county's website, as well as the number of mouse-clicks it takes to access said information from the county website home page. Source: Chicago Metropolitan Agency for Planning analysis of county websites in metropolitan Chicago. More thorough documentation of this indicator is provided in Appendix B of this report.
Methodology:	There are no technological barriers to achieving a perfect score of four for the region by 2020, so it is set as the target. No target is set for 2040 - if the 2020 target is actually met, it will require revising this measure because a perfect score under this system would be the new norm.

10. Pursue Coordinated Investments

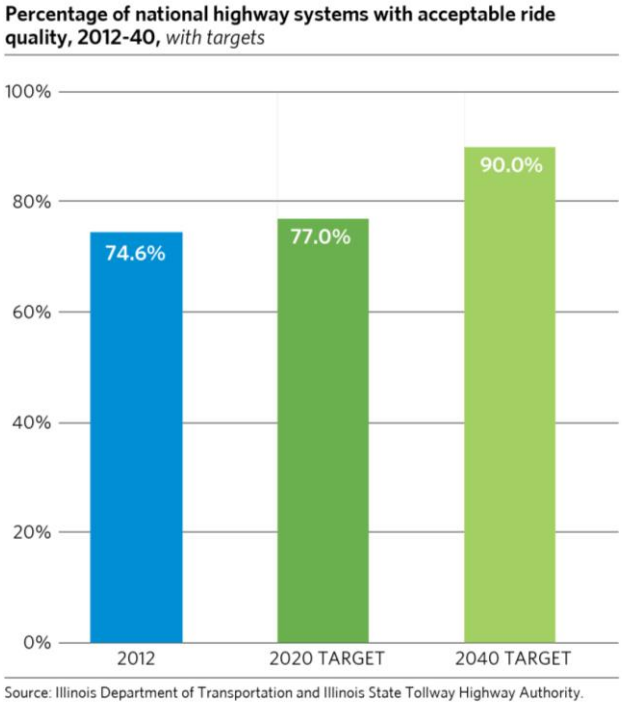
Consistent with GO TO 2040, this section includes no specific indicators or targets. Success will be measured by tracking the level of implementation of all of the plan update recommendations.

11. Invest Strategically in Transportation

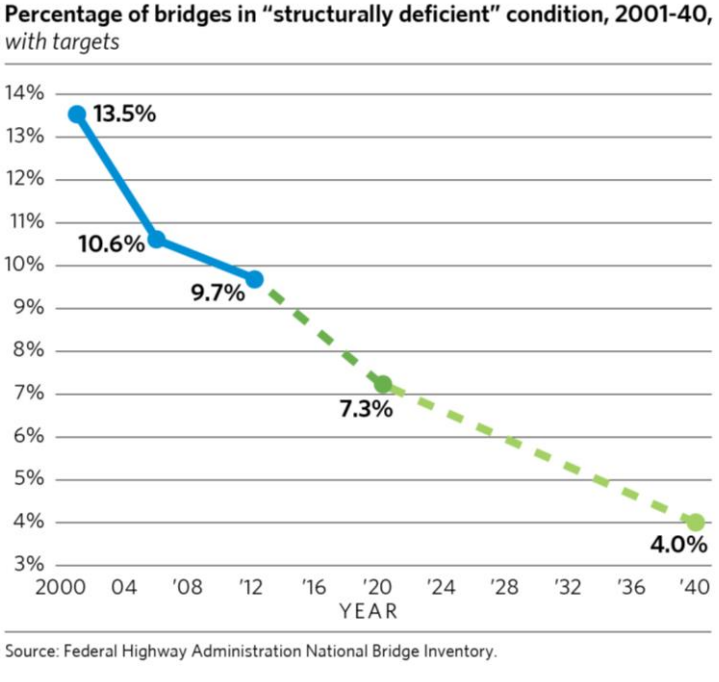
Three of the indicators in this recommendation area have been modified; one represents a new measure not available when GO TO 2040 was adopted.

11.1 Percentage of National Highway System with Acceptable Ride Quality

Indicator:	This indicator measures the percentage of National Highway System (NHS) centerline miles in the region that have an "acceptable" ride quality. Ride quality is defined by an International Roughness Index (IRI) score of less than 170, which measures the cumulative deviation from a smooth surface on a mile of roadway. "Good" ride quality is defined by a score under 95 inches per mile. Ride quality provides a good measure of user experience of the facility. The NHS used for this analysis is the one defined in MAP-21 (Moving Ahead for Progress in the 21st Century), the current federal surface transportation act.
Targets:	*Note: This indicator is modified significantly from the GO TO 2040 version, thus it will not have a 2015 target value.* 2020: 77 percent of NHS with acceptable ride quality 2040: 90 percent of NHS with acceptable ride quality

	
Methodology:	Nearly 75 percent of the current (2012) NHS centerline miles have an acceptable ride quality. Expanding this measure to include the entire NHS (not just principal arterials), changes the overall composition to reflect a larger portion of the system with an acceptable ride quality. This is due to the fact that the expressways generally have higher IRI scores than the arterials, as well as the fact that a number of stimulus package projects were completed in the region. The 2020 target reflects a small improvement from the current conditions – this value is slightly below a straight-line increase between 2012-40 due to the fact that the underlying pavement structures were not necessarily improved in the stimulus projects. The 2040 target reflects the goal of improving the condition of the arterial system to match that of the expressways.
Original GO TO 2040 Indicator:	The original GO TO 2040 indicator measured ride quality only for the principal arterial system.
Rationale for Change:	Including the expressway system along with the principal arterials would provide a more complete assessment of the quality of the region's roadways.

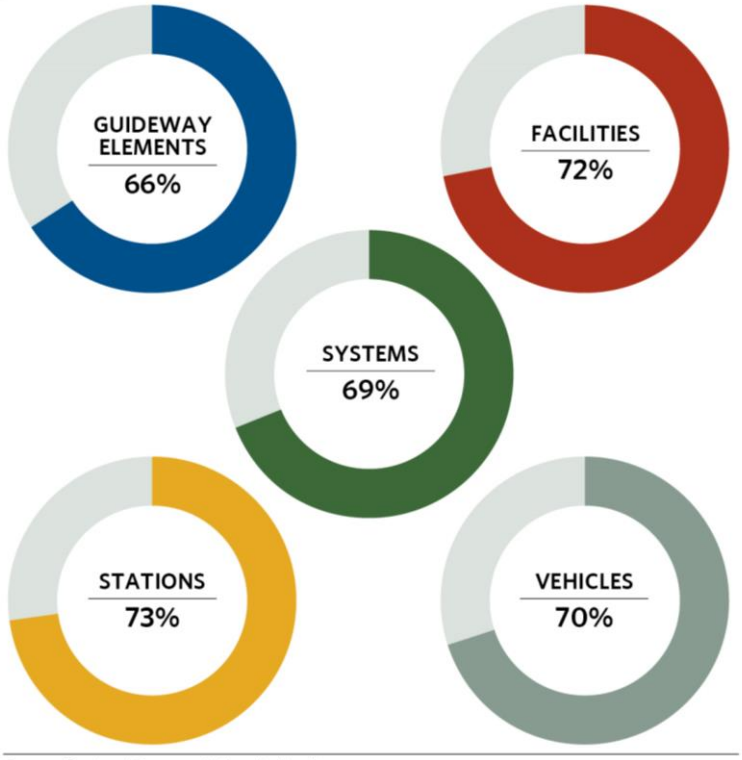
11.2 Percentage of Bridges in "Structurally Deficient" Condition

Indicator:	This indicator measures the percentage of bridges categorized by the Federal Highway Administration's National Bridge Inventory (NBI) as "structurally deficient." Bridges in the NBI assigned to this category are most in need of repair. These are identified through the inspection process as requiring significant maintenance, rehabilitation or replacement. This classification refers to bridges with one or more structural defects that require attention, such as significant load-carrying elements are found to be in poor condition or the waterway adequacy is not sufficient. While a bridge with this classification is in the most severe rating category, it does not necessarily mean that it is unsafe. Data are available for all bridges over twenty feet in length.
Targets:	*Note: This indicator is modified significantly from the GO TO 2040 version, thus it will not have a 2015 target value.* 2020: 7.25 percent of bridges in the region are categorized as structurally deficient 2040: 4 percent of bridges in the region are categorized as structurally deficient 

Methodology:	Current (2012) data indicate that 9.7 percent of the bridges in the region are categorized as structurally deficient. Over the last decade, the percentage of structurally deficient bridges in the region decreased by around 25 percent. The 2020 and 2040 targets reflect a continuation of this rate of improvement in bridge conditions.
GO TO 2040 Indicator:	The original GO TO 2040 measure examined the percentage of bridges categorized by the National Bridge Inventory as "not deficient." By default, bridges in the inventory categorized as either "functionally obsolete" or "structurally deficient" are deemed to be "deficient" in this scheme. Functional obsolescence is used to refer to a bridge whose geometrics (such as lane widths or overhead clearance) do not meet minimum specifications under current federal design standards. A bridge with this classification may be in excellent condition or even be brand new, and localities may have legitimate reasons for not building bridges to the federal specifications.
Rationale for Change:	The use of the term "not deficient" in the original indicator may lead the public to believe that all other bridges must then be, by definition, "deficient," which generally has a negative connotation. To support the public safety goals of this section of the plan, a more representative indicator would be to measure the bridges that are most in need of rehabilitation, repair, and replacement.

11.3 Percentage of Transit Assets in a State of Good Repair

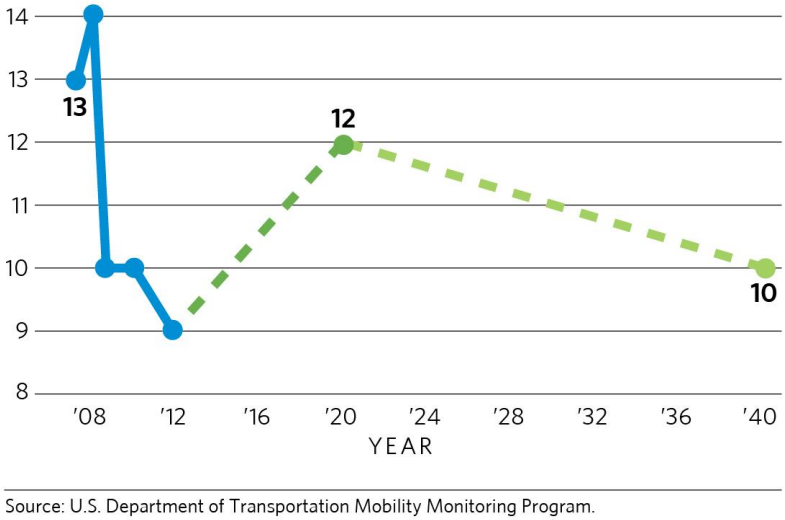
Indicator:	This measure tracks the region's transit assets that are in a state of good repair. The transit asset inventory maintained by the Regional Transportation Authority (RTA) classifies assets into five categories (consistent with the Federal Transit Administration's (FTA) reporting requirements under MAP-21): • Facilities (buildings, equipment, storage yards) • Guideway elements (track, rail, bridges, ties) • Stations (passenger facilities, parking lots) • Systems (signals, fare collection equipment, radios, phones, interlockings) • Vehicles (both revenue and non-revenue) The asset condition assessment has also adopted the transit asset decay

	curves developed by the FTA, which predict the physical condition of assets based on factors such as age and maintenance history, and convert them to a standardized "5 to 1" rating scale.[4] For reporting purposes, assets with a rating of 2.5 or higher are deemed to be in a "State of Good Repair." The current (2011) State of Good Repair values[5] are: **Percentage of transit assets in a state of good repair,** *represented in 2011 values*  Source: Regional Transportation Authority.
Targets:	*CMAP will work in cooperation with the RTA and representatives from the CTA, Metra, and Pace to monitor existing conditions and develop meaningful targets for the State of Good Repair of regional transit infrastructure.*

[4] CH2MHill, URS Corporation, Inc., Kristine Fallon Associates, Inc. and Raul Bravo + Associates, Inc. (2012, November). *Capital Asset Condition Assessment Update: Report for Calendar Year 2011*. Prepared for Regional Transportation Authority. Chicago: Regional Transportation Authority.

[5] Regional Transportation Authority, Department of Finance & Performance Management. (2013, September). *2012 Regional Report Card Performance Measures.* Chicago: Regional Tranportation Authority.

11.4 Average Congested Hours of Weekday Travel for Limited Access Highways

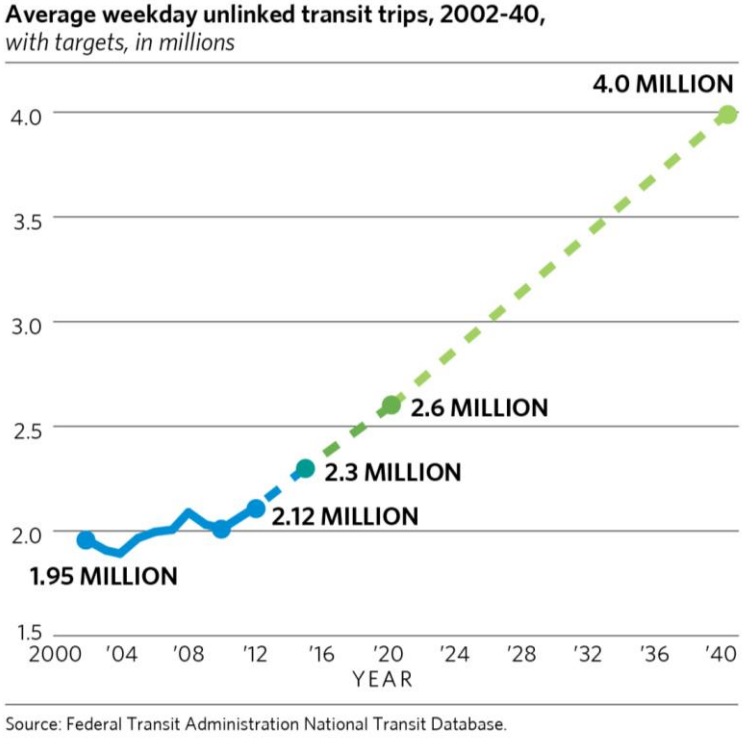
Indicator:	This measure uses the Federal Highway Administration's Urban Congestion Report data to track average weekday congestion. Specifically, it measures the average number of hours during weekdays when the region's instrumented expressways are congested. Data collected from roadway sensors are used to determine the duration of time that travel speeds fall below 45 MPH on the highway segments, which is considered to be congested conditions. Only detector measurements taken between the hours of 6:00 AM and 10:00 PM are used in the analysis. These data are collected for metropolitan areas around the country as part of the U.S. Department of Transportation's Mobility Monitoring Program and are available quarterly.
Targets:	*Note: This indicator is modified significantly from the GO TO 2040 version, thus it will not have a 2015 target value.* 2020: 12 hours of average weekday congestion on limited access highways 2040: 10 hours of average weekday congestion on limited access highways, reflecting no growth in congestion from 2010 conditions **Average congested hours of weekday travel for limited access highways, 2007-40,** *with targets*  Source: U.S. Department of Transportation Mobility Monitoring Program.

Methodology:	The goal for 2040 is to experience no growth in the average number of hours each weekday that the region's expressways are congested, even though the population of the region will increase. The 2040 goal reflects the same duration of average weekday congestion as 2010 -- approximately 10 hours per day. The short-term goal for 2020 allows for a 20-percent increase in the duration of average weekday congestion above the 2010 value -- this reflects the fact that roadway congestion is expected to increase as the country continues to recover from the economic downturn. The 2020 goal is consistent with pre-recession levels of congestion in the region. The lower congestion goal in 2040 reflects that it will take capital improvement projects in the region and the implementation of operational strategies like congestion pricing to address congestion in the long-term.
GO TO 2040 Indicator:	The original version of this indicator measured the aggregate daily congested vehicle hours of travel (VHT) derived from CMAP's regional travel demand model.
Rationale for Change:	Roadway congestion is a reasonable way to measure system performance but is not easily comprehended in aggregate terms. Average Congested Hours of Weekday Travel provides a more-intuitive measure of roadway performance than aggregate VHT. Data drawn from roadway sensors will more accurately gauge the impact changes in the overall economy and highway capacity have on traffic (as evidenced in the decrease in congestion recorded during 2008) than will data from the regional model, which are dependent upon how scenarios are defined. Additionally, a guiding principal in the development of plan indicators is that they be based on observed data, not modeled or simulated values.

12. Increase Commitment to Public Transit

One of the indicators under this recommendation area has been modified from its original version and one remains unchanged.

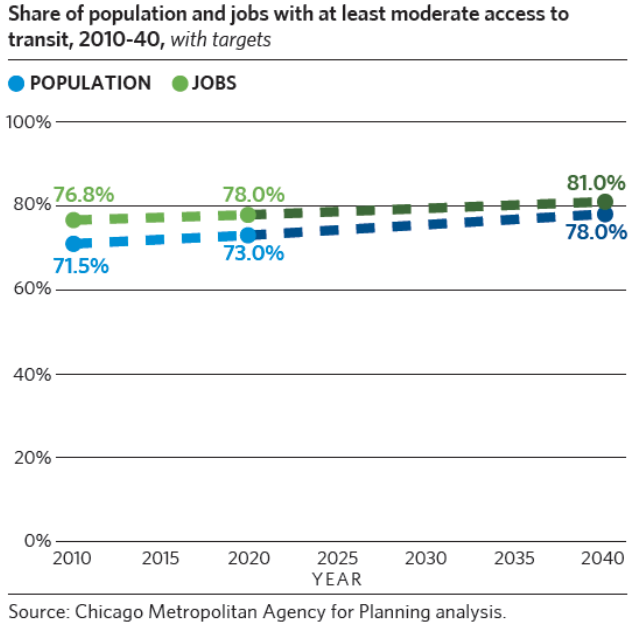
12.1 Average Weekday Unlinked Transit Trips

Indicator:	This indicator tracks the number of average weekday unlinked transit trips (excluding paratransit). Trips are "unlinked" in that this is a total count of trips, so that an individual making one transfer is counted as two unlinked trips. This value is taken directly from the National Transit Database and unlinked trips are the only way the Federal Transit Administration reports transit service used by the public.
Targets:	2015: 2.3 million trips 2020: 2.6 million trips 2040: 4 million trips  The most recent data (2012) indicate that unlinked transit trips will need to increase by nearly 3 percent for each of the next three years in order to reach the 2015 target of 2.3 million trips.

Methodology:	The 2015 and 2040 targets are unchanged from GO TO 2040. The 2020 target was developed by continuing a straight-line increase in the number of annual unlinked weekday transit trips.

12.2 Population and Jobs with at Least Moderate Access to Transit

Indicator:	This indicator will report the percentage of population and jobs with access to transit (as was done in GO TO 2040) but accessibility to transit is defined differently and calculated in a different manner. To measure the percentage of population and jobs in the region with access to transit as a means of tracking plan implementation progress, a new metric was developed – the Access to Transit Index. For a specific area, this index is intended to measure the relative level of access residents have to the transit system regardless of mode. The intent of this new index is to provide a more complete measure of how residents view access to transit by including multiple factors that contribute to one's perception of transit accessibility, while maintaining a metric that is still easily comprehended. This index is not intended to measure the connectivity of the transit system as a whole, or the access to the region that it provides. It is also not intended as a means to evaluate the performance of the various transit operators nor is it a suitable tool for such an evaluation. The new index value is calculated from four component factors: • Weekly frequency of transit service. • Activities that can be reached via a single direct transit route. • Proximity to a transit stop or station measured over the network. • Pedestrian friendliness of the surrounding area. The Access to Transit Index is a uniform measure of transit level of service available during an average week. It permits the tracking of changes in transit level of service over time and presents the results in an intuitive fashion. It also offers a universal comparison of the different service levels offered across the region. The inherent loss of some of the nuances in localized service is balanced against the ability of the index to provide a relatively simple way to compare transit service over a large area over time. Transit service for the region is analyzed using information provided in

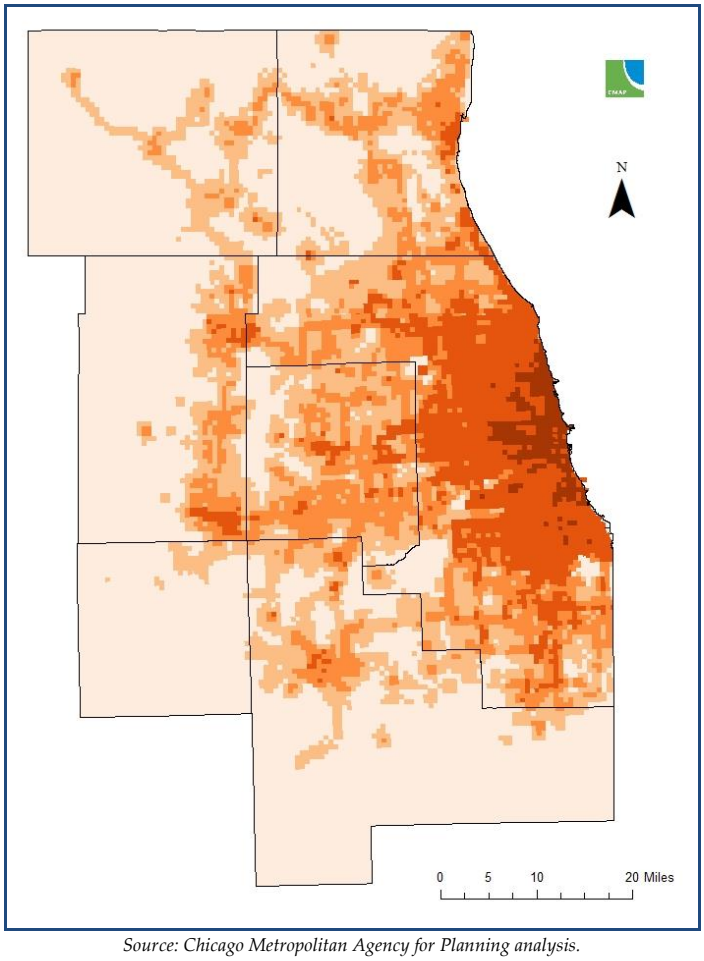
	General Transit Feed Specification (GTFS) files. These are files developed and distributed by the transit operators themselves and use a standard format to provide route and schedule information to automated trip planning applications such as Google Transit. This measure analyzes transit data for the four major operators in the region: the Chicago Transit Authority, Metra, Pace, and the Northern Indiana Commuter Transportation District. This metric analyzes fixed-route transit service only – meaning service along a prescribed route that operates on a fixed schedule. It does not include demand-responsive transit service or paratransit. A more thorough discussion of this metric is included in Appendix C of this report.
Targets:	*Note: This indicator is modified significantly from the GO TO 2040 version, thus it will not have a 2015 target value.* 2020: 73 percent of population with at least moderate access to transit 78 percent of jobs with at least moderate access to transit 2040: 78 percent of population with at least moderate access to transit 81 percent of jobs with at least moderate access to transit  Source: Chicago Metropolitan Agency for Planning analysis. Note: The transit access index measure is calculated using four factors: (1) weekly frequency of transit service, (2) activities that can be reached via a single direct transit route, (3) proximity to a transit stop or station measured over the network, and (4) the pedestrian friendliness of the surrounding area. The index scores localized areas and places them in one of five categories, ranging from low to high transit access. Areas with "at least moderate access" fall within the top three index categories. An analysis of 2010 base year conditions show that 71.5 percent of the

	regional population and 76.8 percent of regional jobs had at least moderate access to transit (see the following table).

Methodology:

For this analysis, transit service attributes from the GTFS files are aggregated to the subzone-level geography for the seven-county region. Each of the four component factors listed previously is measured individually at the subzone level and an index value is assigned. The overall accessibility index value is the average of the four factor indices that were assigned to the subzone. The access to transit conditions for 2010 base year data are displayed below. The share of regional population reflects data from the 2010 Census. Values on the share of regional employment reflect data for 2010 from the Illinois Department of Employment Security.

Access to Transit Index, 2010 Conditions



Source: Chicago Metropolitan Agency for Planning analysis.

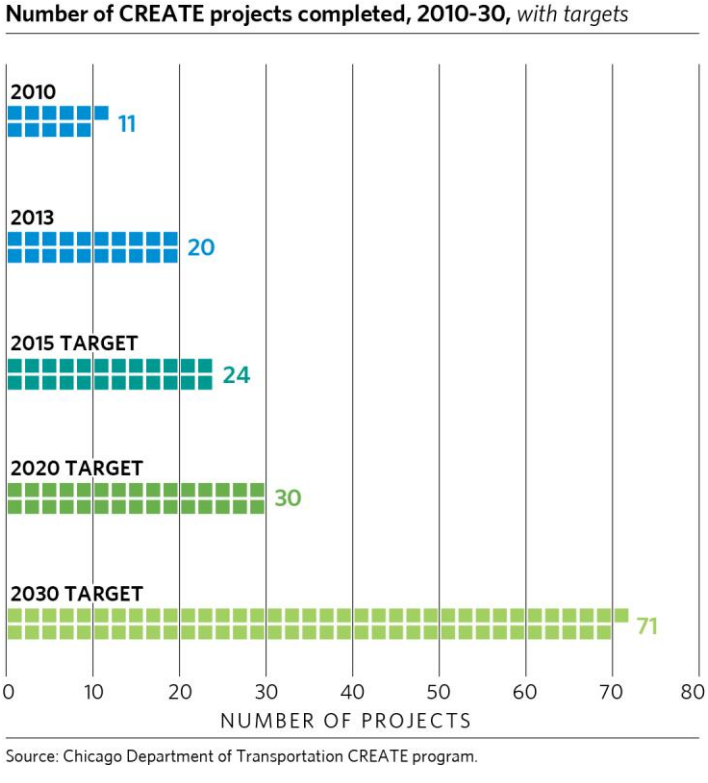
Color Code	Index Value	Subzone count	Share of Regional Population	Share of Regional Employment	Transit Access Level
	1	8,855	7.3%	5.5%	Low
	2	3,473	21.3%	17.7%	Moderately Low
	3	2,194	21.6%	26.6%	Moderate
	4	1,650	37.5%	30.7%	Moderately High
	5	271	12.4%	19.5%	High

GO TO 2040 Indicator:	The original indicator measured the percentages of regional population and jobs with access to transit. Accessibility was defined as being within one-quarter mile of a CTA bus stop or Pace bus route, or within one-half mile of a rail station. The shares of regional population and jobs values were calculated by buffering the transit stops by the appropriate distances, then intersecting with the modeling subzones and calculating accessible values by apportioning the subzone population and employment.
Rationale for Change:	While the original spatial buffering method offers an easily-understood "back-of-the-envelope" estimate of transit access, mere proximity to transit is too simplistic a way to measure accessibility. Further, it says nothing about the transit service itself or about the variations in level of service offered throughout the region.

13. Create a More Efficient Freight Network

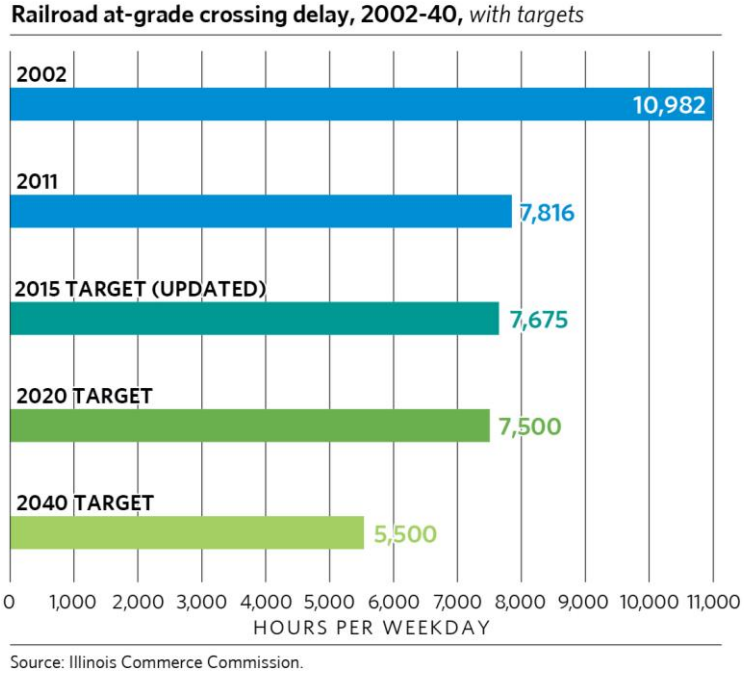
No changes are proposed for the efficient freight network indicators.

13.1 CREATE Project Completion

Indicator:	This performance measure provides a count of the number of Chicago Region Environmental and Transportation Efficiency Program (CREATE) projects that are complete. The count is of projects actually completed, as opposed to "underway" or "obligated." The source for this information is the CREATE program website maintained by the Chicago Department of Transportation.
Targets:	2015: 24 projects completed 2020: 30 projects completed 2030: 71 projects completed 
Methodology:	The 2030 target is unchanged from GO TO 2040, reflecting completion of the entire CREATE program. The 2015 target value has been revised, as the original GO TO 2040 goal of completing 20 CREATE projects by 2015 was achieved in 2013. The 2020 target was developed by continuing a straight-line increase in the number of CREATE projects

	completed. The 2020 target was also compared to the number of CREATE projects in Phase 1 engineering and those that have received a full funding commitment through construction in order to verify its reasonableness.

13.2 At-Grade Highway-Rail Crossing Delay

Indicator:	This indicator measures the aggregate hours of weekday delay experienced by motorists at railroad crossings in the seven-county CMAP region. The source for these data is periodic analyses conducted by the Illinois Commerce Commission.
Targets:	The original 2015 target value for this indicator was set at 10,000 hours of weekday delay in GO TO 2040. This value was developed based on the best data available at the time, which reflected the conditions in 2002. Since the adoption of GO TO 2040, an updated analysis of the rail crossing delay was completed which invalidated the original short-term goal. The target values for the plan update, including a revised 2015 target, are: 2015: 7,675 hours of weekday delay 2020: 7,500 hours of weekday delay 2040: 5,500 hours of weekday delay 

Methodology:	The 2040 target is unchanged from GO TO 2040. Over the last decade a number of strategies were implemented that resulted in a large reduction in weekday delay between the baseline and current analyses -- these include closing lines and grade crossings, re-routing of service, and service realignments. The 2020 target was developed using the current value as a basis but recognizing that in the future such large-scale gains in reducing grade crossing delay will be more difficult to achieve, especially as freight rail traffic increases.

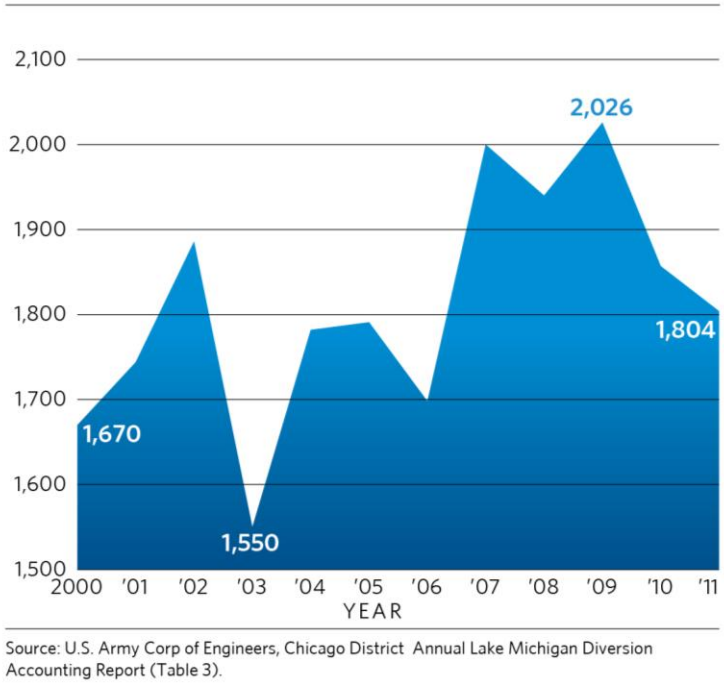
14. Appendix A: Secondary Kindred Indicators

This appendix highlights a set of secondary kindred indicators that will supplement the information provided by the plan performance measures. It is envisioned that the kindred indicators may be used in the narrative of the plan update and in the annual GO TO 2040 Moving Forward implementation reports to tell a more complete story of progress, as well as address data gaps in the plan performance measures.

14.1 Manage and Conserve Water and Energy Resources

Lake Michigan Withdrawals

- Description: In addition to overall water demand, the diversion of water from Lake Michigan is an area of interest for the CMAP region. By a U.S. Supreme Court consent decree, the State of Illinois is allowed to divert water from Lake Michigan at a rate of no more than 2,068 million gallons per day on average.
- Data Source: The U.S. Army Corps of Engineers is responsible for the official accounting of water diverted from Lake Michigan.



Water Year	Lake Michigan Diversions (million gallons per day)
2001	1,744
2002	1,886
2003	1,550
2004	1,782
2005	1,791
2006	1,698
2007	2,000
2008	1,940
2009	2,026
2010	1,857
2011	1,804

Deep Bedrock Aquifer Withdrawals

- Description: In addition to reporting on the diversion of water from Lake Michigan, it will also be instructive to measure total annual groundwater withdrawals from

deep bedrock aquifers (Ancell Unit of bedrock and deeper) in the CMAP region (measured in millions of gallons per day [Mgd]). This will help provide a more complete assessment of water conservation in the region.

- Data Source: The Illinois State Water Survey (housed at the University of Illinois at Urbana-Champaign) is the source for this groundwater data.

Deep Bedrock Aquifer Withdrawals

Year	Withdrawals (Mgd)	Year	Withdrawals (Mgd)
1995	55.2	2004	76.0
1996	47.9	2005	83.1
1997	43.9	2006	79.9
1998	38.5	2007	77.8
1999	43.9	2008	78.5
2000	61.0	2009	65.1
2001	52.1	2010	70.7
2002	57.1	2011	68.0
2003	74.6	2012	61.1

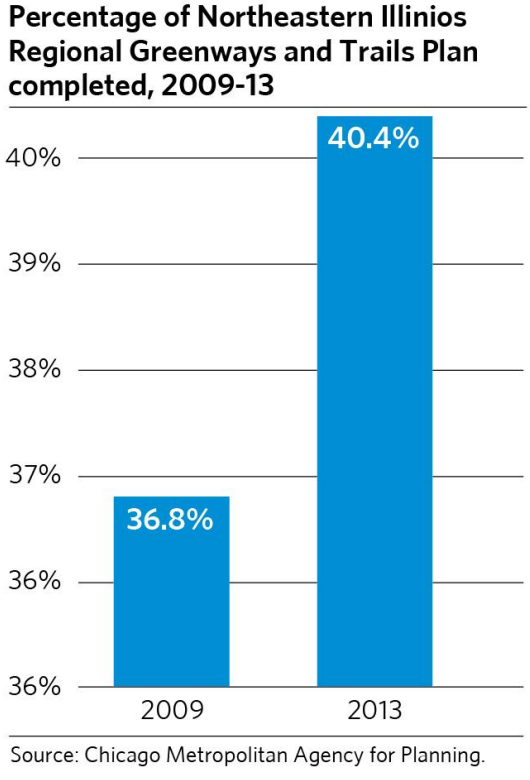
Source: Illinois State Water Survey.

14.2 Expand and Improve Parks and Open Space

Percentage of the Regional Trails Plan Completed

- Description: This indicator tracks the total miles of all trails in the Northeastern Illinois Regional Greenways and Trails Plan that are completed in the region. This is a broader measure of the trails available, as it includes on-street trails and key connector side paths and allows for analyzing trends in the entire planned trails system.

- Data Source: This information is maintained by CMAP staff in the Bicycle Information System.



14.3 Promote Sustainable Local Food

Farmers' Markets in the Region

- Description: This kindred indicator tracks the number of farmers' markets operating in the region annually; a similar value (for the State of Illinois) was included in the Moving Forward 2012 implementation report. Farmers' markets offer consumers farm-fresh, affordable, convenient, and healthy products such as fruits, vegetables, cheeses, herbs, fish, baked goods, and meat in their local communities and can fill an important role in offering fresh nutritious food to under-served areas.

- Data Source: The Illinois Department of Agriculture website maintains a list of the farmers' markets occurring throughout the state. The functionality includes the ability to search by county, so the number of farmers' markets occurring in the region can be determined.

Number of Farmers' Markets in the Region

	Total Number of Farmers' Markets	
	2012	**2013**
Cook County	99	102
DuPage County	17	17
Kane County	13	13
Kendall County	2	2
Lake County	19	19
McHenry County	5	7
Will County	10	13
CMAP Region	**165**	**173**

14.4 Support Economic Innovation

Technology Transfer

- Description: This indicator measures the technology transfer of university research into the private market through licensing revenue, number of university startups, and university patents. In other words, the commercialization of academic research. Information is provided at the state level; with some additional work it is possible to report this information for specific universities.
    - Two examples of how these data were represented in the August 2012 Innovation Index are shown in the following charts.
- Data Source: Data are from the Association of University Technology Managers. This is proprietary data that CMAP is able to access through the Illinois Innovation Index.

Technology Licenses and Options, Top U.S. States, 2007-10 (Fiscal Years)

	2007	2008	2009	2010
California	432	466	417	461
Florida	133	133	162	177
Illinois	130	138	11	142
Massachusetts	527	476	528	494
Minnesota	145	128	131	146
North Carolina	299	243	290	237
New York	230	253	242	278
Pennsylvania	185	217	221	279
Texas	291	312	296	296

Source: Illinois Innovation Network, Illinois Innovation Index, August 2012.

Technology Transfer Activity in Chicago Region Universities

	Licenses	Invention Disclosures	Patents Issued	Startups Formed
2002	114	422	97	19
2003	124	452	132	8
2004	135	515	100	17
2005	72	526	107	13
2006	89	630	72	17
2007	95	652	108	18
2008	90	692	116	15
2009	74	617	98	11
2010	99	594	169	17
2011	143	638	180	32
2012	130	671	200	22

Source: Chicago Metropolitan Agency for Planning analysis of Association of University Technology Managers data.

Manufacturing Exports

- Description: This measure is based on CMAP's analysis of manufacturing data (as described in its drill-down report). The use of this indicator ties in with GO TO 2040's call for organizing the region around its clusters of specialization. Historically, manufacturing has been a key driver of economic growth in the region.
    - The geography for this data is the unique Chicago Customs District comprised of: Chicago (including Waukegan Harbor, Calumet Harbor, and Chicago River to Lockport); Peoria; Gary, IN (including Michigan City Harbor); Davenport, IA; Rock Island and Moline, IL; Greater Rockford Airport; Waukegan Regional Airport; Chicago Executive Airport (formerly Palwaukee); and Decatur User Fee Airport (Decatur, IL).

- Data Source: The data from USA Trade Online includes all goods exported by the region. Data specifically for manufactured goods can be obtained by summing the total of all manufacturing NAICS codes (31-33). The data are updated monthly, but annual data are updated in June.

Exports from Nation's Three Largest Metropolitan Regions

	2010 Exports in Million Dollars		
	Chicago	Los Angeles	New York
Machinery	$10,886.92	$13,613.85	$3,583.82
Health Science	$3,448.17	$5,159.21	$10,584.14
Chemicals, Plastics	$4,794.02	$4,855.66	$5,691.86
Primary Metals, Minerals	$6,626.35	$5,651.91	$1,629.86
Computer, Electronics	$2,399.11	$9,715.77	$2,577.84
Food, Beverage	$1,999.26	$1,641.56	$1,782.96
Fabricated Materials	$1,696.71	$1,545.49	$829.83
Paper, Printing	$1,032.83	$861.51	$1,113.10
Other	$1,286.30	$3,037.71	$2,299.70

Source: Chicago Metropolitan Agency for Planning, Manufacturing Cluster Drill-Down Report, 2013.

Chicago Manufacturing Exports

Chicago Manufacturing Exports Value ($ Billions)	
2002	22.67
2003	24.29
2004	28.87
2005	31.76
2006	33.04
2007	34.02
2008	34.63
2009	30.09
2010	33.68
2011	32.93
2012	32.86
2013	33.79

Source: U.S. Census Bureau

14.5 Invest Strategically in Transportation

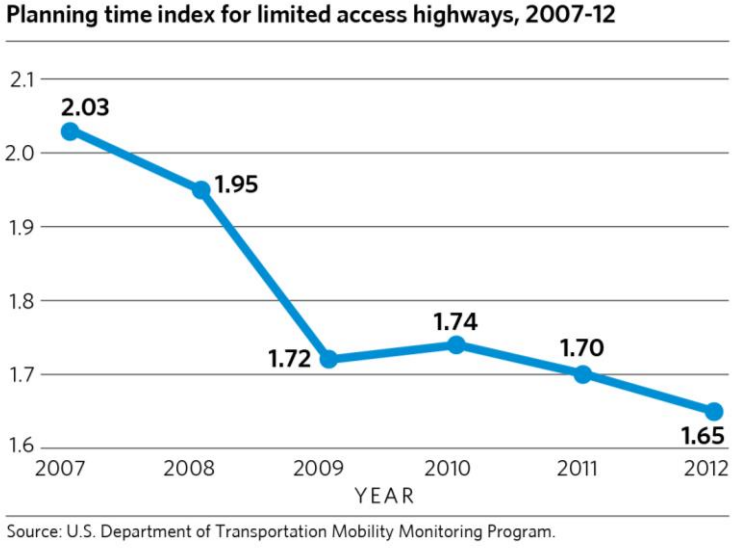
Condition Rating Survey

- Description: In addition to IRI scores, IDOT collects Condition Rating Survey (CRS) data for the state highway system. While the IRI value measures ride quality, the CRS values are a measure of overall pavement distress conditions, which is likely a more accurate measure of maintenance needs. The following categories are used to define pavement condition based on the CRS scores:

        - Excellent (CRS score 7.6-9.0): low distress
        - Good (CRS score 6.1-7.5): not in immediate need of improvement
        - Fair (CRS score 4.6-6.0): will likely need improvement in the short term
        - Poor (CRS score 1.0-4.5): generally in need of improvement
    - Additional documentation to the CRS can be found in the FY13 Condition Rating Survey Summary Report.
- Data Source: Along with the ride quality information, IDOT collects pavement distress conditions. Data are available in the long version of the Illinois Roadway Information System, available only by special request.

Planning Time Index for Limited Access Highways

- Description: The Planning Time Index is a measure of travel time reliability. It is calculated as the ratio of the total time needed to ensure a 95 percent on-time arrival compared to the free-flow travel time. Measuring system reliability is an important component of understanding congestion, as it addresses the non-recurring causes of congestion. The Planning Time Index is a key metric included in the U.S. DOT's Mobility Monitoring program.
- Data Source: Data for this indicator are developed using the same roadway sensor information used to calculate the proposed "Average Congested Hours of Weekday Travel for Limited Access Highways" measure.



14.6 Increase Commitment to Public Transportation

Average Weekday Unlinked Transit Trips per Capita

- Description: Unlinked transit trips per capita can be used to illustrate whether transit mode share is actually increasing. For instance, if population growth outpaces the increase in transit trips, the region is still losing ground in terms of shifting trips to transit. Note that the regional population includes people living in CMAP's seven-county area, while the RTA service area does not include Kendall County.

- Data Source: Transit data are from the National Transit Database. Population data are from the U.S. Census Bureau.

Average Weekday Unlinked Transit Trips per Capita

Year	Weekday Transit Trips per Capita
2002	0.237
2003	0.231
2004	0.229
2005	0.237
2006	0.241
2007	0.241
2008	0.250
2009	0.242
2010	0.238
2011	0.244
2012	0.249

Sources: National Transit Database and U.S. Census Bureau.

15. Appendix B: Government Transparency Documentation

The following pages provide documentation of the Government Transparency Index category ratings for each of the seven county websites, which were reviewed during August-September 2013.

Cook County	
Government Officials & Staff Directory (*Is there a link to contact info for county staff & government officials with pictures of major officials?*) Users can get information about the **County Board** from the "Cook County Leadership" link in the "The Board" drop down menu on the main banner of the home page.	3
Online resources for access to open meetings & records (I*s there a link to a "calendar" or "upcoming meetings" or something with information about the meetings?*) On the lower right side of the home page is a "Media Center" panel with interchangeable displays. User can select the "Event Calendar" button to get a schedule of upcoming events.	3
Document Library i.e. An area for frequently requested records and forms (*Is there a central location where a user could access most of the websites relevant documents and forms?*) The **Open Data** website has a "Files and Documents" filter with about 28 objects; however it has not been updated recently.	1
Ways to file record request online (*Is there a clear link to file a FOIA request?*) The top four results of a search for "FOIA" are located on different cook county websites: **The Office of the President**, **Cook County FOIA**, **Cook County Treasurer**, and **The Cook County Clerk**.	1
Access to budget & Financial information (*Is there access budget and financial information?*) Within the "More Cook County Websites" drop-down menu on the main banner is link to the **Cook County Budget** website. Additionally, within the "Finance & Administration" drop-down menu is a link to the "**Bureau of Finance**" which has the 2012 financial report on its home page and other links along the right-side of the page.	3
Archives of meetings, ordinances, votes (*Are there archives of meeting minutes, ordinances, and/or votes?*) Within the "The Board" drop-down menu on the main banner there are links to Cook County Legislation and Cook County Ordinances. The Ordinance drop-down menu leads to the **Cook County Code of Ordinances** page. The Legislation link leads to the Cook County **Legislative Reference Service** which allows users to search for legislation and ordinances from **Cook County**, **Forest Preserve District**, **Cook County Code of Ordinances**, and **Forest Preserve District Code of Ordinances**.	3
Links to public notices (*Is there an "alerts," "notices," and/or "updates" section with relevant information to the public?*) At the bottom of the home page is "County News" section as well as feed of tweets from board President Toni Preckwinkle.	3

Access to e-government applications (*Are there links with clear information about/forms to pay fines, pay taxes, pay bills, and/or register to vote?*) On the home page there are "Apply or Register" and "Pay" buttons. The "**Apply or Register**" page contains a number of links do different applications and forms. The link to "**Elections**" goes to the County Clerk website's election portal. It takes some more navigation to get to the online **Voter Registration** portal, which is located within the Illinois State Board of Elections webpage. The "**Pay**" page also has a number of links to places where users can pay for: **Building Permits**, **Adoption & Child Advocacy**, and **Business License.** There is also a link the Cook County **Property Tax Portal** which has contains a link to **Pay Property Taxes** online. ▪ A bonus was given because users could perform these functions online.	3*
Public procurements (bids or RFPS) (*Is there information regarding doing business with county government, open requests for proposals, and past RFPs*?) The secondary banner contains a "Business & Lobby Center" link. Within the "**Business & Lobby Center**" users can select the "**Browse Cook County Contracts**" button to see granted contracts. The "Doing Business with Cook County" button takes users to the **Chief Procurement Officer's** website where there are links to **Procurement Opportunity.** ▪ A bonus was given because the **Browse Cook County Contracts** is a searchable dataset that users can filter and manage. It has records of contracts going as far back as 2003.	3*
Maps and Data (*Are there interactive maps and/or supporting data?*) The secondary banner contains a "More Cook County Websites" drop-down menu with a link to the "**Open Data Portal**." There is a menu on the left side, titled "View Types." Here users can view maps of different information with Cook County. The data portal contains **datasets**, **charts**, **maps**, and more. All of which is exportable. ▪ A bonus was given because datasets can be exported as .csv, .xls, .pdf and other formats.	4*
Average Score:	**2.7**

Note: For this assessment the http://home.cookcountyil.gov/ website was designated as the homepage.

DuPage County	
Government Officials & Staff Directory (*Is there a link to contact info about government officials with pictures of major officials?*) Along the banner there are a series of drop down menus. There are **County Board** and **Elected Officials** drop down menus. One can click on the menu title or you can select specific individuals within the menu. It is very easy to access information about these officials. ▪ A bonus was given because more personalized contact and background information was given for elected county board members. There are even links to election information for each elected official. Example: **Paul Fitchner** and his **election information.**	4*
Online resources for access to open meetings & records (*Is there a link to a "calendar" or "upcoming meetings" or something with information about the meetings?*) There are multiple ways to access information about meetings; these link to one of 3 pages: the **Calendar**, County Board Committees' **Agendas & Minutes**, and the **Meeting Portal.** ▪ A bonus was given because meeting agenda and supporting documents were available in advance of the meeting. Additionally, the committees section provides users with **committee information.**	4*
Document Library i.e. An area for frequently requested records and forms (*Is there a central location where a user could access most of the websites relevant documents and forms?*) There is not a central location where one can access all/most documents. When the word "documents" is searched the best result is the **Online Forms** section within the "**Services**" drop-down menu.	1
Ways to file record request (*Is there a clear link to file a FOIA request?*) There are multiple ways to locate information about FOIA requests. In the lower banner of the website there is a link for **FOIA Requests**. Within the Elected Officials drop-down menu there are links to FOIA information for: **County Clerk**, **Auditor**, **Coroner**, **Treasurer**, **Circuit Court Clerk**, & **Recorder**. Within the County board drop down menu there is a link to **FOIA for County Board**. Within the "I Want To…" drop-down menu there is a link to Request **FOIA/Public Records**.	3
Access to budget & Financial data (*Is there access budget and financial data?*) The **Financial & Budget Reports** link on the "Quick Links" left-side panel of the home page takes users to budget reports and other information from the Finance department.	3
Archives of ordinances and votes; of minutes, video and/or audio records (*Are there archives of meeting minutes, ordinances, and/or votes?*) There are multiple ways to access meeting archives. From the **Calendar** link users can select an event on the calendar. Within these pages users can select links to meeting **agenda& minutes.** The "Watch Meetings" link on the "Quick Links" left-side panel of the home page takes users to the **Meeting Portal**. Within, this site one can see supporting documents for **past meetings**. ▪ A bonus was given because within the **Meeting Portal** there is a complete **video archive** of county meeting proceedings.	4*
Links to public notices (*Is there an "alerts," "notices," and/or "updates" section with relevant information to the public?*) On the home page, there is a "**News**" link. Currently there is also a "**West Nile Virus**" panel indicating risk level recommendations for fighting West Nile Virus. There is also a rotating banner in the middle of the home screen with various links to information for users.	3

Access to e-government applications (*Are there links with clear information about/forms to pay fines, pay taxes, pay bills, and/or register to vote?*) From the "I Want To" drop-down menu there is a "Pay" section with information about paying: highway permits, OW/OD permits, court fees, property/real estate taxes, special road & trail permits, and traffic tickets ▪ A bonus was given because users are able to pay **taxes**, **traffic tickets** and some **permit fees** online.	4*
Public procurements (bids or RFPS) (*Is there information regarding doing business with county government, open requests for proposals, and past RFPs?*) Within the "Quick Links" left-side panel there is a link to "Doing Business with DuPage" which leads to the **Procurement page**, this contains information for companies attempting to do business with the county. There is also a link to the **Bids and RFPs** website. This website can also be accessed from the "**I Want To**" drop down menu within the "Find" section. ▪ A bonus was given because there was a sortable **RFP database.**	4*
Maps and Data (*Are there interactive maps and/or supporting data?*) From the "I Want To" drop-down menu there is a "Find" section with a link to Online "**Maps and Data**." This link leads to an interactive map of DuPage County. Users can manipulate the map and export a PDF copy of the map. ▪ A bonus was given because users export a PDF report of the information the map displays.	4*
Average Score:	**3.4**

Kane County	
Government Officials & Staff Directory (*Is there a link to contact info for county staff & government officials with pictures of major officials?*) Along the main banner, there is a "**Government**" link. This leads to a page with an organizational chart of Kane County offices and departments (each contains a link to the Department). Along the left side of this section is a link to "**County Board Members**" which has links and contact information for all board members. ▪ A bonus was given because some members provided office, home and cell phone numbers.	3*
Online resources for access to open meetings & records (I*s there a link to a "calendar" or "upcoming meetings" or something with information about the meetings?*) On the home page there is "Current Calendar Events" panel with links to upcoming County meetings. Along the main banner, there is a "**Calendar**" link. On this page are sections for events within the "Next 7 Days," "Next 30 Days," and "Cancelled & Rescheduled for Next 30 Days." ▪ A bonus was given because the events lead to links with downloadable Agenda packets for the nearest meetings. (**Example** the Sept 26th, 2013 KANECOMM Committee meeting.)	4*
Document Library i.e. An area for frequently requested records and forms (*Is there a central location where a user could access most of the websites relevant documents and forms?*) At the bottom of the pages within the Kane County website is a link to the county's **Document Library.** Another way to access the data library is from the "**Government**" link on the main banner. Along the left-side of this page is a link to the "**Document Library.**"	3
Ways to file record request online (*Is there a clear link to file a FOIA request?*) At the bottom of the pages within the Kane County website is a link to an "**FOIA**" page. This page has information about the FOIA process as well as contact information for the FOIA Officers for each department and elected official. ▪ A bonus was given because there is **Request Form PDF** that users can fill out online and either print or attach to an email.	4*
Access to budget & Financial information (*Is there access budget and financial information?*) Under the Featured Links panel on the home page, "2013 Adopted Budget" and "Your Tax Dollars" links. The budget link leads to a PDF of the **2013 Budget**. "Your Tax Dollars" leads to the Kane County **Finance Department.** This page has expandable menus with information including Annual Financial Reports, County Budgets back to 2006, and Wage and Salary Reports.	3
Archives of meetings, ordinances, votes (*Are there archives of meeting minutes, ordinances, and/or votes?*) Under the Featured Links panel on the home page, is a link to "**Agendas & Meeting Minutes**." This page contains links to different active committees. There's also an option to show inactive committees as well. Within these Committee page users can view PDF copies of agendas and meetings minutes. (**Example:** the Agriculture Committee).	2

Links to public notices (*Is there an "alerts," "notices," and/or "updates" section with relevant information to the public?*) Along the bottom of the home page is banner with links to different alerts, including: **Emergency Alerts**, **Health Alerts**, **Traffic Advisories**, **Road Closures**, and **CodeRED** (an emergency telephone alert system)	3
Access to e-government applications (*Are there links with clear information about/forms to pay fines, pay taxes, pay bills, and/or register to vote?*) On the main banner of the home page is a link to "**A-Z Service**." Within the section users should select the "**UVWXYZ**" link. On this page users can locate "Voter Registration." This link will take them to the Kane County **Clerk's website**. Here they will find information about registering to vote. There is "**Real Estate Tax Information**" link; however this does not provide information about paying taxes.	1
Public procurements (bids or RFPS) (*Is there information regarding doing business with county government, open requests for proposals, and past RFPs*?) Under the Featured Links panel on the home page, is a link to "**County Bids.**" On this page users can see information such as "Bids & RFPs" and "Results of Bids & Proposals."	3
Maps and Data (*Are there interactive maps and/or supporting data?*) On the main banner of the home page is a link to "**Maps**." This page has links to different county maps, including an **Interactive GIS Online Map.** Users can print or download a PDF version of their map.	2
Average Score:	**2.8**

Kendall County	
Government Officials & Staff Directory (*Is there a link to contact info for county staff & government officials with pictures of major officials?*) From the "County Board" drop-down menu, users can access information about the county board. Just click the "**County Board**" drop-down menu takes users to a page with contact information about each board member. ▪ A bonus was given because more personalized contact and background information was given for elected county board members. **Example.**	4*
Online resources for access to open meetings & records (I*s there a link to a "calendar" or "upcoming meetings" or something with information about the meetings?*) There is a **Calendar** link on the drop-down menu. On this page users can select meetings which contain links providing further details such as time and location.	3
Document Library i.e. An area for frequently requested records and forms (*Is there a central location where a user could access most of the websites relevant documents and forms?*) There is not a data library. The closest thing is the "**Kendall County Transparency**" page, which can be accessed from a link at the very top, right corner of the website.	1
Ways to file record request online (*Is there a clear link to file a FOIA request?*) From the drop-down menu users can either select a department-specific FOIA information or just click the "**FOIA**" menu and view the same options with more information about the departments. This allows users to consider which departments would have the information they desire.	3
Access to budget & Financial information (*Is there access budget and financial information?*) Along the left-side panel of the home page users can select the "**Financial Reports**" link where users can choose from links to **Audits**, **Fiscal Budgets**, & **Monthly Fund Balances**. Also under the Quick Links panel, users can select the "2013 Annual Fiscal Budget" which opens a PDF copy of the **2012-2013 Budget**.	3
Archives of meetings, ordinances, votes (*Are there archives of meeting minutes, ordinances, and/or votes?*) From the County board drop down menu users can select the "**Meeting Information**" link. This provides a set of links to all of Kendall County's committees with agendas, packets, and minutes. Under the Quick Links panel is a link to "**Kendall County Ordinances**" where users can view PDF copies of ordinances dating back to 2007.	3
Links to public notices (*Is there an "alerts," "notices," and/or "updates" section with relevant information to the public?*) On the right-side of home page is an "**Alerts**" link. Additionally, there is a "News" panel along the center of the home page.	3
Access to e-government applications (*Are there links with clear information about/forms to pay fines, pay taxes, pay bills, and/or register to vote?*) Beneath the "Quick Links" panel on the left-side of the home page is a link to "**Pay Traffic /Court Case**." ▪ A bonus was given because users can pay traffic tickets (that don't require a court appearance) and court fees online.	4*

Public procurements (bids or RFPS) (*Is there information regarding doing business with county government, open requests for proposals, and past RFPs*?) There is an "**RFP, RFQ, Call for Bids**" link on the left-side panel of the home page where current RFPs and call for bids or displayed.	3
Maps and Data (*Are there interactive maps and/or supporting data?*) From the "County Offices" drop-down menu users can select "**Geographic Information Systems**." Along the left side of this page is "GIS Links" menu from which users can select "**Interactive maps**" which leads them to menu of four interactive maps. Users can print the maps that they work on.	2
Average Score:	**2.9**

Lake County	
Government Officials & Staff Directory (*Is there a link to contact info for county staff & government officials with pictures of major officials?*) From the "County Government" drop down menu users can select the "County Board" link. From the **County Board** users can select the "**County Board Members**" page. Within this one can select a board member to receive contact and background information.	2
Online resources for access to open meetings & records (I*s there a link to a "calendar" or "upcoming meetings" or something with information about the meetings?*) On the right-side panel of the home page, users can select the "**Public Meeting Info/Legislation**" link. From This page, users can select the **Meetings** tab which gives users time and location for upcoming meetings. ▪ A bonus was given because downloadable meeting details and agendas are available as the dates get closer. Additionally, there is a link on the homepage to "**Watch LCTV**" where users can watch live broadcast from the local access channel.	4*
Document Library i.e. An area for frequently requested records and forms (*Is there a central location where a user could access most of the websites relevant documents and forms?*) There is not a document library; the closest thing is the **Legislation** tab within the "Public Meeting Info/Legislation."	1
Ways to file record request online (*Is there a clear link to file a FOIA request?*) There is link on the right-side panel to "**Freedom of Info Act (FOIA)**." **This page** has information about the process of submitting and FOIA request. There is no way to file a record request online.	3
Access to budget & Financial information (*Is there access budget and financial information?*) From the right-side panel there is "**Budget**" link. **This page** contains the 2013 budget. Along the left-side panel, there are also links to **Monthly Expense Reports** & **Budget Documents**.	3
Archives of meetings, ordinances, votes (*Are there archives of meeting minutes, ordinances, and/or votes?*) On the right-side panel of the home page, users can select the "**Public Meeting Info/Legislation**" link. From this page, users can select the **Meetings** tab which gives meeting details, agendas, and minute for most meetings dating back to June 2008. ▪ A bonus was given because some archived board meetings also had video records. These videos can be accessed from the "Public Meeting Info/Legislation" link. Additionally, from the "I Want To..." drop-down menu within the "Watch" section, users can select **Board Meetings** to watch archives of monthly board meetings. Users can export excel, word, and PDF copies of **Legislation**.	4*
Links to public notices (*Is there an "alerts," "notices," and/or "updates" section with relevant information to the public?*) Along the left-side of the home page there is link to "**Alert Lake County.**" This can also be accessed from the "I Want To…" drop-down menu in the "Check" section. The majority of the home page is occupied with Lake county news updates, with link at the bottom of the page to the **County News** page.	3

Access to e-government applications (*Are there links with clear information about/forms to pay fines, pay taxes, pay bills, and/or register to vote?*) From the "I Want To…" drop-down menu in the "Pay" section, users can choose **Fees**, **Property Taxes**, & **Water/Sewer Bills** ▪ A bonus was given had clearly accessible online access to these functions on the home screen and/or users were able to pay **property taxes** & **water/sewer bills** online.	4*
Public procurements (bids or RFPS) (*Is there information regarding doing business with county government, open requests for proposals, and past RFPs*?) There are two ways from the home page to access information about bids and RFPS. From the "I Want To…" drop-down menu in the "Find" section users can select "Bids" which takes them to a page of **sortable bids and RFPs.** From the right-side panel there is a link for "**Doing Business with Lake County**." from this page users can select "Invitation for Bids" or "Requests for Proposals" which lead to the same **sortable bids and RFPs.** ▪ A bonus was given because the Bids and RFPS could be sorted by their current status.	4*
Maps and Data (*Are there interactive and printable maps and/or supporting data?*) On the right-side panel of the home page, users can select the "**Maps Online**" link. From this page users can choose from four maps. The primary "**Maps Online Map**" also allows users to print and share maps that they manipulate.	3
Average Score:	**3.1**

McHenry County	
Government Officials & Staff Directory (*Is there a link to contact info for county staff & government officials with pictures of major officials?*) From a drop-down menu that is present on most pages within the website users can access the **County Board** & **Department Staff** pages with contact information. ▪ A bonus was given because more personalized contact and background information was given for elected county board members. **Example.**	4*
Online resources for access to open meetings & records (I*s there a link to a "calendar" or "upcoming meetings" or something with information about the meetings?*) From the homepage there are a number of ways to get to the **County Meetings** & **Monthly Calendar** pages. There are clear links above the drop-down menu and search bar. Within the County Government drop-down menu there is a section for "County Meetings." ▪ A bonus was given because meeting agendas and supporting documents were available in advance of the meeting.	4*
Document Library i.e. An area for frequently requested records and forms (*Is there a central location where a user could access most of the websites relevant documents and forms?*) There is a **Document Library** which can be found on the county board page. There is a link from the "County Government" drop-down menu to "**Meet Your County Board Members**," but the average user might not realize that this section is actually a subsection of the "**County Board**" section of the website.	1
Ways to file record request online (*Is there a clear link to file a FOIA request?*) From the County Government drop-down menu there is a link to **FOIA Requests.** This section has FOIA forms, possible sources of information within the website, fee information, and departments' FOIA Officers' contact information.	3
Access to budget & Financial information (*Is there access budget and financial information?*) Located between the dropdown menu and the search bar is small white drop down menu labeled "Connect Me To…" From this users can access pages for: **Bids & RFPs,** the **County Budget** & **Financial Reports**, **E-news Archives** & **Subscriptions**, **FOIA Request**, and more.	3
Archives of meetings, ordinances, votes (*Are there archives of meeting minutes, ordinances, and/or votes?*) Within the **County Meetings** (*ref. criteria 2)* site there is a complete archive of **past meetings**, supporting documents, minute from proceedings. ▪ A bonus was given because within the **County Meetings** site there is a complete **video archive** of county meeting proceedings.	4*
Links to public notices (*Is there an "alerts," "notices," and/or "updates" section with relevant information to the public?*) On the **home page** there is prominent **Latest News** section and an **Upcoming Events** section just underneath. Additionally, there is currently a bright red alert at the very top of every page alerting users that they can make **flu shot appointments** through the health department.	3

Access to e-government applications (*Are there links with clear information about/forms to pay fines, pay taxes, pay bills, and/or register to vote?*) From the "How Do I…" drop-down menu there is link to "**Pay…**" This page has links to post bond, pay child support, liquor license, property tax, and traffic tickets. Additionally, within the "Services" drop-down menu there is a section for **Online Services**. This page provides links to a number of the resources available through the website. The FAQs page, a link is visible on the home page.	3
Public procurements (bids or RFPS) (*Is there information regarding doing business with county government, open requests for proposals, and past RFPs*?) Located between the dropdown menu and the search bar is small, white drop down menu labeled "Connect Me To…." From this users can access pages for: **Bids & RFPs**, the **County Budget** & **Financial Reports**, **E-news Archives** & **Subscriptions**, **FOIA Request**, and more.	3
Maps and Data (*Are there interactive and printable maps and/or supporting data?*) From the "County Government" drop-down menu users can select "**Maps – Aerial (GIS)**." This takes users directly to McHenry County's interactive map where users can manipulate and print maps that they work on. ▪ A bonus was given because users can export .csv files of parcel information that they look up.	4*
Average Score:	**3.2**

Will County	
Government Officials & Staff Directory (*Is there a link to contact info for county staff & government officials with pictures of major officials?*) On the drop down mention there is an "Elected Officials" and a "Department Directory" drop-down menu. Clicking these menus takes user to contact information for **County Elected Officials** and a **Department Directory**, respectively.	3
Online resources for access to open meetings & records (I*s there a link to a "calendar" or "upcoming meetings" or something with information about the meetings?*) There is an "Upcoming Meeting & Events" panel on the home page. On the bottom of this panel is a link to a more **complete calendar** with information about meetings.	3
Document Library i.e. An area for frequently requested records and forms (*Is there a central location where a user could access most of the websites relevant documents and forms?*) There is not a document library. There is a **Frequently Requested Forms** section with four forms: Liquor Ordinance, Application for Raffle License, Solicitor Application, and FOIA Request Form.	1
Ways to file record request online (*Is there a clear link to file a FOIA request?*) On the right side, just below the red banner, drop-down menu on the home page, is another drop-down menu. From this menu, users can select Freedom of Information Act (FOIA) Request. This takes users to a **PDF** with information about FOIA request in Will County.	3
Access to budget & Financial information (*Is there access budget and financial information?*) There are multiple ways to access Will County budget and financial information. From the "Department Directory" drop-down menu, users can select the **Finance Department** link. On this page are links to final approved, budgets, annual financial reports, and audits. From the "Elected Officials" drop-down menu, within the "**County Executive**" section users can find links to county budgets back to 2010.	3
Archives of meetings, ordinances, votes (*Are there archives of meeting minutes, ordinances, and/or votes?*) From the "Links" drop-down menu users can select the "**County Board Minutes**" link.	3
Links to public notices (*Is there an "alerts," "notices," and/or "updates" section with relevant information to the public?*) There is a "Will County News & Services Panel" and an "Informational Links" panels on the right side of the home page. They contain links to news (Information about **Cooling Centers** during the summer), information (the new **RTA Reduced Fare** program), and updates (**Election Results**) for Will County.	3
Access to e-government applications (*Are there links with clear information about/forms to pay fines, pay taxes, pay bills, and/or register to vote?*) From the "Property Tax Bill Information" link within the "Taxes" drop-down menu on the home page users are taken to the **County Treasurer**'s page. From this home page users can select links to view their Tax Bill or use the "I Need To…" drop down menu to pay **Property**, This drop-down menu also has link to information about paying **Back** and **Forfeited** taxes. User can select the Will County Clerk Link from the "County News & Services" panel or from the "Elected Officials" drop-down menu. It's from the **County Clerk**'s website that users	2

can get election information such as **Results** and **Voter Registration**.	
Public procurements (bids or RFPS) (*Is there information regarding doing business with county government, open requests for proposals, and past RFPs*?) From the "Links" drop-down menu users can select links from within the Invitations to Bid section. These links include **Current Bids** and past warded bids all the way back to **2008.** ▪ This received a bonus for including a link to a sortable database of **Will County Government Bids.**	4*
Maps and Data (*Are there interactive maps and/or supporting data?*) From the "Department Directory" drop-down menu users can select "**GIS Department**." From the GIS Home page users can select "**WISARD**" to access the Will Interactive Spatial Application and Resource Depiction home page, Will County's interactive map. On this page users can select a **link to access WISARD.** From this page they can launch the **WISARD** application. Users can print PDF versions of their maps.	1
Average Score:	**2.6**

16. Appendix C: Access to Transit Documentation

In anticipation of the GO TO 2040 plan update, CMAP staff developed a new method of measuring transit accessibility as a means of determining the percentage of regional population and jobs with access to transit, one of the plan's indicators for measuring the progress of plan implementation. This document describes the methodology used to develop this measure and presents analysis results.

16.1 Measure Description

The transit accessibility metric included in GO TO 2040 is derived from a simple spatial analysis that relies on fixed buffers around bus stops and train stations (one-quarter mile and one-half mile, respectively) to define the accessible area. The land area ratio of buffered area divided by total area is then applied to the total population and jobs values for each Trip Generation zone (commonly referred to as subzones) to determine the final "accessible" values. This metric ostensibly measures the number of people who live and work within walking distance of fixed-route transit service, based on the underlying assumption that both population and jobs are uniformly distributed within the subzones. While this spatial buffering offers an easily-understood "back-of-the-envelope" estimate of transit access, mere proximity to transit is too simplistic a way to measure accessibility. Further, it says nothing about the transit service itself or about the variations in level of service offered throughout the region.

To measure the percentage of population and jobs in the region with access to transit as a means of tracking plan implementation progress, a new metric was developed – the Access to Transit Index. For a specific area, this index is intended to measure the relative level of access residents have to the transit system regardless of mode. The intent of this new index is to provide a more complete measure of how residents view access to transit by including multiple factors that contribute to one's perception of transit accessibility, while maintaining a metric that is still easily comprehended. The new index value is calculated from four component factors:

- Weekly frequency of transit service.
- Activities that can be reached via a single direct transit route.
- Proximity to a transit stop or station measured over the network.
- Pedestrian friendliness of the surrounding area.

The Access to Transit Index is a uniform measure of transit level of service available during an average week. It permits the tracking of changes in transit level of service over time and presents the results in an intuitive fashion. It also offers a universal comparison of the different service levels offered across the region. The inherent loss of some of the nuances in localized service is balanced against the ability of the index to provide a relatively simple way to compare transit service over a large area over time. This index also adheres to a number of tenets CMAP staff used in developing a revised set of performance measures for the GO TO 2040 plan update:

principally that the indicator use actual observed data rather than modeled values, that it is widely comprehensible and that the data are updated with sufficient frequency for the index to serve as a reasonable benchmark for measuring progress.

The index is not intended to measure the connectivity of the transit system as a whole, or the access to the region that the transit system provides. The index is not intended to reflect the actual transit service conditions one may encounter on a specific transit trip. It is also not intended as a means to evaluate the performance of the various transit operators nor is it a suitable tool for such an evaluation.

16.2 Data Description

Transit service for the region is analyzed using information provided in General Transit Feed Specification (GTFS) files. These are files developed and distributed by the transit operators themselves and use a standard format to provide route and schedule information to automated trip planning applications such as Google Transit. This measure analyzes transit data for the four major operators in the region: the Chicago Transit Authority, Metra, Pace and the Northern Indiana Commuter Transportation District. This metric analyzes fixed-route transit service only – meaning service along a prescribed route that operates on a fixed schedule. It does not include demand-responsive transit service or paratransit. The analysis also excludes seasonal and event-specific transit service that does not operate throughout the entire year. Examples of this type of service include express buses serving events at locations such as the United Center, Soldier Field, Wrigley Field, U.S. Cellular Field and Toyota Park, among others.

For this analysis, transit service attributes are summed at the subzone-level geography for the seven-county region. Subzones are quarter-section sized geographies that CMAP uses for household and employment forecasting; generally they are ½ mile by ½ mile square throughout the region. Subzones in the Chicago Central Business District (CBD) are generally ¼ mile by ¼ mile square due to the densities of activities and the street network in that area. For the transit accessibility analysis, buffers around the subzones were used to identify a reasonable transit service area. This was done to reflect that fact that transit stops located within a close distance of the subzone boundaries may be an acceptable choice to residents of the subzone. Due to their small size and the density of transit stops available, subzones in the CBD were buffered by a distance of 0.1 miles (equivalent to one Chicago city block). All other subzones were buffered by a distance of 0.25 miles, representing a distance that could be traversed by walking within a five-minute period, assuming a pace of three miles per hour.

Consolidation of bus stops into generalized locations

This analysis uses generalized bus stop locations representing composite levels of transit service. The GTFS files include information on the spatial location of every bus stop in the region, thus stops serving the opposite direction runs of the same bus route are physically located on different sides of the same street. Therefore, when service frequency values are attached to bus stops, it represents half of the service provided by the route because it only measures one direction. In order to place all stops (regardless of mode) on equal footing, a

method was employed to consolidate each pair of single-direction stops on every bus route into one physical location that represents the combined service of both directions. The underlying concept is that a passenger would perceive the bus stop pair as a single destination, regardless of which side of the street the stop was on. This concept was taken to the next level at intersections, where all stops at an intersection were consolidated into one location, based on the notion that travelers view an intersection containing multiple stops as one general location. During the stop consolidation process, the data integrity of each individual stop is maintained so that the individual attributes can be aggregated to the composite stop location and that the composite stop can be linked back to each of the individual stops that it represents. Figure 1 illustrates the process used to create generalized bus stop locations at an intersection.

Figure 1. Bus Stop Consolidation Process

The intersection of Ashland Avenue and 74th Street is serviced by two CTA bus routes: Route 9 which runs north-south on Ashland, and Route 75 which runs east-west on 74th. Each route has two stops located at the intersection: the blue triangles designate the stops for Route 9 and the red triangles identify the stops for Route 75.	
The initial round of processing collapses the directional stops of each specific bus route into one location that represents the intersection, as denoted by the blue and red squares to the right.	
A final round of processing combines all bus stops associated with this intersection into one location, as represented by the purple circle in the graphic to the right. The data integrity of all of the individual stops is maintained so that the composite stop location can be linked to each of the individual stops that it represents.	

The consolidated stops are used throughout the analysis process.

Access to Transit Components

Data files representing 2010 transit service were analyzed to develop a base year Access to Transit Index, consistent with the year GO TO 2040 was adopted. This information is presented in the body of this Indicators Appendix along with the description of this measure. Each of the four component factors was measured individually at the subzone level and an index value was assigned to each subzone. The overall accessibility index value is the average of the four factor

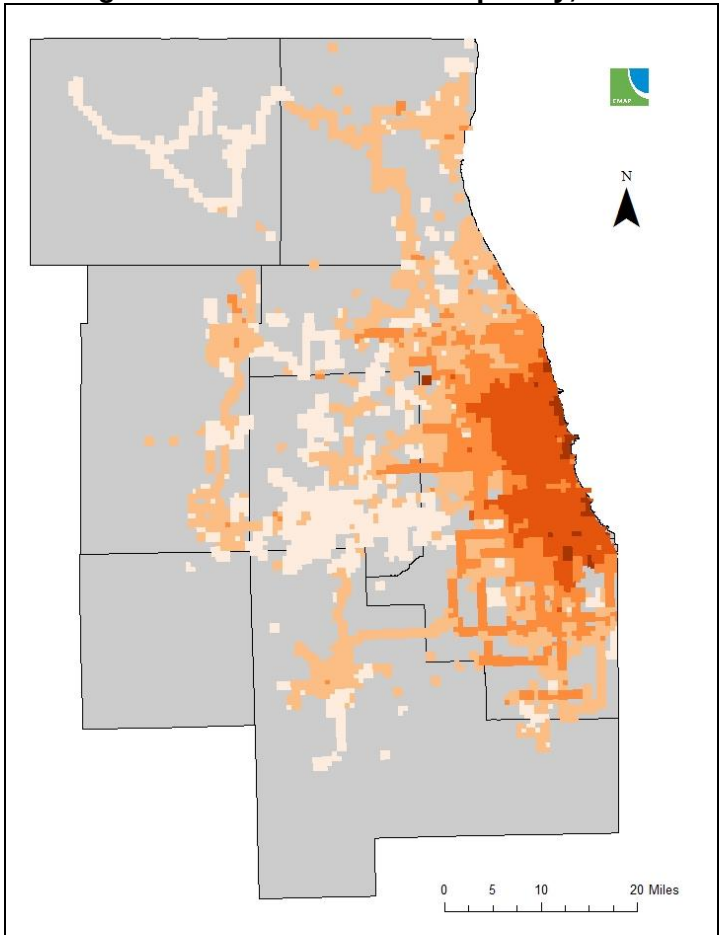
indices that were assigned to the subzone. The remainder of this section discusses the four component factors of the overall index.

Average weekly transit service frequency

The transit service frequency component of the index measures the average number of times a stop in the buffered subzone area is visited by a fixed-route transit service vehicle during one week. The service frequency at the consolidated stop locations is the aggregate total of the service frequencies of the individual stops that comprise it.

Figure 2 shows the transit service frequency component of the overall index. The analysis methodology places all subzones without transit into Category 0, so that credit for this measure is only given if transit service is offered in the subzone. The subzones with transit service are categorized based upon actual service levels using the following categories developed by the Regional Transportation Authority based on the types of services that are operated in the Chicago region and Chapter 5 Section 2 of the Transit Capacity and Quality of Service Manual (TCQSM) 3rd Edition:

Figure 2. Transit Service Frequency, 2010



Color Code	Index Value	Average transit stops per week	Subzone count
	0	No transit service in subzone	11,307
	1	Less than 100	1,475
	2	100 – 299.9	2,038
	3	300 – 999.9	946
	4	1,000 – 1,999.9	611
	5	2,000 and above	66

Source: Chicago Metropolitan Agency for Planning analysis.

- Category 1: Less than 100 stops per week – At the stop level, this generally represents infrequent commuter services in which passengers must consult transit schedules and adapt significantly to them. This service is operationally feasible in low density areas. Examples of this type of service include Pace routes 709 and 806.
- Category 2: 100 to 299.9 stops per week – At the stop level, this generally represents moderately frequent commuter services in which passengers must consult transit schedules and adapt somewhat to them. This service is operationally feasible in low

density areas. Examples of this type of service include Pace route 330 and Metra's Rock Island District service.

- Category 3: 300 to 999.9 stops per week – At the stop level, this generally represents frequent commuter services in which passengers will likely consult transit schedule and adapt somewhat. This service is operationally feasible in low-to-moderate density areas. Examples of this type of service include Metra's Burlington Northern service and CTA route 84.

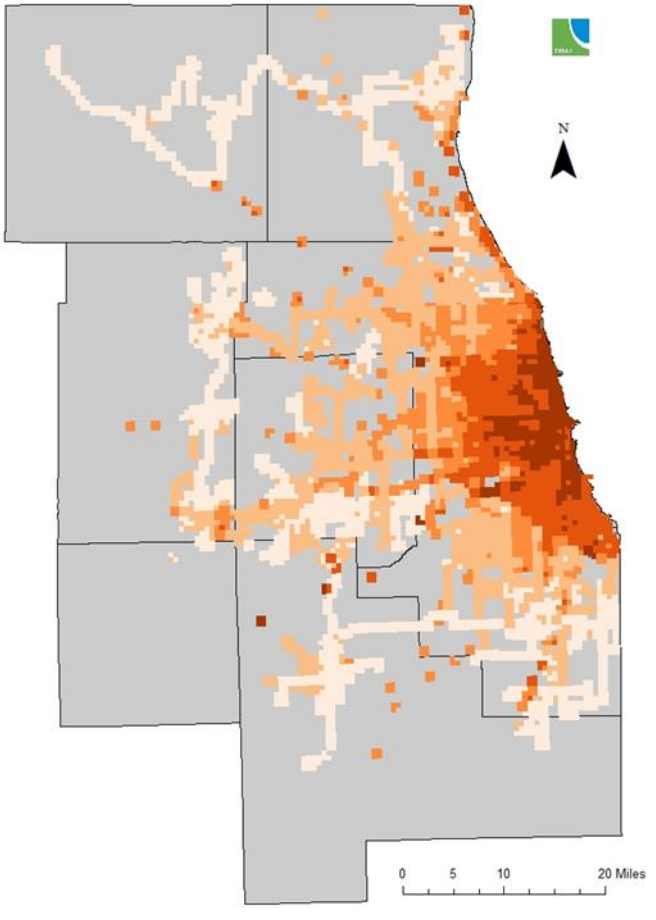
- Category 4: 1000 to 1999.9 stops per week – At the stop level, this generally represents relatively frequent urban service where it is not necessary to consult schedules due to the brief wait time for the next vehicle. This service is operationally feasible in moderately dense areas. Examples of this type of service include the CTA Orange Line and CTA route 9.

- Category 5: At least 2000 stops per week – At the stop level, this generally represents frequent urban service where passengers can wait without a schedule. This service is operationally feasible in high-density corridors.

Activities that can be reached via a single direct transit route

This component measures the relative value to individuals that transit service provides, measured in terms of the activities that can be reached from a subzone, using a single direct transit route. The assumption is that individuals deem a transit trip that reaches a destination without using a transfer as more accessible than one that does use a transfer. Activities are defined as the sum of the number of people residing in a subzone and the number of jobs located in a subzone. Reachable activities are calculated for each subzone by first finding all other subzones that can be reached from the buffered origin subzone using a single direct transit route. For each origin subzone, the reachable activities value is the activity density; i.e., the total activities that can be reached in the destination subzones divided by the total area of the destination subzones. The result is reported as direct activities per acre. This calculation is limited to only those destinations within the 7-county region. Figure 3 shows the direct activities index.

Figure 3. Direct Activities, 2010



Color Code	Index Value	Connected activities per acre	Subzone count
	0	No transit service in subzone	11,307
	1	10 activities and fewer	1,742
	2	10.1 – 15	1,729
	3	15.1 – 20	699
	4	20.1 – 40	644
	5	More than 40	322

Source: Chicago Metropolitan Agency for Planning analysis.

As with transit service frequency, all subzones without transit service are classified as Category 0. The remaining subzones are assigned to five categories of activity density, which were developed based on the ranges of densities derived from the U.S. Census Bureau's Public Use Microdata Areas.

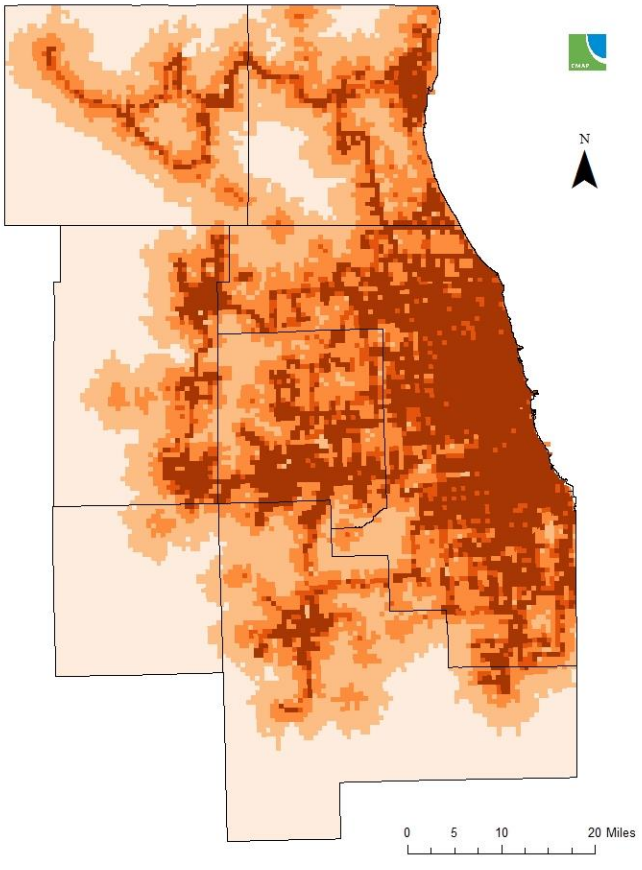
Average proximity to transit

The proximity to transit measures the average distance one would need to travel to reach a transit stop, regardless of the mode of travel. This value is measured differently depending on whether or not the subzone being analyzed has transit service. For subzones containing transit stops, the measurement for each stop is the average network-based distance one must travel to reach that stop without encountering a closer stop. To calculate this value, a catchment area is created for each stop which represents all locations that are closer to that particular stop than to any other stop. An average distance is assigned to the stop based on the shortest distances to all

locations within the catchment area. Finally, the stop distances are weighted by the stop's service frequency to calculate the overall subzone proximity value.

For subzones that do not contain transit stops, the measurement is simply the shortest network distance from the subzone centroid to the five nearest transit stops. A threshold value derived from the network-based distance to the closest stop is used to limit the selection of the remaining stops to ensure the group has comparable proximity to the centroid. For all subzones where the minimum distance to the closest stop is less than one mile, the remaining stops selected cannot be more than double that distance from the centroid. For the remaining subzones, the transit stops selected cannot be more than one mile farther away from the centroid than the closest stop. The proximity value for these subzones is the average of the distances to the relevant nearest stops, weighted by the stop service frequency. Subzones that only contain transit stops in their buffered area (not the core subzone) are analyzed using the same method as for subzones without transit service.

Figure 4. Proximity to Transit, 2010



Color Code	Index Value	Average distance	Subzone count
	5	0.25 miles and under	3,153
	4	0.26 – 0.5 miles	881
	3	0.51 – 2.0 miles	3,501
	2	2.01 – 5.0 miles	3,928
	1	More than 5 miles	4,980

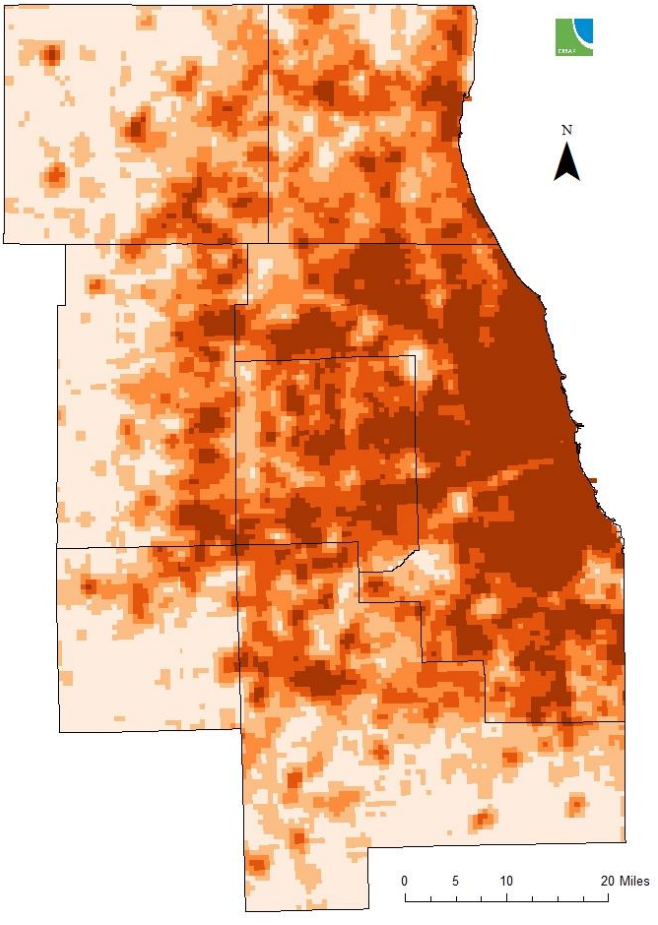
Source: Chicago Metropolitan Agency for Planning analysis.

The distance values are grouped into categories based on the ranges of values shown in Figure 4. The two highest value categories represent the areas with the greatest likelihood of potential walk trips to access transit: one category with a high degree of potential walk trips to access transit (up to 0.25 miles) and a category with a somewhat lesser likelihood of potential walk trips (between 0.26 miles and 0.5 miles). As the index values decline, the presumption is the number of non-motorized trips used to access transit service will also decline.

Pedestrian environment

The Pedestrian Environment Factor (PEF) is a measure of walkable street density that is used in CMAP's Trip Generation model. It serves as a proxy for the "pedestrian-friendliness" of an area. An "all-streets" network is used to perform the PEF calculation, which reports values in terms of centerline miles of roadway per subzone. Street segments identified as being unsuitable for walking are excluded from the calculation. Subzones are assigned index values based on their PEF score, as shown in Figure 5. The PEF values are used to separate the subzones into five equal-sized categories. Values for the PEF are rounded to one decimal place; this is done so that the precision of the measure is not overstated as it is only a proxy for pedestrian-friendliness.

Figure 5. Pedestrian Environment, 2010



Color Code	Index Value	PEF score	Subzone count
	1	Less than 0.5	4,253
	2	0.5 – 1.2	3,220
	3	1.3 – 2.2	3,027
	4	2.3 – 3.4	3,012
	5	3.5 and above	2,931

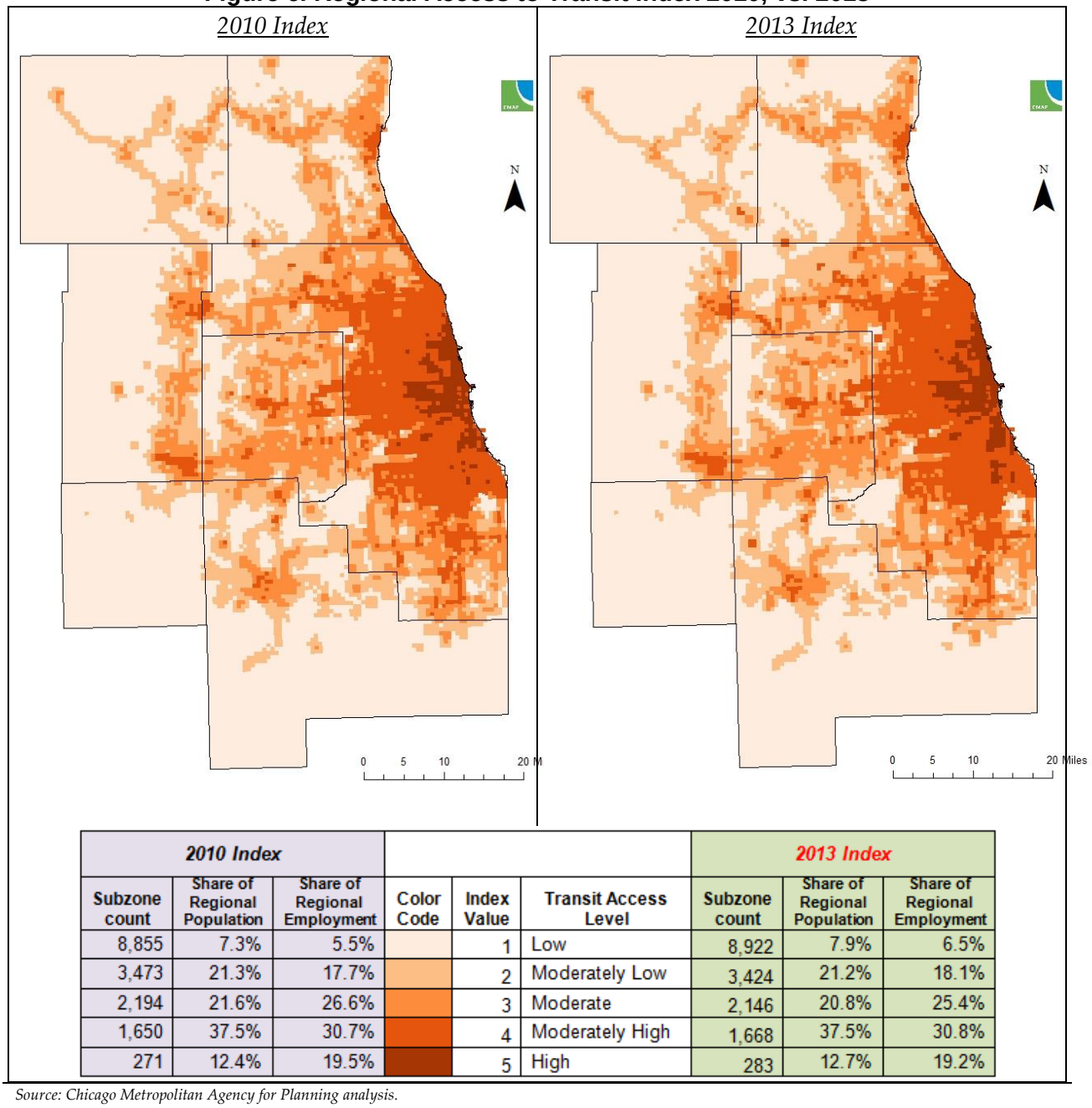
Source: Chicago Metropolitan Agency for Planning analysis.

Sensitivity to Service Changes

An important measure of whether or not the Access to Transit Index provides meaningful information is the extent to which it can reflect localized changes in transit service. To test the index's responsiveness, CMAP staff analyzed data reflecting 2013 transit service and compared the results to the 2010 base year data. This comparison is shown in Figure 6.

The table in Figure 6 presents a comparison of the regional population and jobs in each of the accessibility categories. The 2013 values for employment and households are CMAP estimates based on the expected growth in the region through the year 2040. The transit service data are from 2013 GTFS files. The data show that 71.5% of the regional population had at least moderate access to transit in 2010; in 2013 that value declined slightly to 71.0%. Similarly, 76.8% of regional jobs had at least moderate access to transit in 2010, with that value inching down to 75.4% in 2013.

Figure 6. Regional Access to Transit Index 2010, vs. 2013



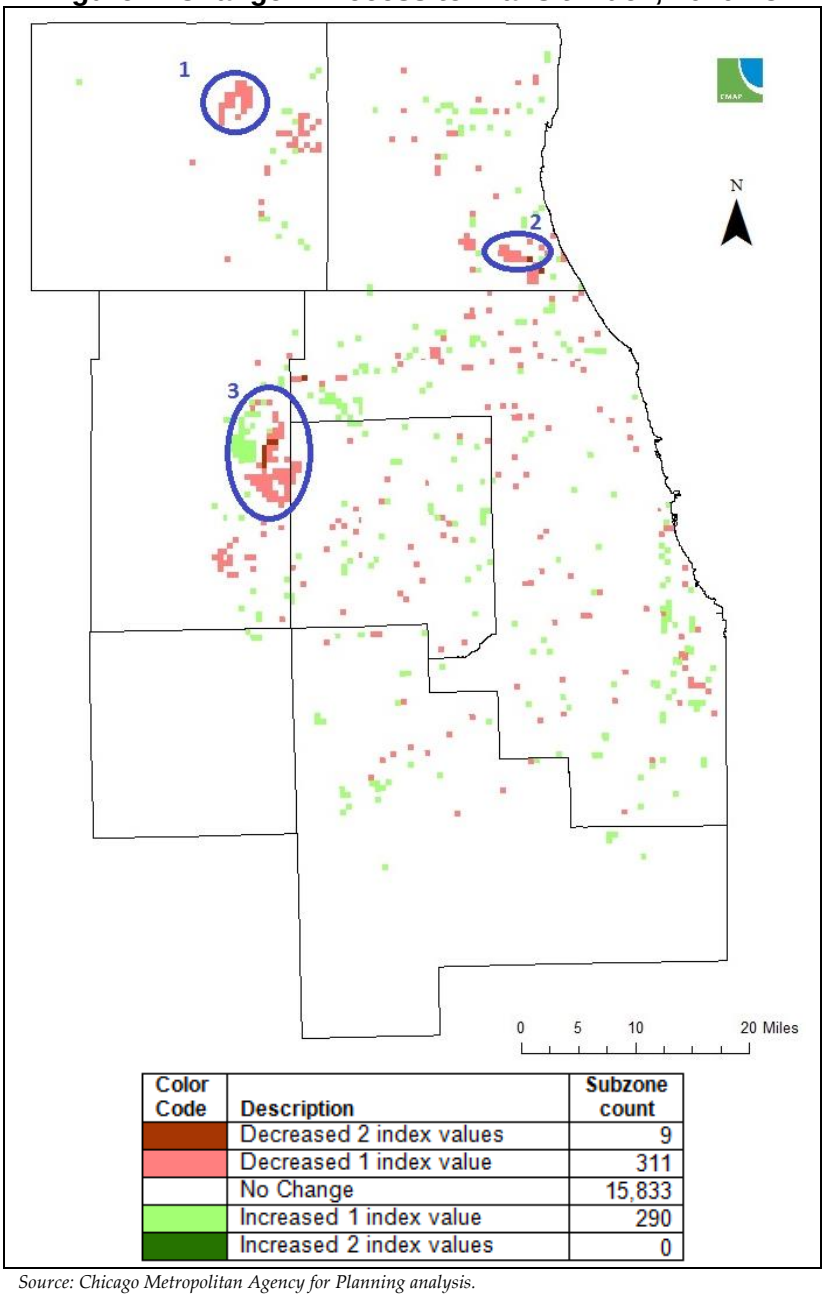
2010 Index						2013 Index		
Subzone count	Share of Regional Population	Share of Regional Employment	Color Code	Index Value	Transit Access Level	Subzone count	Share of Regional Population	Share of Regional Employment
8,855	7.3%	5.5%		1	Low	8,922	7.9%	6.5%
3,473	21.3%	17.7%		2	Moderately Low	3,424	21.2%	18.1%
2,194	21.6%	26.6%		3	Moderate	2,146	20.8%	25.4%
1,650	37.5%	30.7%		4	Moderately High	1,668	37.5%	30.8%
271	12.4%	19.5%		5	High	283	12.7%	19.2%

Source: Chicago Metropolitan Agency for Planning analysis.

While at first glance the two maps shown in Figure 6 appear to be the same, they do contain subtle differences. To clearly illustrate those differences, Figure 7 presents the change in overall index values from 2010 to 2013. Following are brief descriptions of what occurred to cause the change in index values for three specific locations:

Location 1: This area in McHenry County shows a decrease in transit accessibility between 2010 and 2013. This change is due to a re-routing of Pace route 807. In 2010, this route traveled on IL 120, then made a loop to the north into Wonder Lake before continuing on IL 120. Effective December 2012, the loop into Wonder Lake was discontinued on the route. As this was the only transit route serving this area, the index reflects the loss of transit service in the immediate area.

Figure 7. Change in Access to Transit Index, 2010-13



Color Code	Description	Subzone count
	Decreased 2 index values	9
	Decreased 1 index value	311
	No Change	15,833
	Increased 1 index value	290
	Increased 2 index values	0

Source: Chicago Metropolitan Agency for Planning analysis.

Location 2: This area in southeastern Lake County also shows a decrease in transit accessibility between 2010 and 2013. This is explained by the elimination of Shuttle Bug route 622, due to the withdrawal of corporate subsidies to support the service. Again, this was the only transit service provided in the affected subzones. Note that this service had an average weekday ridership of only 47 passengers in 2011.

Location 3: This area in eastern Kane County highlights a number of subzones that saw an improvement in their accessibility score, next to an equally large number that experienced a decline. This pattern of change is due to the shifting of Pace route 801 to the west. In 2010, this route traveled north-south on IL 25. By 2013, this route was using Randall Road instead.

This brief analysis illustrates that the Access to Transit Index is sensitive enough to capture localized changes in transit service over time. As one would expect, in areas saturated with transit service, the impact of changes to a specific route are muted in the index. Conversely, transit service changes in areas with limited service available show a more significant impact.



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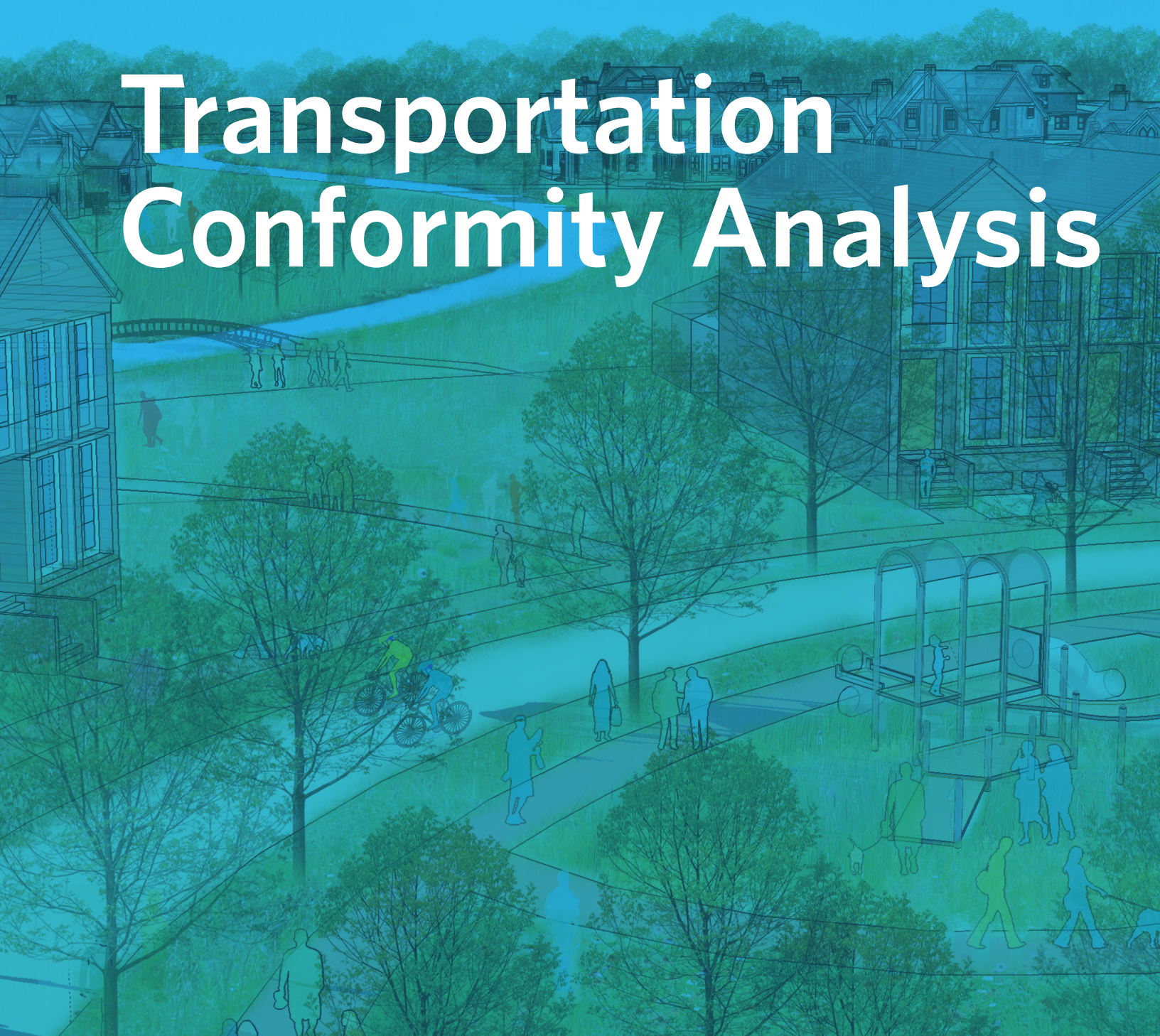
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FY14-0107

CMAP

GO TO 2040
UPDATE APPENDIX

Transportation Conformity Analysis



October 2014

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1.0 GO TO 2040 PLAN UPDATE AND FFY 14-19 TIP CONFORMITY

1.1 Conformity Finding

Chicago Metropolitan Agency for Planning (CMAP) staff finds that the GO TO 2040 plan update and the *Federal Fiscal Year 2014-2019 Transportation Improvement Program* (FFY 14-19 TIP) conform to the State Implementation Plan (SIP) for the 8-hour ozone standard and the annual fine particulate matter ($PM_{2.5}$) standard based on the results of the conformity analysis.

This report makes the determination that the region's transportation plan and program satisfy all applicable criteria and procedures in the conformity regulations.
The *Transportation Conformity Analysis for the $PM_{2.5}$ and 8-Hour Ozone National Ambient Air Quality Standards* documentation was the subject of a public comment period running from June 13 through August 1, 2014. CMAP recognized, considered and responded to comments received. The GO TO 2040 plan and FFY 14-19 TIP, including this conformity determination, were updated in accordance with federal regulations on October 9, 2014.

1.2 History of attainment status

Based on air quality monitoring data gathered between 1988 and 1990, the northeastern Illinois area was designated as a "severe" nonattainment area for the 1-hour national ambient air quality standard (NAAQS) for ozone by the United States Environmental Protection Agency (US EPA) on November 6, 1991 (56 FR 56694). The northeastern Illinois ozone nonattainment area included the counties of Cook, DuPage, Kane, Lake, McHenry and Will, the townships of Aux Sable and Goose Lake in Grundy County and Oswego Township in Kendall County. The Indiana counties of Lake and Porter were also included in the nonattainment area.

On April 15, 2004, US EPA issued final designations of areas not attaining the 8-hour NAAQS for ozone promulgated in 1997 under the Clean Air Act (69 FR 23898). The same area of northeastern Illinois and northwestern Indiana was designated as a "moderate" nonattainment area under this standard. On August 13, 2012, US EPA issued a final rule finding the region in attainment of this standard, approving the Illinois Environmental Protection Agency's (IEPA's) redesignation request, and approving and finding adequate motor vehicle emissions budgets for 2008 and 2025 for volatile organic compounds (VOC) and nitrogen oxides (NOx) for use in conformity (77 FR 48062).

On June 11, 2012, US EPA issued final designations of areas not attaining the 8-hour NAAQS for ozone promulgated in 2008 (77 FR 34221). The northeastern Illinois nonattainment area included the counties of Cook, DuPage, Kane, Lake, McHenry and Will,

the townships of Aux Sable and Goose Lake in Grundy County and Oswego Township in Kendall County. The Indiana counties of Lake and Porter were included in the nonattainment area as were Pleasant Prairie and Somers Townships in Kenosha County, Wisconsin. These areas were designated as marginal nonattainment, meaning that they are expected to attain the NAAQS by the attainment year of 2015.

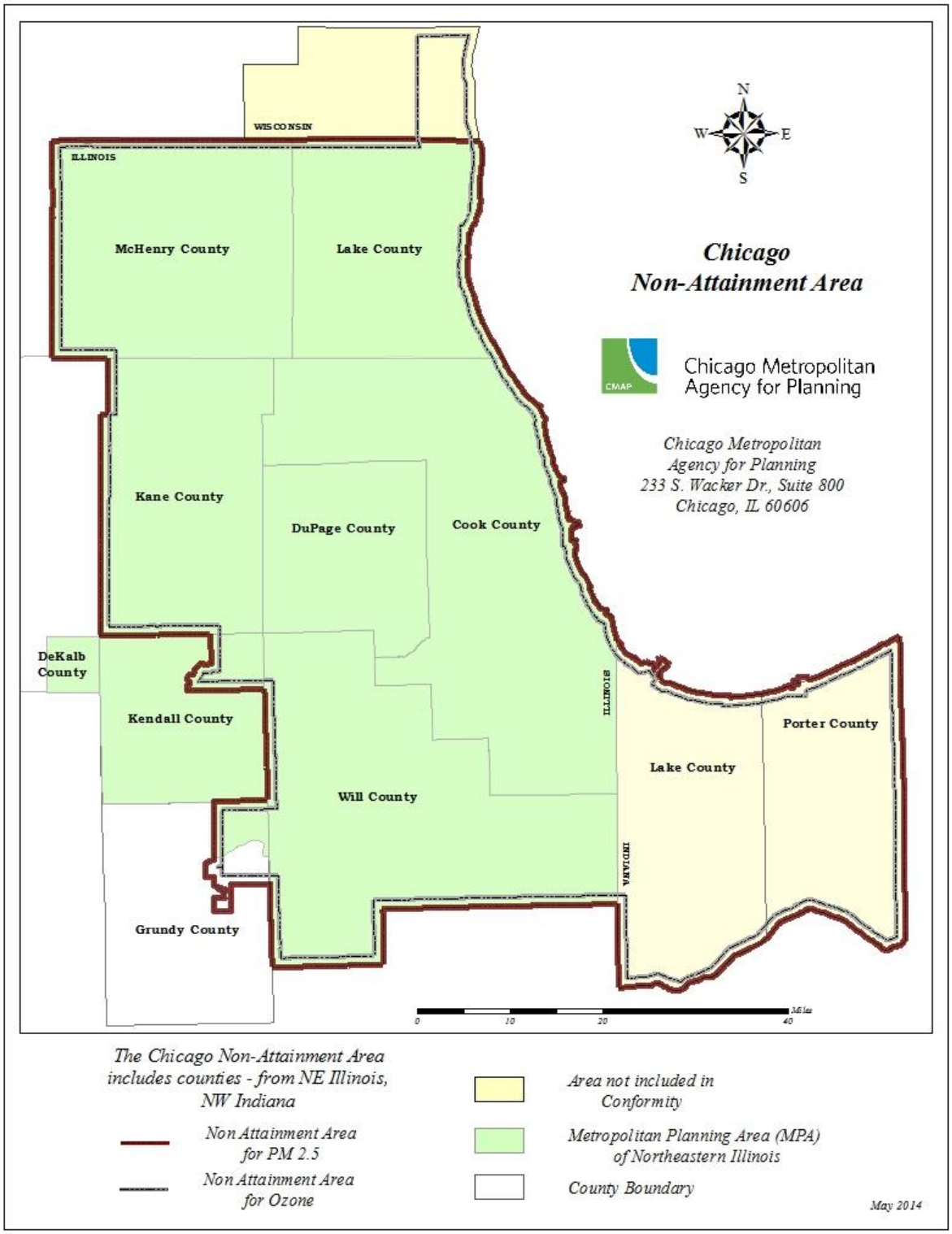
Based on air quality monitoring data gathered between 2001 and 2003, the northeastern Illinois area was designated as a "moderate" nonattainment area for the 1997 annual $PM_{2.5}$ NAAQS by the US EPA on April 5, 2005 (70 FR 944). The northeastern Illinois $PM_{2.5}$ nonattainment area includes the counties of Cook, DuPage, Kane, Lake, McHenry and Will, the townships of Aux Sable and Goose Lake in Grundy County and Oswego Township in Kendall County. The Indiana counties of Lake and Porter are also included in the nonattainment area.

On October 2, 2013, US EPA issued a final rule finding the region in attainment of the 1997 annual $PM_{2.5}$ standard, approving IEPA's redesignation request, and approving and finding adequate motor vehicle emissions budgets for 2008 and 2025 for direct $PM_{2.5}$ emissions and NOx for use in conformity (78 FR 60704).

On January 15, 2012, US EPA issued a final rule lowering the annual $PM_{2.5}$ NAAQS from 15.0 micrograms per cubic meter to 12.0 micrograms per cubic meter (78 FR 3086). On December 13, 2013, IEPA submitted a recommendation to US EPA that the same counties and townships be designated as nonattainment as have been designated for the prior $PM_{2.5}$ and ozone NAAQS. US EPA is expected to act on this recommendation by December 2014.

Exhibit 1 shows the nonattainment areas designated by US EPA for ozone and $PM_{2.5}$, as well as the metropolitan planning area. This conformity analysis is for the nonattainment areas within the northeastern Illinois portion of the nonattainment area.

Exhibit 1: Northeastern Illinois Nonattainment Area for Ozone and $PM_{2.5}$



1.3 Overview of the Conformity Process

The transportation conformity provisions of the Clean Air Act Amendments of 1990 require that the Metropolitan Planning Organization (MPO) for northeastern Illinois, make a determination that the region's transportation plan, program and projects conform to applicable SIPs and that emissions, taken as a whole from the plan, program and projects will not negatively impact the region's ability to meet the NAAQS deadlines. Conformity to a SIP means that the region's transportation plan and program: 1) will not cause any new violations of the NAAQS; 2) will not cause any worsening of existing violations; and 3) will not delay efforts to attain the NAAQS in a timely manner. This demonstration is conducted by comparing motor vehicle emissions estimates developed from implementation of the GO TO 2040 plan update and the FFY 14–19 TIP for specific analysis years to the motor vehicle emissions budgets contained in the applicable SIP.

Although transportation plans and metropolitan TIPs do not need to be approved by the Federal Highway Administration (FHWA) or the Federal Transit Administration (FTA), they must approve conformity determinations for the Plan and TIP. In addition, the region's TIP needs to be amended into the Statewide TIP (STIP), which amendment must be approved by FHWA and FTA.

The purpose of this report is to document the process and findings developed as part of the transportation conformity analysis of the GO TO 2040 plan update and the FFY 14–19 TIP for northeastern Illinois.

1.4 Summary of 8-Hour Ozone Conformity Process

The IEPA submitted a redesignation request and maintenance SIP for the 1997 8-hour ozone standard to US EPA on March 18, 2009. In 2011, IEPA submitted a revised redesignation request that included proposed budgets developed with the US EPA's MOtor Vehicle Emission Simulator (MOVES) model. US EPA approved these MOVES-based budgets and found them adequate for conformity on August 13, 2012. On March 28, 2014, IEPA submitted to US EPA updated motor vehicle emissions budgets for its maintenance SIP. On October 6, 2014, US EPA published approval of the revised budgets in the Federal Register (79 FR 60073). This conformity analysis evaluated emissions in the region against these budgets.

Although northeastern Illinois was designated in nonattainment of the 2008 ozone NAAQS, the region was designated as marginal nonattainment, and no further budgets are required; the maintenance SIP budgets can be used for this purpose.

At the August 28, 2012 Tier II Consultation meeting, US EPA staff reported that the portion of southeast Wisconsin designated as nonattainment of the 2008 ozone standard would be able to make its own conformity determination without referencing budgets or analysis

years for northeastern Illinois or northwest Indiana. Consequently, this conformity analysis does not refer to southeast Wisconsin.

Northwest Indiana has budgets for the ozone precursors, so northeastern Illinois and northwest Indiana are able to demonstrate ozone conformity independently of each other.

1.5 Summary of $PM_{2.5}$ Conformity Process

With the October 2, 2013 final rule approving and finding adequate motor vehicle emissions budgets for 2008 and 2025 for NOx and $PM_{2.5}$ for use in conformity (78 FR 60704) the region now has budgets, and conformity for northeastern Illinois can proceed without reference to the Indiana portion of the nonattainment area.

Pursuant to final rules published May 6, 2005 (40 CFR 93.102(b)(2)(iv) and (v) and 93.119(f)(9) and (10)), $PM_{2.5}$ nonattainment areas are required to perform a regional emissions analysis for direct $PM_{2.5}$ motor vehicle emissions and for NOx as a $PM_{2.5}$ precursor unless the head of the state air agency and the US EPA Regional Administrator make a finding that NOx is not a significant contributor to the $PM_{2.5}$ air quality problem in a given area. Such a finding has not been made for northeastern Illinois, so this conformity analysis includes NOx as well as direct $PM_{2.5}$ emissions.

Regional emissions analyses under the annual $PM_{2.5}$ standard are not required for VOC, sulfur oxides (SOx) or ammonia unless the head of the state air agency or US EPA Regional Administrator makes a finding that on-road emissions of any of these precursors is a significant contributor, or an adequate or approved SIP budget for such precursors is established. Since no budgets have been established for these precursors, nor has a finding of significance been made for the northeastern Illinois nonattainment area, these precursors have not been analyzed for this conformity determination.

2.0 FEDERAL ACCEPTANCE OF THE PLAN AND TIP

The most recent federal review of the TIP conformity determination occurred on March 26, 2014. The United States Department of Transportation (US DOT), through the FHWA Illinois Division and the FTA Region V, found that the conformity analysis performed by CMAP met the applicable criteria of 40 CFR 51 and 93, and approved the amendment to the FFY 11-15 TIP.

US DOT acceptance letters are available on the TIP Archives web page.

3.0 INTERAGENCY CONSULTATION

Interagency consultation is required under the transportation conformity rule, as described in 40 CFR 93.105. In the northeastern Illinois region, these procedures are addressed through the consultation process described below and through the work of CMAP's committees, working committees, and other groups as described in the region's Public Participation Plan.

In the northeastern Illinois region, consultation involving CMAP, IEPA, the Illinois Department of Transportation (IDOT), the Regional Transportation Authority (RTA), FHWA, FTA and US EPA and other entities as appropriate facilitates the local, regional and state decision-making process by providing a forum for all affected federal, state, regional and local agencies to discuss and resolve important issues. Decisions made through this interagency consultation process guide CMAP in making the conformity determination.

3.1 Consultation Process

The consultation process facilitates the regional planning process in several ways. First, consultation assures early and proactive participation by the US EPA, FTA, and FHWA in the plan and TIP development process. Second, consultation serves as a forum for interagency communication and understanding to prevent or resolve potential obstacles in the conformity process. Finally, the expertise of the federal agency representatives is relied upon for assistance in interpreting air quality regulations, as well as transportation plan and TIP requirements.

Acceptable means of communication for the purpose of consultation include telephone, fax, e-mail, person-to-person communication and arranged meetings. The consultation team has found that having all parties present at meetings greatly facilitates interagency coordination and assures mutual understanding of issues and determinations. Therefore, CMAP relies heavily upon scheduled consultation meetings with federal agency representatives and other members of the consultation team.

The consultation group is comprised of representatives of FHWA, FTA, US EPA, IEPA, IDOT, RTA and CMAP.

The consultation process in northeastern Illinois consists of two levels, or "tiers." Tier I participants include federal representatives from headquarters offices in Washington, D.C. Tier II participants include federal representatives from US EPA's Region V office, FTA's Region 5 office, FHWA's Division Office, IEPA, IDOT, RTA and CMAP. In addition to the standing members of the consultation team, representatives of local transportation implementing agencies and other stakeholders are invited to attend as appropriate. The Tier I consultation team is convened in the event the Tier II team is unable to resolve a particular issue.

The consultation process used during the development of the GO TO 2040 plan update and the FFY 14-19 TIP and this conformity analysis consisted solely of Tier II meetings.

The consultation team meets at the CMAP office on an as-needed basis. Every attempt is made to schedule meetings so that all representatives can attend, but the meetings are held whether or not all members are present. No decision is put into effect until the concurrence of all parties involved in the consultation process is achieved.

To provide a reference for discussion items and issue resolution, CMAP staff prepares meeting summaries following the completion of each scheduled consultation meeting. These summaries are reviewed for accuracy and approved by the consultation team at a subsequent meeting. Following resolution of an issue, staff typically provides a verbal update to pertinent CMAP committees to assist committee members in their decision-making processes.

3.2 Summary of Formal Consultation Meetings

Minutes of consultation meetings and other materials used by the Tier II Consultation Team are available on the CMAP web site:

http://www.cmap.illinois.gov/about/involvement/committees/other-groups/tier-ii-consultation/minutes.

4.0 PUBLIC PARTICIPATION

The *Public Participation Plan*, adopted by the CMAP Board and the MPO Policy Committee in January 2013 establishes the mechanisms by which CMAP reaches out to its many stakeholders and the public. Specific methods CMAP uses to encourage public participation are documented in the Unified Work Program appendices.

A formal public comment period for the draft Transportation Conformity Analysis for the $PM_{2.5}$ and 8-Hour Ozone National Ambient Air Quality Standards was held from June 13 to August 1, 2014. A formal public hearing was held July 31, 2014. Comments were accepted via fax, the U.S. Mail and via email.

No comments on the conformity analysis were received during the public comment period.

5.0 PROCEDURES FOR DETERMINING REGIONAL TRANSPORTATION DEMAND

The procedures for determining regional transportation demand are subject to requirements set out in the conformity regulations, at 40 CFR 93.122(b).

The GO TO 2040 plan update appendix, Travel Demand Model Documentation, describes the modeling process used for this conformity analysis. This material demonstrates the inherent behavioral connections between regional land use, demographics and transportation infrastructure and policy input to the quantification of travel demand levels and patterns and the subsequent measurement of transportation system performance, which the models contain.

The following is a description of how CMAP's demand model meets the specific criteria from the regulations:

Paragraph	Requirement	How the Requirement is Satisfied
(b) (1) (i)	Network-based travel models must be validated against observed counts (peak and off-peak, if possible) for a base year that is not more than 10 years prior to the date of the conformity determination. Model forecasts must be analyzed for reasonableness and compared to historical trends and other factors, and the results must be documented.	The models were validated against the most recent ground counts as documented in the *CMAP Travel Demand Model Validation Report*
(b) (1) (ii)	Land use, population, employment, and other network-based travel model assumptions must be documented and based on the best available information.	The socioeconomic forecasts used are based on the best available information including census data and a sound methodology as described in the Socioeconomic Forecast Update Overview appendix of the GO TO 2040 plan update.
(b) (1) (iii)	Scenarios of land development and use must be consistent with the future transportation system alternatives for which emissions are being estimated. The distribution of employment and residences for different transportation options must be reasonable.	The analysis uses forecasts of population, employment and land use developed by CMAP. The transportation simulation model has been structured with a feedback mechanism. Analysis and scenario testing were performed on land use/transportation interactions during the development and update of GO TO 2040.
(b) (1) (iv)	A capacity-sensitive assignment	Separate capacity restraint assignments are

	methodology must be used, and emissions estimates must be based on a methodology which differentiates between peak and off-peak link volumes and speeds and uses speeds based on final assigned volumes.	produced to estimate vehicle miles and travel speeds for eight time periods during the day. Results of the separate period assignments are accumulated into daily volumes and tabulated by vehicle mile by speed range as required for the emission calculations.
(b) (1) (v)	Zone-to-zone travel impedances used to distribute trips between origin and destination pairs must be in reasonable agreement with the travel times that are estimated from final assigned traffic volumes. Where use of transit currently is anticipated to be a significant factor in satisfying transportation demand, these times should also be used for modeling mode splits.	The modeling process includes five iterations through the steps of distribution, mode split and assignment. The final highway distribution and assignment is based on the times from the fifth iteration. In the iteration process, the highway and transit times for each step are the same for distribution, mode split and assignment.
(b) (1) (vi)	Network-based travel models must be reasonably sensitive to changes in the time(s), cost(s), and other factors affecting travel choices.	The binary logit mode-choice model contains the full range of pricing (or cost) variables in the individual utility equation expressions for both auto and transit. These cost variables include destination zone parking cost, rail station parking cost, automobile operating cost (cents per mile), tolls, and transit fares. The intervening opportunities trip distribution model utilizes a composite impedance measure, also known as the LogSum variable, as a measure of zonal accessibility. The LogSum variable includes travel time and cost associated with both highway and transit travel. In addition the transit path selection uses the transit fares as one of the key parameters in selecting the transit path. The use of transit fares in path building is very important in a region that has transit options including commuter rail, rapid transit, express bus and local bus.

5.1 Travel Demand for Ozone Conformity

Since the ozone NAAQS is based on daily measurements, the vehicle miles of travel (VMT) estimates for conformity analysis are daily values. Furthermore, since the highest ozone concentrations are monitored during the summer, the VMT estimates are adjusted to be daily VMT for a summer weekday. The travel demand model runs produce weekday averages over the year, so the VMT results of the model runs are adjusted by increasing the model averages to summer weekday averages, based on analysis of traffic monitoring data by IDOT. The adjusted VMT values are then used as input to the MOVES emissions model. The adjustment factors are:

Table 1: **Daily Average Daily Traffic (ADT) conversion factors**

Facility	Multiplier
arterial	1.0700
expressway	0.9969
local	1.0700
ramp	1.0700

5.2 Travel Demand for $PM_{2.5}$ Conformity

In contrast to ozone, the annual $PM_{2.5}$ NAAQS to which the northeastern Illinois region must demonstrate conformity is based on annual measurements, so the VMT estimates must be annual values. To convert weekday average VMT model output to monthly VMT, traffic monitoring data were obtained from IDOT. The data give the ratio of average weekday traffic to weekly traffic. In addition, the IDOT data supply the ratio of each month to annual traffic. To obtain monthly VMT estimates, the weekday to average (7-day) factor is multiplied by the month-to-year ratio. The following table gives the monthly ADT factors as a percentage of Annual Average Daily Traffic (AADT):

Table 2: Monthly ADT conversion factors

Month	Freeway Monthly ADT (% of AADT)	Non-Freeway Monthly ADT (% of AADT)
January	87%	86%
February	95%	87%
March	96%	89%
April	97%	96%
May	96%	99%
June	98%	101%
July	95%	95%
August	98%	97%
September	95%	97%
October	94%	95%
November	94%	94%
December	90%	95%

6.0 LATEST PLANNING ASSUMPTIONS

6.1 Socioeconomic Forecasts

A major input to any transportation demand modeling process is the socioeconomic data used to develop the number and types of trips to be assigned to the transportation system. There are three components to this data: the geographic or spatial component; the socioeconomic variables used to describe or characterize these areas; and the base and forecast years which define the time horizons for the analysis.

CMAP has systematically forecast 2040 population, employment and economic activity from the land use and transportation strategies found in the GO TO 2040 Preferred Scenario, and revised the forecast for the GO TO 2040 plan update based on final 2010 Census data. The CMAP travel demand models are then used to estimate travel behavior, congestion and VMT resulting from these forecasts. Population and employment estimates for interim conformity years are interpolated and tested against transportation improvements expected to be implemented at the time. A description of the method used to prepare the forecasts and data summaries are included in the Socioeconomic Forecast Update Overview appendix to the GO TO 2040 plan update.

6.2 Transit Operating Policies

The Regional Transportation Authority Operating Budget, Financial Plan and Capital Programs, which are updated annually, serve as the basis for considering the impact of transit operating policies on travel demand model estimates. These documents include projections over the near term of key transit operating policies including fare, service and ridership levels.

Since the most recent conformity determination was adopted in March 2014, transit operating policies (including fares and service levels) and assumed transit ridership have not changed.

6.3 Transit Fares and Highway Costs in the Conformity Analysis

The transportation model used in the conformity analysis requires information on the cost of transportation by each mode. Of particular importance are the relative costs of transportation versus all other costs, and the relative costs of the transit and auto modes to each other. Auto costs used in the model are based on the cost to own and operate an automobile, parking costs and charges for tollway facilities. Transit costs include information on the base fares, transfers and access costs.

It was assumed the relative costs of the two transportation modes (highway and transit) would be the same in the future years as that which existed in the base year. This treatment of future costs for the transit mode and for the toll component of the auto operating cost is consistent with observed trends.

6.4 Transportation Control Measures (TCMs)

TCMs were used in development of SIPs related to the 1-hour ozone standard, including the 15% ROP SIP (1993), Control Strategy SIP (1995), 1996 ROP SIP, 9% Control Strategy SIP (1998) and 9% ROP Control Strategy SIP (1999). All the TCMs adopted for these SIPs were implemented by 1999.

The ozone maintenance SIP and the $PM_{2.5}$ attainment SIP, which have budgets found adequate for conformity, assume no TCMs. Thus, no such measures are identified here.

7.0 EMISSION BUDGETS AND MOVES MODEL SETTINGS

Four analysis years are included in the region's conformity analyses:

- 2015 – the attainment year for the 2008 ozone standard
- 2025 – the horizon budget year for the ozone maintenance SIP
- 2030 – an intervening year not more than 10 years apart from the preceding and succeeding scenario years
- 2040 – the horizon year of the plan

7.1 Ozone Conformity

Mobile source emissions budgets for ozone precursors – VOC and NOx – were developed by IEPA as part of the 8-hour ozone maintenance SIP. On August 13, 2012, US EPA issued a final rule approving and finding adequate motor vehicle emissions budgets for 2008 and 2025 (77 FR 48062). These budgets are MOVES-based, and enabled the region to comply with the grace period for using MOVES in conformity determinations.

IEPA and CMAP worked closely during the development of the VOC and NOx emission budgets to determine the appropriate MOVES model settings. This conformity demonstration uses the same applicable settings in MOVES runs as were used in developing the SIP budgets. A full discussion of the settings and input files is provided in the Travel Model Documentation.

On March 28, 2014, IEPA submitted to US EPA updated motor vehicle emissions budgets for its maintenance SIP. On October 6, 2014, US EPA published approval of the revised budgets in the Federal Register (79 FR 60073). These approved budgets are used in this conformity analysis.

7.2 $PM_{2.5}$ Conformity

On October 2, 2013, US EPA issued a final rule approving and finding adequate motor vehicle emissions budgets for 2008 and 2025 for NOx and PM2.5 for use in conformity (78 FR 60704).

Since the requirements for including VOC, SOx or ammonia emissions were not met, these precursors have not been analyzed for this conformity determination.

The northeastern Illinois region was in nonattainment of the annual $PM_{2.5}$ standard so the emissions inventory must reflect annual emissions totals. To accomplish this, a daily emission inventory appropriate to each month and day type was developed, and the daily emission value was multiplied by number of days for the month. Monthly emissions were then added to obtain the annual emissions.

A more complete description of the MOVES runs and listings for the input files are given in the Travel Model Documentation.

8.0 OFF-NETWORK CALCULATIONS

The final estimate of regional emissions does not include credit for off-network calculations.

However, many of the projects that are not currently incorporated explicitly in the travel demand model have been programmed using federal Congestion Mitigation and Air Quality Improvement funds. These funds are programmed by CMAP on the basis of the project's demonstrated air quality benefits. A benefit evaluation method has been developed for each type of project. The methods are structured so that, if appropriate, a project's benefits can be incorporated in the appropriate SIP by the IEPA as a TCM, or used in conformity determinations.

9.0 MODELED PROJECTS

Projects included in the GO TO 2040 plan update and the FFY 14-19 TIP transportation demand estimation modeling process are listed on the CMAP web site. Major capital projects included in the GO TO 2040 plan update are listed and discussed in detail in the Major Capital Projects appendix of the GO TO 2040 plan update; TIP projects that require conformity are listed on the CMAP Conformity Analysis web page.

10.0 RESULTS OF THE CONFORMITY ANALYSIS

Results of the conformity analysis for the GO TO 2040 plan update and the FFY 14-19 TIP are given below. CMAP maintains a policy of accepting amendments and updating the conformity analysis semiannually. The results of the most recent analysis are listed on the CMAP Conformity Analysis web page.

10.1 Ozone Conformity Results

The VOC and NOx emissions estimates for each of the scenario years are shown in Table 3. No credits are taken for projects that have air quality benefits but are not represented within the transportation networks. Emission reductions from the National Energy Policy Act Credit and Clean Fuel Fleet Program have not been claimed.

As shown in the table, the emission results from the conformity analysis for the analysis years show that the VOC and NOx emissions are lower than the applicable SIP budgets, and conformity for the 8-hour ozone standard is demonstrated.

Table 3: VOC and NOx Emissions in Tons per Summer Day for Ozone Conformity

	Volatile Organic Compounds		Nitrogen Oxides	
Year	Northeastern Illinois	SIP Budget	Northeastern Illinois	SIP Budget
2015	70.41	117.23	155.83	373.52
2025	47.14	60.13	76.77	150.27
2030	45.57	60.13	70.93	150.27
2040	48.26	60.13	72.62	150.27

10.2 $PM_{2.5}$ Conformity Results

The direct $PM_{2.5}$ and NOx emissions estimates for each of the scenario years are shown in Table 4. No credits are taken for projects that have air quality benefits but are not represented within the transportation networks.

The emission results from the conformity analysis for the analysis years show that the direct $PM_{2.5}$ and NOx emissions from motor vehicles are lower than the applicable SIP budgets, and conformity for the annual $PM_{2.5}$ standard is demonstrated.

Table 4: Direct PM2.5 and NOx Emissions in Tons per Year for PM2.5 Conformity

	Fine Particulate Matter		Nitrogen Oxides	
Year	Northeastern Illinois	SIP Budget	Northeastern Illinois	SIP Budget
2015	**2,609.82**	5,100.00	**58,764.01**	127,951.00
2025	**1,676.80**	2,377.00	**29,911.86**	44,224.00
2030	**1,602.30**	2,377.00	**27,824.01**	44,224.00
2040	**1,676.58**	2,377.00	**28,607.40**	44,224.00

10.3 Conclusion

The conformity analysis conducted by CMAP concludes that the GO TO 2040 plan update and the FFY 14-19 TIP meet all applicable requirements for conformity for the 8-hour ozone standard and the annual $PM_{2.5}$ standard; the GO TO 2040 plan update and the FFY 14-19 TIP are recommended for approval by US DOT.

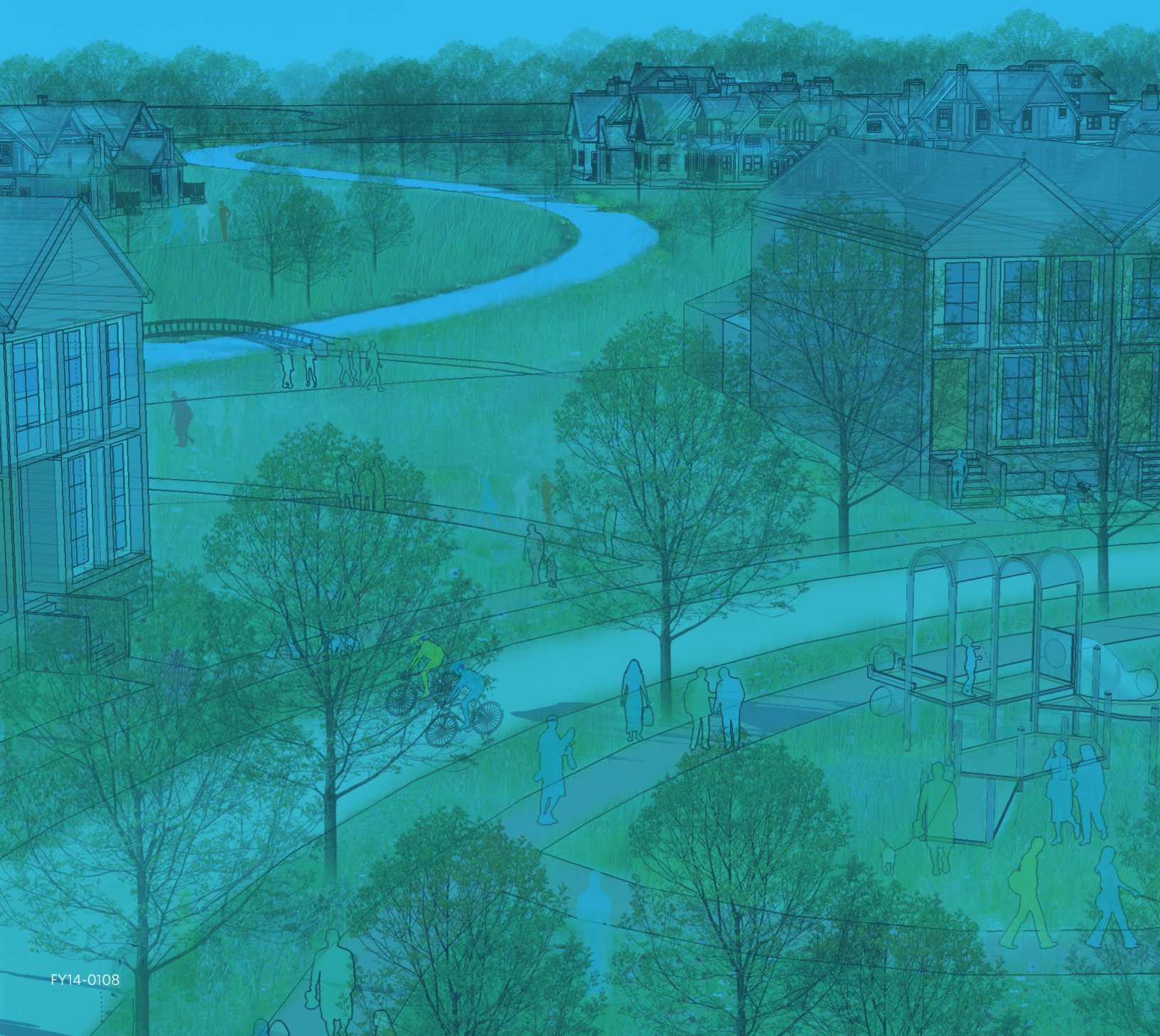
The *Transportation Conformity Analysis for the $PM_{2.5}$ and 8-Hour Ozone National Ambient Air Quality Standards* was the subject of a public comment period running from June 13 through August 1, 2014. This report and the accompanying appendices make the determination that the region's transportation plan and program satisfy all applicable criteria and procedures in the conformity regulations and comply with all applicable implementation plan conformity requirements.

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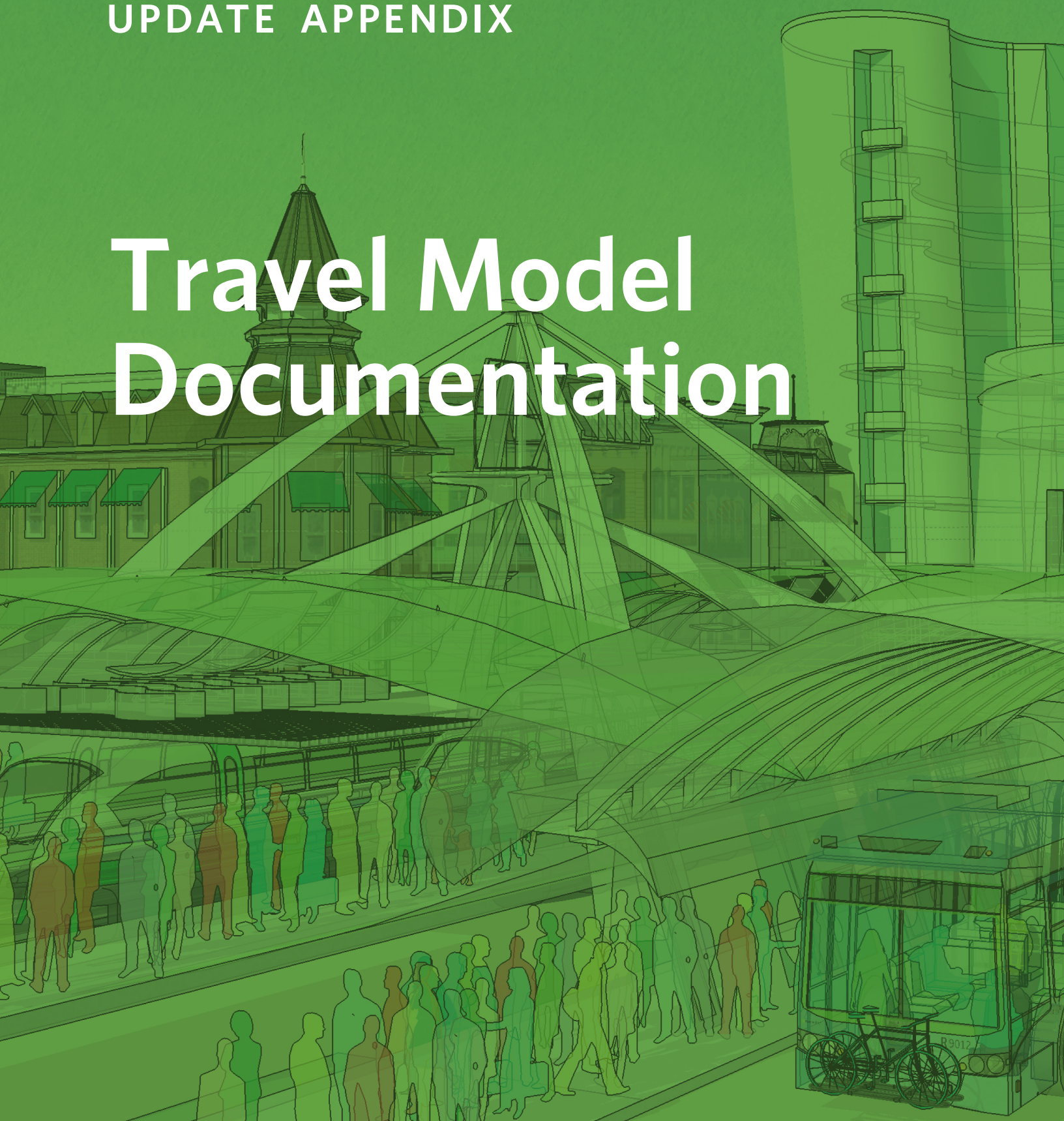


FY14-0108

CMAP

GO TO 2040
UPDATE APPENDIX

Travel Model Documentation



October 2014

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1. Overview

The northeastern Illinois region does not attain national ambient air quality standards for certain pollutants. It is classified as a marginal non-attainment area for the 8-hour ozone standard under the Clean Air Act Amendments of 1990, and a non-attainment area for the annual fine particulate matter (PM2.5) standard. Provisions of this act require regional transportation plans and programs to conform to the State Implementation Plan (SIP) for air quality, which sets out how the region will meet emission reduction targets specified by the act.

As part of the transportation planning and programming process, staff at the Chicago Metropolitan Agency for Planning (CMAP) evaluates the impact of proposed transportation activities on the region's air quality. This evaluation, called a conformity analysis, is submitted to the Illinois Environmental Protection Agency and the U.S. Environmental Protection Agency for their review before a long-range Regional Transportation Plan or Transportation Improvement Program (TIP) is approved. The conformity analysis must demonstrate that the emissions resulting from the plan or TIP meet the requirements of (i.e., "conform with") the regulations governing air quality.

The travel demand models, and emission calculations that depend on the models' travel forecasts, are the technical core of the conformity evaluations of the region's TIP and Regional Transportation Plan. The purpose of this report is to document the travel demand modeling process used in the conformity analysis.

CMAP is the official regional planning organization for the northeastern Illinois counties of Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will. CMAP developed and now guides the implementation of metropolitan Chicago's first comprehensive regional plan in more than 100 years, GO TO 2040, which was adopted unanimously by leaders from across the seven counties in fall 2010. To address anticipated population growth of more than 2 million new residents, GO TO 2040 is an innovative, policy-based plan that establishes coordinated strategies that help the region's 284 communities address transportation, housing, economic development, open space, the environment, and other quality-of-life issues.

CMAP was created in 2006 by the merger of two long-standing agencies: the Chicago Area Transportation Study (CATS) and the Northeastern Illinois Planning Commission (NIPC). For fifty years, CATS was responsible for regional transportation planning in northeastern Illinois and served as the federally-designated Metropolitan Planning Organization, responsibilities that were transferred to CMAP upon its creation. Concurrently, NIPC was the regional land use planning agency for northeastern Illinois.

Since the early 1990s, CMAP/CATS has been working to enhance the travel demand modeling process used in the air quality conformity analysis of transportation improvement programs and regional transportation plans. Travel demand modeling was first employed to assist in the development of regional transportation plans. The four-step process (trip generation,

distribution, mode split and assignment) was fundamental from the beginning. Early enhancements focused on making the process run more quickly on the computers available at the time and on the calibration of individual model components. In the 1970s, in response to concerns about improving public transit, CMAP/CATS concentrated enhancement activities on the mode split model and transit assignment techniques.

In the late 1970s and early 1980s, efforts were focused on adapting the modeling process to sub-area and project specific studies. For example, CMAP/CATS developed a block-by-block zone system for the downtown area. Trips were generated based on zonal floor space from a building-by-building file of the area. Networks were coded with detailed pedestrian links. These techniques were employed to evaluate transit alternatives for the Central Business District. Similarly, zone sizes were reduced and more detailed highway networks were coded in suburban areas to evaluate freeway proposals.

When federal regulations were changed to require emissions estimates for conformity analysis, the regional models were initially employed as they then existed. It was in 1994 that the first significant model changes, explicitly motivated by conformity issues, were implemented. Since then, CMAP has committed substantial resources to develop models that are responsive to the needs imposed by air quality requirements. CMAP continuously strives to improve its travel forecasting techniques in response to policy priorities.

This document describes the regional travel demand model used by CMAP to generate the inputs required to calculate regional motor vehicle emissions. The regional model is a classical four-step or trip-based travel demand model. CMAP is also aggressively implementing a ten year strategic plan for developing a set of advanced models to address the policy needs of the region, as documented in the CMAP Strategic Plan for Advanced Model Development.

This report documents the current status of CMAP's regional travel demand model. Much of the text in this document is drawn from a predecessor report (Chicago Metropolitan Agency for Planning, 2010) developed for the adoption of the GO TO 2040 plan. Since that time a number of procedural and model coefficient updates have been implemented within the CMAP model. Most of these improvements were developed by a consulting firm under contract with either CMAP or the Illinois Department of Transportation. Where appropriate, the work of the consulting firm is cited within this document.

Overview of the Regional Model Structure and Process

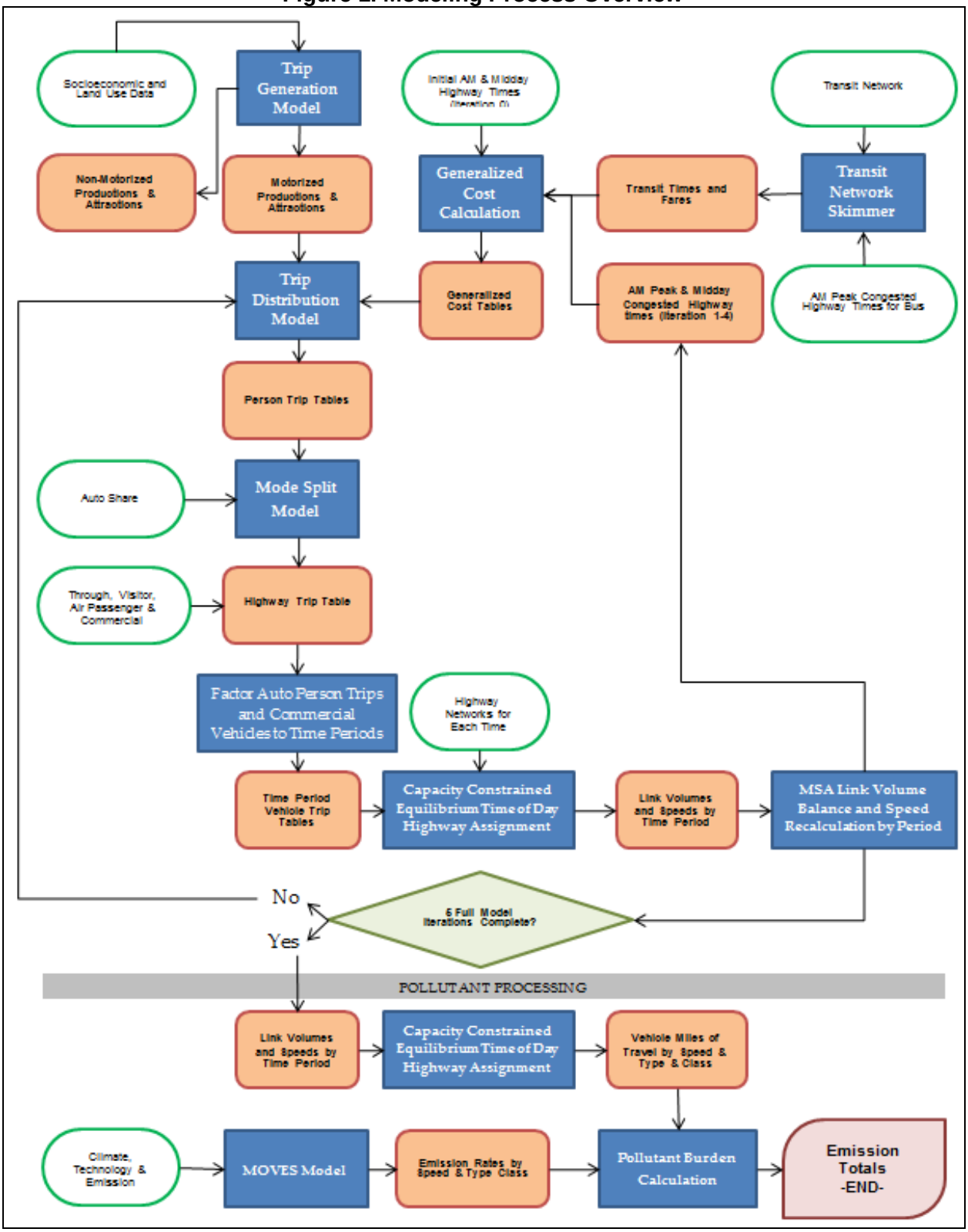
The CMAP travel demand models represent a classical "four-step" process of trip generation, distribution, mode choice, and assignment, with considerable modifications used to enhance the distribution and mode choice procedures. The present CMAP region, for analysis purposes, includes the counties of Cook, DuPage, Kane, Lake, McHenry, Will, Kendall, in Illinois and parts of other Illinois, Indiana and Wisconsin counties buffering the region.

Figure 1 contains a flow chart showing the general steps used in the travel demand modeling process. The ovals in the chart represent data inputs that feed model procedures and processes. These model processes are represented by the blue rectangles. The orange rectangles denote data that are generated by the model processes; in most instances these also serve as input to subsequent procedures.

The first step in the procedure is to use the socioeconomic/land use data to estimate the trip ends for each trip type. For home based trips, trip ends located at the travelers' homes are defined as productions, and trip ends located at the non-home end are defined as attractions.

The CMAP procedure to estimate productions consists of several sub-models. One of these models estimates the number of households stratified by adults, workers and children in the household. Another model adds vehicle ownership to the stratification. Vehicle ownership rates are dependent on the composition and income of the household as well as the transportation characteristics of the area in which the household is located. Area characteristics include a measure of the pedestrian friendliness and the availability of transit. Transit availability is based on a modeled mode split estimate for the zone. Consequently trip generation is network dependent. In general, higher transit mode shares decrease vehicle ownership rates, which in turn decrease trip rates. The attraction model uses employment, categorized as retail and total, and the number of total households to estimate the attractions, by purpose, for each analysis zone. The model has a trip rate associated with each type of employment and household, used with the total number of employees and households.

Figure 1. Modeling Process Overview



The trip generation model estimates total trips, including both motorized trips such as those made by auto and public transit, and non-motorized trips such as those made by pedestrian and bicycle modes. A model calculates the estimated number of non-motorized trips in an area. Non-motorized trips are subtracted out from the total number of trips generated from an area, and only the motorized trips are carried through the remaining model steps. The regional motorized trip total is therefore sensitive to the allocation of development between areas that differ in their measure of pedestrian and bicycle friendliness.

The next model in the four step process is the distribution model, which "distributes" the trip ends to produce person trips being made between modeling zone origins and destinations. The CMAP procedure uses an intervening opportunity distribution model, which uses the trip ends from the trip generation model as a measure of the number of satisfying opportunities, and a measure of the "difficulty" to travel between analysis areas (a trip impedance measure). The impedance measure used in the distribution model is the combined time and cost for both the highway and transit systems. This combined impedance (or generalized cost) measure is called the *LogSum* variable. The use of generalized cost allows the distribution model to be sensitive not only to highway and transit service levels but also to highway and transit costs.

The distribution model also incorporates the use of L-values, measures of how "selective" trip makers are towards "accepting" an opportunity to fill a trip need. The lower the L-value is, the more selective the person is in accepting an opportunity and, therefore, the longer the trip length is for a set of given opportunities. Typically the L-values are low in the center city, where there are many opportunities (attractions) and a person can be more selective, and high in low density suburban areas, where the opportunities are more limited. Years ago, L-values were developed based upon the geographic location of the traveler. These locations were primarily identified as the counties in the region and the city of Chicago. The current procedure relates the L-values to the number of opportunities that can be reached within a given generalized cost boundary. Thus the L-value is now related to the transportation service level (the generalized cost) and the land use form (the number of destination opportunities) which are explicit measures of transportation system service rather than travelers' location which was, at best, a proxy for this service level. This change in the method of estimating L-values allows the distribution model to respond to changes in residential and employment density (as density increases the L-value decreases) and changes in both transit and highway travel times and costs (as times or costs decrease the L-value decreases).

Mode choice is the third model in the process. This model, used after distribution, divides the total person trips resulting from the distribution model into transit person trips or automobile person trips. This allocation is based upon the times and costs for the available modes and the socioeconomic status of the traveler. The CMAP mode choice model is a multinomial logit model and is unique in that it uses simulation techniques to estimate many of the time and cost variables. The Monte Carlo simulation is an attempt to decrease the errors inherent in using average values by allowing the model to use knowledge of the distribution of attributes. The

simulation techniques are used to estimate parking costs, the traveler's income, and the access and egress times from the primary transit routes. The mode choice model is applied once for each person trip resulting from the distribution model. The model estimates the probability of this person trip using either mode and then the Monte Carlo simulation technique is used to allocate this person's trip to a specific mode, i.e. transit or auto user.
The fourth step of the travel demand procedure is the assignment model. The assignment model uses the auto person trips from the mode choice model and a description of the transportation system to estimate the volume of trips on each segment of the road network. For the air quality analysis, the highway assignment procedure is essential for estimating the vehicle miles of travel (VMT) on each highway segment, and also to estimate the speed of each highway segment. The highway assignment step has two significant features that are important for both transportation and air quality analysis. First, because it is a capacity-constrained equilibrium assignment, the level of service (in terms of travel time) worsens as additional volumes are assigned to each link. Second, the equilibrium procedure solution ensures that simulated travelers are not able to improve their level of service (i.e. travel time) by any alternate routing. For each individual simulated traveler, travel times are optimal to the supply and demand of transportation because the traveler cannot find a shorter route.

As shown in the diagram, the steps of trip distribution, mode split and time-of-day assignment are iterated through five times (iterations zero through 4). AM peak congested times and distances are used for the work trip purposes and midday times and distances are used for the nonwork purposes. To create these, the link volumes from each full model iteration time of day assignment are combined (the step termed volume balancing and speed recalculation) with the link volumes from the same period in the previous iterations using the Method of Successive Averages (MSA). For example, the link volumes resulting from the first and second iterations of the time-of-day highway assignment for period 3 are combined using the MSA procedure, then skimmed to produce the highway travel information input to the generalized cost calculation for the next iteration of the process.

The time-of-day procedure more realistically matches travel demand to network supply and structure as these vary over the course of 24 hours. The time of day procedure also incorporates features such as multiclass traffic assignment. This enables the conformity emissions analysis to reflect link volumes by specific vehicle type, rather than using regional or statewide averages. The highway time-of-day assignment splits into eight time periods the final highway trip tables from the iterated process. Separate assignments estimate highway vehicle-miles and travel speeds for eight time periods during the day: (1) the ten hour late evening-early morning off-peak period; (2) the shoulder hour preceding the AM peak hour; (3) the AM peak two hours; (4) the shoulder hour following the AM peak hour; (5) a four hour midday period; (6) the two hour shoulder period preceding the PM peak hour; (7) the PM peak two hours, and; (8) the two hour shoulder period following the PM peak hour. Results of the separate period assignments are accumulated into daily volumes, and also tabulated into the vehicle-mile by vehicle type by speed range tables needed for the vehicle emission calculations. The principal new element in

this analysis is the adaptation of model outputs for emissions calculation by the MOVES (the MOtor Vehicle Emissions Simulator) model.

The remainder of this document discusses each component of the four-step model and describes the various data inputs required to run the model.

2. Travel Model Data Inputs

A number of data inputs are required to provide the trip-based models with the information necessary to estimate travel patterns. "Demand" side information includes travel surveys to inform the models, as well as socioeconomic data on where people live and work. "Supply" side data include the physical roadway and transit networks. Different zone systems are used to aggregate data to meaningful geographies. This chapter briefly describes the data needs of the regional model.

2.1 Travel Survey Data

CMAP (and before it the Chicago Area Transportation Study) is the primary agency responsible for the development and maintenance of travel forecasting methods for the Chicago region. CMAP/CATS has been developing and improving these travel forecasting procedures regularly since 1956. The present set of models was originally developed using a 1970 home interview survey, which obtained the daily travel patterns for over 21,000 households in the region. The original CATS home interview survey was taken in 1956 and consisted of almost 40,000 household interviews.

In 1979 a much smaller home interview was conducted. This survey was combined with the 1980 Census Journey to Work data and was used to review and modify the agency's modeling procedures. Between 1988 and 1991 another large-scale home interview survey (over 19,000 households) was conducted. The information from this survey and the 1990 and 2000 Censuses have been used to update and modify the travel demand procedures.

Most recently, starting in January 2007 and lasting one year, CMAP completed a comprehensive travel and activity survey for northeastern Illinois called the "Travel Tracker Survey." A total of 10,552 households participated in either a 1-day or 2-day survey, providing a detailed travel inventory for each member of their household on the assigned travel day(s)[1]. As a test of available technology, four-hundred and sixty Travel Tracker participants also volunteered to wear global positioning devices (GPS) or to use auto-based devices to track their travel.

In addition to the home interview surveys, there have been several other data collection efforts, including a 1986 Commercial Vehicle Survey, a 1963 Pedestrian Survey, a 1987 Survey of Parkers in the Chicago Central Business District, and a 1991 Survey of Parking Spaces in the Chicago Central Business District, all of which have been used to enhance the region's travel demand procedures.

[1] In coordination with CMAP the same data were also collected for the Northwestern Indiana Regional Planning Commission (NIRPC) for three counties in northwest Indiana. The CMAP Travel Tracker data are available at Travel Tracker Survey -- Chicago Metropolitan Agency for Planning.

2.2 Socioeconomic Data

Base Year (2010) Data

Socioeconomic data used for trip generation estimates are derived primarily from three sources: 2010 Census Summary File 1 (SF-1), 2008 – 2012 American Community Survey (ACS), and ES-202 data from the Illinois Department of Employment Security. Block-level SF-1 data were summarized to subzones (described in section 2.5) using a block-to-subzone assignment procedure; ACS data were obtained at the split-tract (incorporated vs. unincorporated) level and allocated to subzone.

All data are reported at the subzone level for the entire modeling area. Along with the necessary geographic identifiers, the Socioeconomic file contains the following variables:

- **Number of Households (HH)**
  This is a straight count of Households (*Occupied Housing Units, Table H3*) from 2010 block-level Census counts, summarized to subzones.

- **Average Number of Adults (aged 16 & over) per Household (AHH)**
  Average Number of Children (aged 15 & under) per Household (CHH)
  Census SF-1 data report the number of people per block per age-year up to age 20 (*Table P14*) broken out by sex; however, this table does not distinguish between Household and Group Quarters (GQ) populations. For blocks without a reported GQ population, all age columns between "Under 1 Year" and "15 years" are summed for a total count of children (15 & under); the adult count for these blocks then is the total population minus children.

  For blocks that include a Group Quarters population, the Population in Households (*Table P16*) data were used to get a count of household population aged 18 and up as well as the below-18 population. Assuming adjacent blocks had similar age distribution characteristics, a GIS-based "near" function was used to get the average percentage of the under-18 population in the 12-15 and 16-17 age groups for the five non-GQ census blocks closest to each GQ census block. Those percentages were then applied to the "Under 18 Population in Households" total for GQ blocks to estimate the number of people in households aged 12-15 (needed for **P1215**, below) and 16-17 in those blocks.

  Once age 0-15 and 16+ totals were calculated for each block, they were summarized at the subzone level using block assignment procedures, and applied against subzone Household counts to determine Adults per Household and Children per Household rates.

- **Average Number of Workers per Household (WHH)**
  Developed using the Census' American Community Survey (ACS) split-tract (Summary Level 080) data (*Workers 16 Years and over in Households, B08137.001*), pushing the worker

count estimate down to each split-tract's component blocks by using the ratio of aforementioned workers to the total population in households aged 16 & over. This ratio was applied to the total count/estimate of persons in households over age 16 at the block level. Workers-per-block estimates were then summarized to subzone using the block assignment procedures.

- **Household Income Index (HHII)**
  This is defined as the *mean income of the subzone* divided by the *regional median income*.
  - Subzone Mean Income**:** Used tract-level ACS table *Aggregate Household Income in the Past 12 Months* (*Table B19025*), along with ACS household estimate for each tract[2]. Using a tract-to-subzone allocation table, each tract's aggregate income and ACS household total was apportioned to all subzones that the tract participates in (this apportionment is based on 2010 block-level household counts, with the portions going to the corresponding subzone that each block is assigned to). A new, subzone-level aggregate income is created by summing all of the tract-portions assigned to each subzone; this total is divided by the number of apportioned ACS housing units summed to the subzone.

    For consistency with previous trip generation files, all subzones with a "0" HHII value (due to being unpopulated) were assigned a non-zero value based on the HHII of the closest subzone, using the GIS "Near" function

  - Regional Median Income: Since the CMAP modeling area does not conform to a reported Census geography, a regional median was estimated using the sum of split-tract income data presented as a grouped frequency distribution in *Table B19001, Household Income in the Past 12 Months (in 2010 inflation-adjusted dollars*). The general approach was to determine a median value using grouped frequency distributions.

- **Private Vehicle Mode Share of All Worker Trips to Work (PVMS)**
  This is the ratio between the workers in a subzone (all workers, not just those in households) who commute by auto (single-occupant vehicles, carpool & taxi) divided by the number of workers in the subzone. Estimates of workers at the block level were taken from tables generated during the **Workers per Household** (above) and **Workers in Non-Institutional Group Quarters** (below) procedures. This total was then split into a sum of "drivers" (car, truck or van, alone or in carpool, plus those taking a taxi) based on the ACS (*Table B08301, Means of Transportation to Work*) percentage of workers using those modes for the census split-tract that each block belongs to. The drive/no-drive totals were then summed to subzone; final PVMS is calculated as (Drivers) / (Drivers + Non-Drivers).

[2] Note that two missing tract-level values were replaced by subtracting the known tract values from the parent Township values.

For consistency with previous trip generation files, all subzones with a "0" PVMS value (due to being unpopulated) were assigned a non-zero value based on the PVMS of the closest subzone, using the GIS "Near" function.

- **Pedestrian Environment Factor (PEF)**
  Pedestrian Environment Factor is used to help predict mode choice based on how walkable an area is and is also used to estimate household vehicle availability. There is no single, commonly-accepted method for calculating PEF; however, most case studies cite the need for a large amount highly-detailed data (such as availability and condition of sidewalks, pedestrian route connectivity, and amenities/destinations) which are not available for the entire CMAP region. Street network density is used as a proxy for walkability, filtering out the obviously non-walkable roadways (such as Interstates), and adding pedestrian routes where available. The source for this street/pedestrian network is NAVTEQ®.

  Network density is calculated for each subzone's "catchment area," which is an expanded version of the subzone. Finally, the density figure is scaled by a constant value so that the range of scores conforms to the historic range of values used in earlier versions of the models, which relied on a straight count of Census blocks.

- **Percent of Children (aged 15 & under) Between the Ages of 12 and 15 (P1215)**
  Generated with the **HH**, **AHH** and **CHH** variables; population aged 12-15 is summed (in non-GQ blocks) or estimated (in GQ blocks) and divided by total population in households aged 0 - 15.

- **Workers Living in Non-Institutionalized Group Quarters (WNIGQ)**
  Non-Workers Living in Non-Institutionalized Group Quarters (NWNIGQ)
  The WNIGQ/NWNIGQ figures were based on the 2008-12 ACS estimate for Civilian Population Living in Households *(B27015.001*) at the split-tract level. The Civilian Workers in GQ and Civilians in NIGQ were generated by comparing a series of different population totals from the ACS [Armed Forces (*B23001*), Civilians in Households (*B27015*), Civilian Non-Institutionalized Population (*B27001*), Total Population in Households (*B09019*), Total Workers in Households (*B08137*), and Total Workers (*B08101*)]. A ratio between Civilian Workers in GQ and Civilian Workers in NIGQ was then applied to the college/other categories at the block level to develop a civilian employed NIGQ population. Totals were then summarized to subzone.

- **Number of Retail Trade Jobs in Subzone (RETAIL)**
  Total Number of Jobs in Subzone (TOTEMP)
  Employment totals for all Illinois subzones (CMAP region plus Illinois counties in the modeling area) are internally-derived estimates based on Illinois Department of Employment Security (IDES) ES-202 data, geocoded at CMAP; totals are controlled by

the Bureau of Labor Statistics' (BLS) *Current Employment Statistics* and the Census Bureau's *County Business Patterns* reports.

Employment estimates for the Indiana and Wisconsin portions of the CMAP modeling area used Dun and Bradstreet business location data as a starting point to determine the distribution of employment in those areas; they were then subject to the same BLS/Census control procedures as the Illinois data.

Retail totals are based each businesses' NAICS code. Companies with a two-digit NAICS code of 44 or 45 (Retail Trade) were counted as Retail, with the exception of those businesses with a three-digit NAICS of 454 (Non-Store Retailers).

Forecast Year Data

Most socioeconomic variables for the 2040 horizon originate with the revised Forecast of Population, Households and Employment (see *GO TO 2040 Update Appendix: Socioeconomic Forecast Update Overview*). Households, Population in Households, and Total and Retail Employment were all direct outputs from the forecast model. Household composition was based on existing rates of adults per household, workers were derived from the existing worker-to-adult ratio, and children were based on subtracting adults in households from the total household population. Household Income, Pedestrian Environment Factor, and Private Vehicle Mode Share were based on current (2010) figures.

Horizon-year data for the extra-regional portion of the modeling area were derived from figures provided by the Southeastern Wisconsin Regional Planning Commission (SEWRPC) and Northwestern Indiana Regional Planning Commission (NIRPC). These data were supplemented by the original CMAP 2040 forecast for these areas, as well as household and employment projection data from Woods and Poole.

2.3 Highway Network

The Master Highway Network (MHN) is the official road network database used to develop travel demand model networks at CMAP. The MHN includes roads within northeastern Illinois that have a functional classification of Minor Collector or higher. In certain instances, additional local roads have been included in the MHN to provide connectivity within the network.

The MHN covers an area of more than 10,000 square miles and extends into northwestern Indiana and southeastern Wisconsin, as shown in Figure 2. The MHN includes roadways for the following areas:

- *Illinois*: Twelve full counties (Boone, Cook, DeKalb, DuPage, Grundy, Kane, Kankakee, Kendall, Lake, McHenry, Will and Winnebago) and three partial counties (LaSalle, Lee and Ogle).
- *Indiana*: three full counties (Lake, LaPorte and Porter).

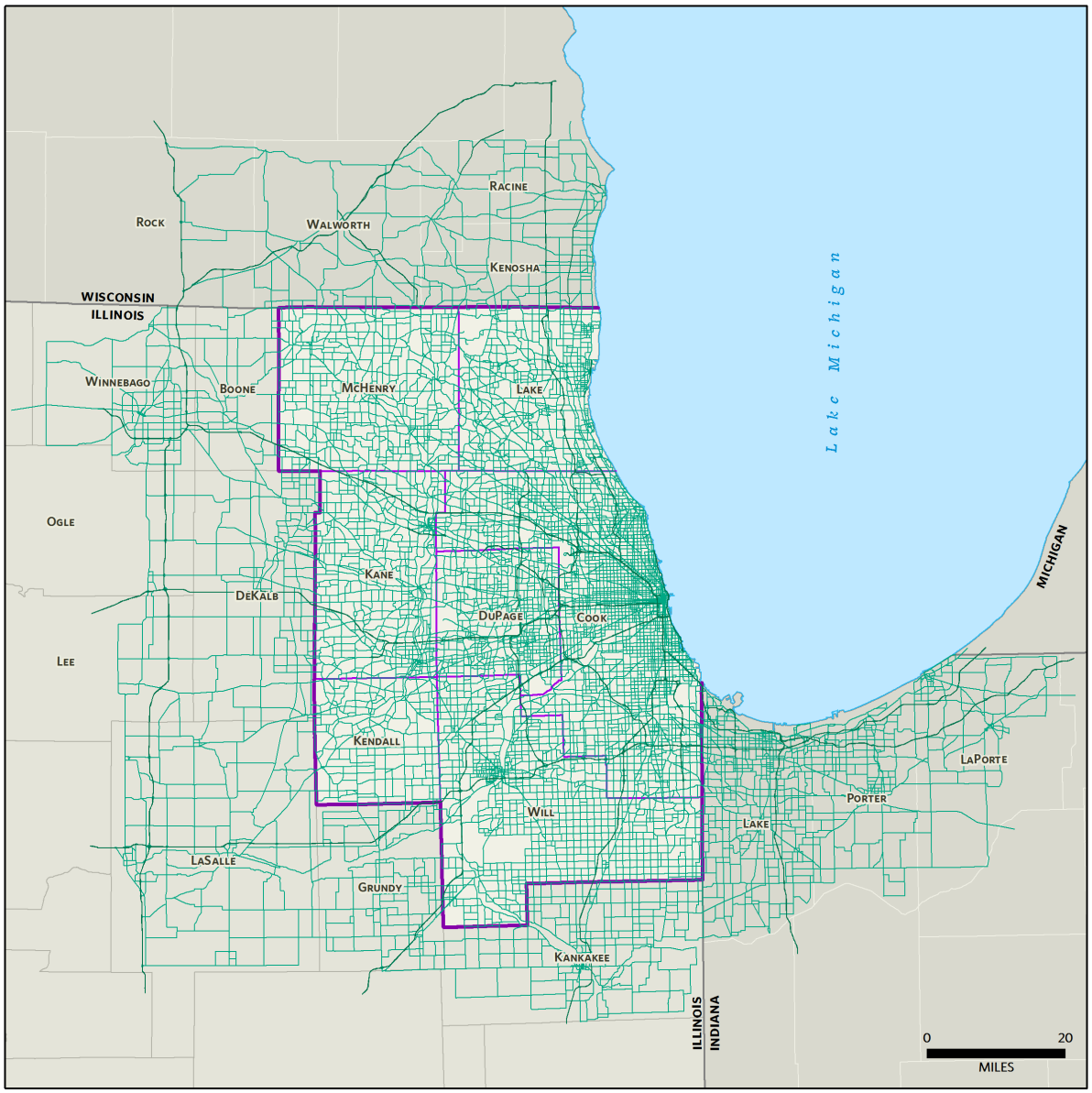
- *Wisconsin*: three full counties (Kenosha, Racine and Walworth) plus additional minimal roadway network extends into two other counties (Milwaukee and Rock).

The current CMAP Planning Area only includes the Illinois counties of Cook, DuPage, Kane, Kendall, Lake, McHenry and Will, along with Aux Sable Township in Grundy County. In March 2013 the CMAP Board and MPO Policy Committee approved expanding the Planning Area to include the townships of Sandwich and Somonauk in DeKalb County; final approval by the Governor is anticipated by June 1, 2014. The three Indiana counties covered by the MHN represent the planning area for the Northwestern Indiana Regional Planning Commission. Most of the Wisconsin terrain covered by the MHN is within the planning area of the Southeastern Wisconsin Region Planning Commission.

The MHN is a collection of links and nodes that represents roadway segments and intersections throughout the region. It contains information on more than 45,000 directional roadway segments and includes more than 17,500 nodes. The MHN is a comprehensive database for CMAP's regional travel demand modeling needs: it contains not only existing roadway segments and intersections, but also future planned facilities and improvements.

The MHN itself is edited and maintained using ESRI's ArcGIS® Geographic Information System (GIS) software. The MHN has a current base year of 2010, meaning that the roadway attributes on existing facilities represent the "on-the-ground" conditions from that year. It is a relational database (specifically, an ESRI file geodatabase) that maintains spatial and topologic relationships between features classes. The feature classes that define the roadway network in the MHN are arcs (also called links) and nodes. The projection of the data is State Plane Coordinate System, Illinois East zone, North American Datum of 1927. The unit of length is the U.S. Survey foot.

Figure 2. CMAP Master Highway Network



Network Arc-Node Topology

MHN arcs represent roadway segments located between intersections. Most arcs in the MHN are digitized as bi-directional links with the appropriate direction-specific attributes coded to the link. Expressways are digitized as a set of parallel single-direction links in order to replicate their limited-access characteristics.

Table 1 lists the highway network link variables contained in the arc attribute table that are relevant to CMAP's production modeling work. The attribute table also contains additional information not currently used for modeling purposes. As most links in the network represent

bi-directional roadway segments, attributes must be included for each direction. Variable names ending in "1" describe attributes in the anode-bnode direction of the link (this is the "from-to" direction of a link, recognized by GIS software based on how the link was digitized). Those variable names ending in "2" represent attributes in the opposite direction. The directions variable indicates whether a link is a single or bi-directional segment and has three possible values, which determines how link attributes are coded:

- 1 – The link represents a single direction of travel; no second direction variables are coded (i.e., they equal 0).
- 2 – The link represents both directions of travel and all attributes are the same in both directions; no second direction variables require coding (except applicable parking restrictions).
- 3 - The link represents both directions of travel and at least one attribute differs between the two directions; all second direction variables require explicit coding.

The *baselink* variable identifies whether a segment represents an existing facility (value of one) or a future facility (value of zero, referred to as skeleton links). If *baselink*=0, only *anode*, *bnode*, *miles* and *directions* are coded on highway links. The exception to this *baselink*=0 rule is if *modes*=4 (transit only): then *thrulanes1* and *type1* are also coded. All other link attributes are fairly straightforward in their definition. Each link in the coverage is identified by a unique anode-bnode-baselink combination (variable *ABB*).

Table 1. Master Highway Network Link Attributes

Variable	Description
ANODE	CMAP "From" node of link.
BNODE	CMAP "To" node of link.
MILES	Link length in miles.
TYPE1 & 2	Facility Type: 1=Arterial 2=Freeway 3=Freeway/Arterial Ramp 4=Expressway 5=Freeway/Freeway Ramp 6=Centroid Connector 7=Toll Collection link 8=Metered Ramp
TOLLDOLLARS	Toll amount in dollars. [This is the I-PASS rate for autos.]
AMPM1 & 2	Time period restrictions: 1=open all time periods 2=open periods 2-5 (Kennedy reversible lanes inbound) 3=open periods 1, 6-8 (Kennedy reversible lanes outbound) 4=open off-peak periods only
SIGIC	Signal interconnect flag: 0=no, 1=yes
POSTEDSPEED1 & 2	Posted speed limit.
THRULANES1 & 2	Number of driving lanes. [This represents the most-restrictive capacity on the link, i.e., the fewest number of lanes present.]
PARKLANES1 & 2	Number of on-street parking lanes.
PARKRES1 & 2	Peak period parking restrictions, when on-street parking is not available and an extra through lane is available. *Coded separately for each direction on **all** 2-way links.* Code is text string of affected time periods (currently only 3 & 7). Default blank value means no peak period parking restrictions.
THRULANEWIDTH1 & 2	Average driving lane width.
BASELINK	Link description flag: 0=future project link ("skeleton" link); attributes added with project coding 1=existing network link ("base" link); all attributes present,
DIRECTIONS	Link directions flag: 1=one way 2=two way, attributes in both directions identical 3=two way, at least one attribute different in opposing direction
MODES	Modes permitted on link: 1=all vehicles 2=autos only 3=trucks only 4=transit only (only called for transit networks, currently only used for Grant Park busway links)
ABB	Text concatenation of Anode "-" Bnode."-" Baselink.
TRUCKRES	Truck restriction code: 0=no known restriction. 1=no trucks. 2=no trucks greater than 5 tons. 3=no trucks except B plates.

Nodes in the MHN represent intersections between roadways or junctions where roadway segments converge/diverge, such as an entrance ramp merging into an expressway through lane. The arc-node topology enforced in the MHN is that nodes represent the end points of arcs and arcs with common end points are connected. CMAP's modeling staff maintains a set of scripts that automatically update network topology after edits have been made and populate a number of attribute fields.

Node attribute variables are listed in Table 2. These mostly serve to define the network arcs by providing values for *Anode* and *Bnode*. Values for the entire set of node variables listed are automatically populated through scripting. If desired, the unique node number may be manually edited, but all other node attributes are addressed through the scripts.

Table 2. Master Highway Network Node Variables

Variable	Description
NODE	CMAP network node number.
POINT_X	Auto-generated x-coordinate (NAD27 IL East State Plane feet).
POINT_Y	Auto-generated y-coordinate (NAD27 IL East State Plane feet).
ZONE09	Zone number from current CMAP modeling zone system.
CAPACITYZONE09	2009 Capacity zone code: 1=Chicago Central Business District (2009 subzones 1-47) 2=Remainder of Chicago Central Area (2009 subzones 48-80) 3=Remainder of City of Chicago (2009 subzones 81-976) 4=Inner ring suburbs where Chicago street grid is generally maintained 5=Remainder of Illinois portion of the Chicago Urbanized Area 6=Indiana portion of the Chicago Urbanized Area 7= Other Urbanized Areas and Urban Clusters within the CMAP Metropolitan Planning Area **plus** other Urbanized Areas in northeastern Illinois 8=Other Urbanized Areas and Urban Clusters in northwestern Indiana 9=Remainder of CMAP Metropolitan Planning Area 10=Remainder of Lake County, IN (rural) 11= External area 99= Points of Entry – not defined in the Capacity Zone system

Spatial and Geometric Accuracy

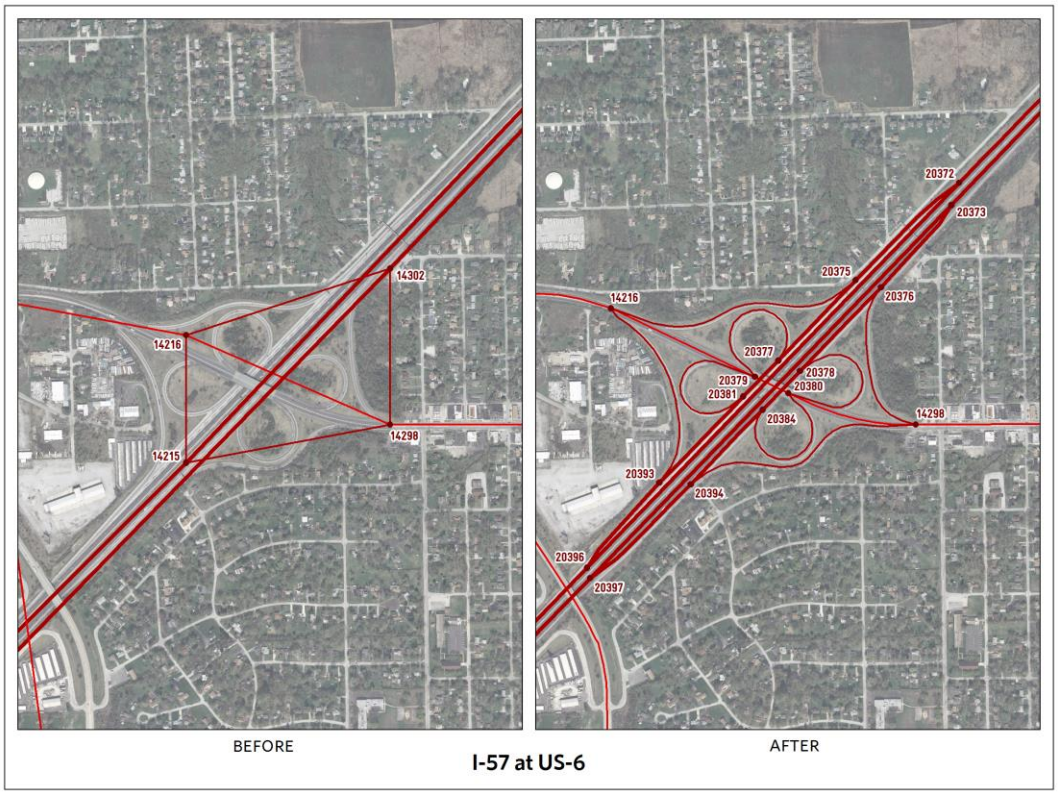
Standard trip-based modeling software only requires that networks be schematic representations of the roadway system, explicitly defining the length of roadway segments, selected attributes and providing general network connectivity. Advanced modeling techniques such as microsimulation require a more robust network, as roadway geometry enters into the calculus of operational performance. Additionally, the ubiquitous use of GIS software has increased the possibility that the MHN may be viewed as a general data resource for purposes other than travel demand modeling. These factors led CMAP staff to undertake a systemic process of improving the spatial accuracy of intersection locations and incorporating roadway geometry into the MHN, guided by the model network improvement needs identified in the **CMAP Strategic Plan for Advanced Model Development**.

The legacy of travel demand modeling at CMAP (and one of its predecessor agencies, CATS) predates the advent of GIS software. While CMAP has been maintaining the MHN in GIS since the mid-1990s and the network has been greatly expanded and modified over the years, staff resources did not allow for a wholesale update of the network to make it appear more realistic. From mid-2010 through the end of 2012 CMAP staff undertook an effort to update the network. A set of scripts and procedures was developed to automate the network update as much as possible, and to automate quality control review to target specific areas requiring manual review and adjustment. Among the network improvements made were:

- Moving intersection locations to spatially accurate positions.
- Applying vertex coordinates to links in order to replicate roadway geometry.
- Converting expressway interchanges from schematic representations to fully-expanded interchanges including ramps representing all possible traffic movements.

Figure 3 illustrates one interchange in the MHN, both before and after the spatial and geometric updates were applied to the network.

Figure 3. Master Highway Network Geometric Improvement Example



Highway Project Coding

As mentioned, the MHN includes links serving as placeholders for future planned facilities, identified by *baselink*=0. The TIP database is the official and only correct repository of all project information. While only projects which can be modeled are analyzed within the travel demand models, relying solely on the TIP database for project information provides a single direct link for reconciling network coding with the planned improvement.

Highway project coding is stored within a route system in the MHN database. A group of network links is selected to define an individual route (i.e., a specific highway project) within a route system. The route attribute table contains summary information for each project, shown in Table 3. Routes are understood within the database topology through the individual sections which comprise them; sections correspond to the arcs which are referenced by the individual highway project. This data structure allows a single highway project to be associated with numerous MHN arcs and by extension, allows a single MHN arc to be associated with multiple highway projects. The end result is that the section attribute table contains one record for every arc referenced by every highway project.

Table 3. Master Highway Network Highway Project Route Attributes

Variable	Description
TIPID	TIP project identification number.
COMPLETION_YEAR	Project completion year from TIP.

The section table is used to store link attributes that will be updated or applied when the associated highway projects are completed, and an action code that determines how the attributes for each link are processed. The list of section table variables is shown in Table 4; most directly correspond to link attributes in the arc table. As with the arc attribute table, variables ending in "1" apply to the "from-to" direction of the link. During network processing data from the arc attribute table are updated (overwritten) with section table entries to represent conditions after the project is implemented. Only those attributes changing due to project implementation are coded in the section table.

Section table coding rules for parking lanes are slightly different than for other variables. The values for this attribute are added to (or subtracted from) arc table coding to yield the final result. This allows for these attributes to be increased, decreased or removed. This is necessary because there is no practical way to determine whether a zero in the section table represents no change in conditions or the removal of this particular attribute.

Four action codes control the link processing. Action code 1 modifies the coded attributes on links with existing attributes. Action code 4 is applied to new links (skeleton links), which have no attributes except *miles* and *directions*. Action code 2 is used when new links replace an old link without any change in its attributes (such as when a new intersection is introduced into the network). This action code requires that *replace_anode* and *replace_bnode* are filled in; these

represent the nodes of the link where the attributes will be drawn from. Action code 3 deletes a link from the network.

Table 4. Master Highway Network Highway Project Section Attributes

Variable	Description
TIPID	TIP project identification number.
ACTION_CODE	CMAP action code: 1=modify (change an existing network link) 2=replace (replace an existing link with a new one but retain all attributes) 3=delete (remove a link from the network) 4=add (add a new link to the network)
NEW_TYPE1 & 2	New facility type number.
ADD_SIGIC	Add signal interconnect to link (code=1).
NEW_THRULANEWIDTH1 & 2	New driving lane width.
NEW_THRULANES1 & 2	New number of driving lanes.
NEW_POSTEDSPEED1 & 2	New speed limit.
REP_ANODE REP_BNODE	CMAP nodes of link providing attributes, ONLY for action_code=2.
NEW_TOLLDOLLARS	New toll amount.
NEW_DIRECTIONS	New directions flag.
ADD_PARKLANES1 & 2	Add/remove parking lanes, coded number will be added to number in AAT to calculate final lanes (code positive to add, negative to remove).
NEW_AMPM1 & 2	New time period restrictions.
NEW_MODES	New modes permitted.
TOD	Time-of-day code indicating specific time periods when changes are applied. Default of blank or 0 means changes applied to all periods. Code is text string of affected time periods: 1=8 PM – 6 AM 2=6 AM – 7 AM 3=7 AM – 9 AM 4=9 AM – 10 AM 5=10 AM – 2 PM 6=2 PM – 4 PM 7=4 PM – 6 PM 8=6 PM – 8 PM

Storing the existing and future highway network components in a single database allows the analyst to ensure that project and base network information reconciliation is handled comprehensively, with all of the analysis networks for a particular application, at one step, existing in a single dataset. Storing the MHN in a GIS format also greatly simplifies project-coding tasks. The MHN structure allows for:

- Analysis into multiple future years – Assignable networks are produced that maintain consistent project coding into future years (e.g., a project that is built in an earlier year will be included in all subsequent networks).
- Analysis across multiple scenarios – Assignable networks are produced that maintain consistent project coding between differing analysis scenarios (e.g., a project that is included in one land use scenario will be identically coded in any other appropriate scenario).

This topology was in direct response to the types of comparative evaluations that were necessary under the air quality conformity baseline/action rules. With approval of a State Implementation Plan budget, conformity analysis no longer entails a baseline/action test so a simpler hierarchy is utilized. Nonetheless, this ability is useful within any forecasting exercise where multiple time frames and scenarios are compared (e.g. land use/transportation interactions).

A list of modeled project TIP identification numbers and the year in which they are to be constructed is all that is required to create a set of highway network files for the travel demand modeling software (Emme®). The completion year is attached to each project and stored in the route table. As complete project coding information exists in the section and route tables, a simple mathematical expression is able to select only those records needed to prepare the desired analysis year network. A set of scripts written in Python and SAS® process all of the project coding information, apply the attribute updates to the set of links comprising the scenario network, and create a set of time-of-day link and node attribute files suitable for import into Emme®. Figure 4 provides an illustration of this process.

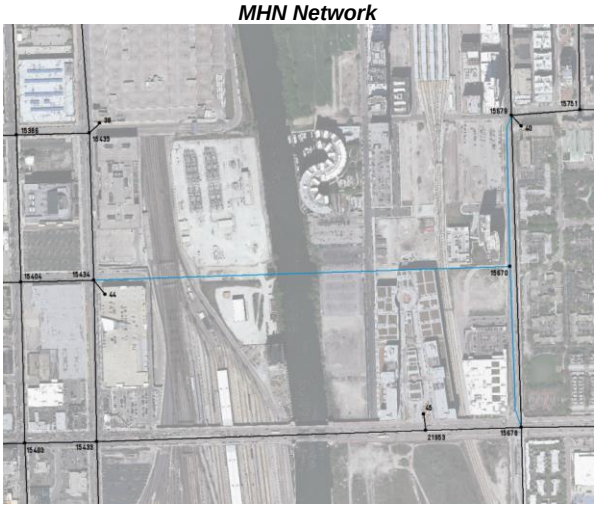
Bus Route Coding

The northeastern Illinois region has one of the most extensive public transportation systems in North America. Bus and rail service is provided by three local public operating agencies: the Chicago Transit Authority (CTA), Metra commuter rail and Pace suburban bus. Each of the three agencies has its own autonomous board, management and operating personnel. The agencies' service areas overlap to varying degrees and many riders' trips involve transfers between services provided by different operators.

The CTA operates bus service within the city of Chicago and several adjacent older suburbs. Pace operates nearly exclusively in the suburbs, with selective express service to downtown Chicago. Pace operates regular bus routes, feeder buses focused on providing connections to suburban Metra commuter rail and CTA rail stations, all paratransit service in the region, a vanpool program and some long distance express buses. Bus route coding maintained in the model networks includes publicly-operated fixed route service, but does not include vanpools, paratransit or subscription service.

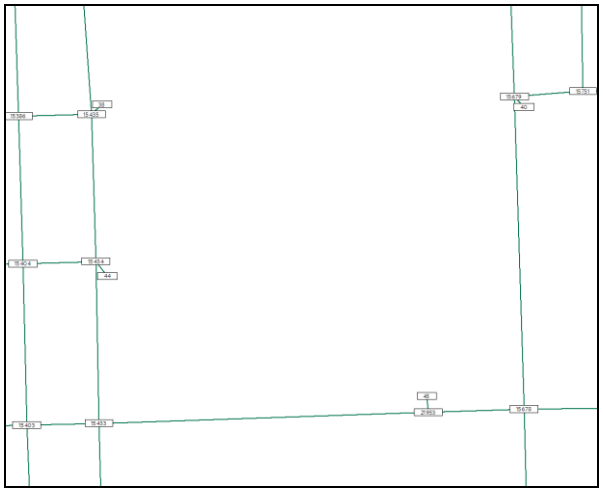
Figure 4. Highway Network Coding Example

MHN Network



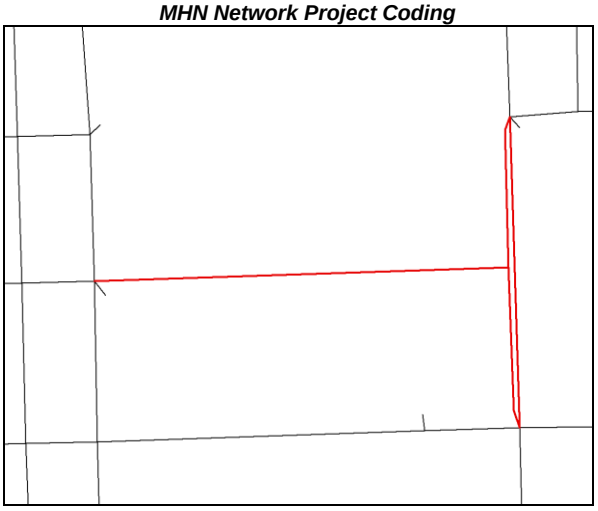
Step 1.
All existing roadway facilities (black) and a future planned facility (blue) are coded into the MHN. The future roadway extension will span a rail yard and a river, will tie into an existing intersection on the west and will create a new intersection on the east.

Emme Network – Base Year Scenario



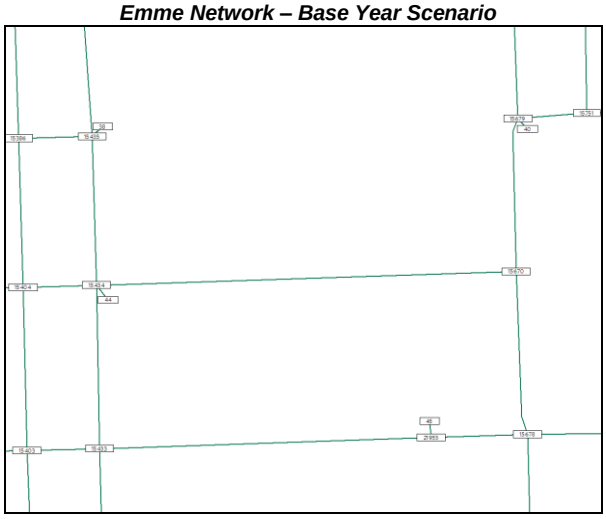
Step 2.
An Emme base year scenario network is created. Since the roadway extension does not currently exist, it is not reflected in the model network.

MHN Network Project Coding



Step 3.
All links impacted by the project are associated with the project ID through a route system (red). The link coding contained in the route system's section table serves as a set of instructions on how to process each link. The coding identifies which links associated with this project to: (1) add to the network, (2) delete from the network and (3) replace with new links but apply the attributes of the old link.

Emme Network – Base Year Scenario

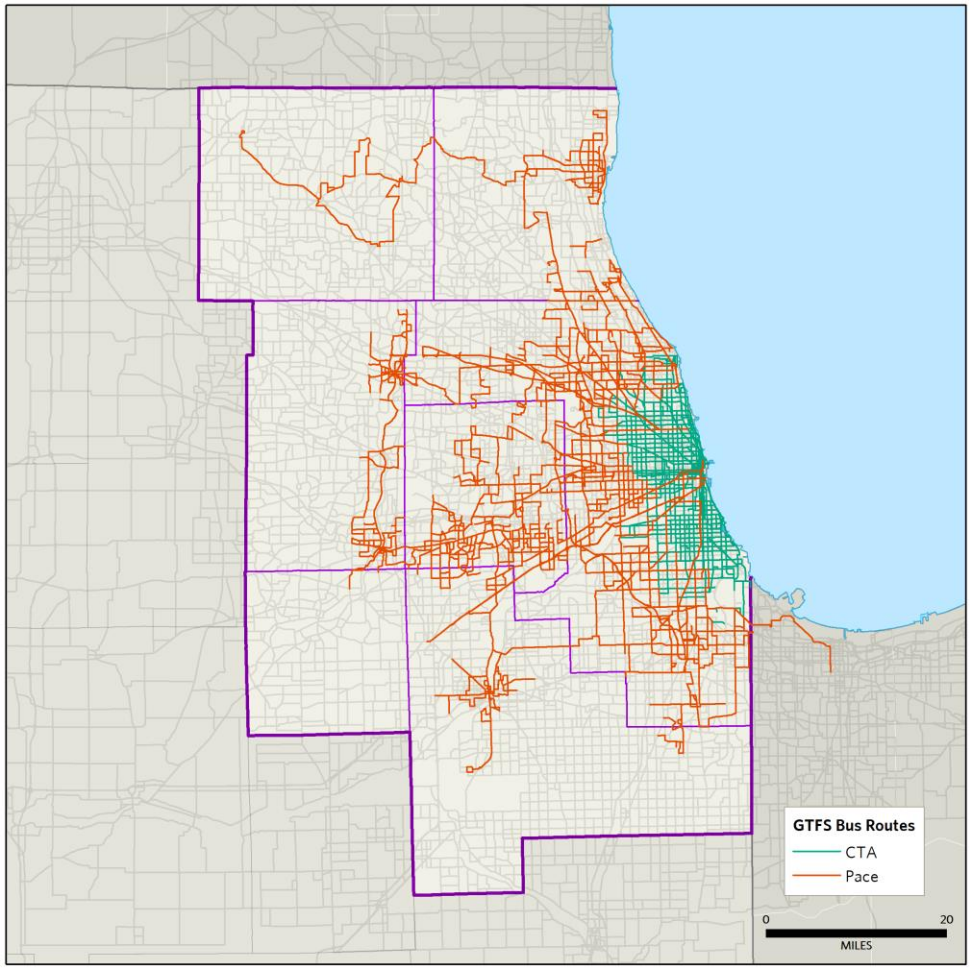


Step 4.
A future scenario modeling network includes the roadway extension and the new intersection.

Bus route coding is maintained as a separate route system within the MHN. This ensures that bus coding always reconciles with the underlying highway network arcs. Bus routes are forced to conform to the available MHN links: if a particular route uses local streets that are not

included in the MHN, the coding for the route is altered accordingly so that it only uses MHN links. Figure 5 shows the extent of the region's bus service.

Figure 5. Master Highway Network GTFS-Based Bus Coding



Bus coding in the MHN includes the complete itinerary (or node-by-node path) of the bus route and attributes associated with each itinerary segment. Bus routes are coded as single-direction runs. CMAP bus coding is derived from General Transit Feed Specification (GTFS) data files created by the transit operators. The GTFS files contain data on all runs of every bus during the entire week. As CMAP models weekday traffic, the bus coding data from the GTFS files are limited to a representative weekday (Wednesday).

Conversion of the GTFS data from its raw form into usable bus coding proceeds through a series of steps:

1. Geographic data are stored in MySQL. Python scripting is used to identify a group of potential MHN nodes that corresponds to each of the bus stop locations contained in the data files.

2. Using a set of rules, a MySQL query determines which stop(s) are assigned to specific MHN nodes. Bus run data are then reformatted into itineraries, which include departure and arrival times at each itinerary stop, calculated from the GTFS time associated with each stop. At this stage, the itineraries are somewhat independent of the MHN network: while they are constructed using MHN nodes, there is no guarantee that the itinerary segments formed correspond to actual network links, as defined by a specific *anode-bnode* combination. This is true because a particular bus may not stop at a consecutive set of connected nodes within the network, especially if it is express service.
3. Reconciliation with the network arcs is accomplished through a set of SAS and Python scripts. In instances where the segments do not align with a network arc, a shortest path algorithm is used to link the itinerary segment nodes together by building a useable path on the network. The segment attributes are then apportioned over the new sections appropriately and they are inserted into the bus route itinerary. Additional logical tests are performed and faulty data (such as an itinerary segment with the same node at both ends or a route with an initial departure time equal to the final arrival time) are corrected using a set of rules. The end result is a set of itineraries with all segments corresponding to MHN links. Automated procedures ensure logical coding is developed: for instance, coded buses are not allowed to travel the wrong direction on a one-way link.
4. The bus route and itinerary data are then imported into the MHN database.

As with the highway project coding, bus route data are stored in a set of related data tables; these tables relate to the arc table in the same manner as the highway project coding tables. The bus coding route and section tables are linked through the *transit_line* variable, which is a unique identifier given to each bus run.

Table 5 highlights the data fields maintained in the MHN that are used to describe bus route attributes. The variables shaded in blue correspond to header information Emme requires when reading in bus itineraries; others attributes are merely informational. Note that at this point the *headway* value only represents the total number of minutes in the time-of-day period within which the bus run occurs. The actual bus service headway is calculated at a later stage.

Table 5. Master Highway Network Bus Route Attributes

Variable	Description
TRANSIT_LINE	Unique CMAP bus route identifier (6 characters).
DESCRIPTION	Real-world description of bus route (20 characters maximum – limit imposed by Emme).
MODE	Bus mode code: B=CTA regular service E=CTA express service P=Pace regular service Q=Pace express service L=Pace local service
VEHICLE_TYPE	Bus vehicle type code (based on mode code): 1=mode B 2=mode E 3=mode P 4=mode Q 5=mode L
HEADWAY	Length of the time-of-day period (in minutes) within which the bus run falls.
SPEED	Average bus route speed in MPH from GTFS data; minimum value of 15 allowed. [Not used in CMAP modeling but a non-zero value is required by Emme.]
FEEDLINE	Unique GTFS identifier for each run.
ROUTE_ID	Number of bus in route name (e.g. 52A, 112, X98).
LONGNAME	Proper name of bus in route name (e.g. Wentworth, Halsted/95th).
DIRECTION	Predominant direction of travel for bus run.
TERMINAL	Location of final stop on bus run.
START	Start time of bus run in seconds.
STARTHOUR	Start hour of bus run.
AM_SHARE	Proportion of run that occurs within the AM Peak period (7 AM - 9 AM). Simple count of itinerary segments; full segment must be covered within the time period.
CT_VEH	Extended transit vehicle types used for CT-RAMP.

The actual itinerary information for bus routes is contained in the section table variables which are listed in Table 6. The itinerary provides the node-by-node path on the MHN that the bus follows. Again, most of these variables reflect information that Emme expects to receive when bus routes are imported.

Two GTFS-based bus coding route systems exist simultaneously in the MHN database:

- Bus_base – GTFS–based coding that corresponds to CMAP's model base year of 2010 (reflecting service at that time).
- Bus_current – Coding built from the most recent GTFS data files. This represents up-to-date coding and is used as the basis for future modeling scenarios.

Each of the bus route systems listed above contains nearly 26,000 bus runs comprised of more than 700,000 itinerary segments, representing one weekday of service. For travel demand modeling purposes, the bus runs are combined into representative bus routes. A script analyzes the runs of each particular bus route that occur during a time-of-day period, and uses the stopping pattern to determine which are similar enough to be collapsed into a "typical" directional bus route. The start times of all of the individual runs that are associated with a representative bus route are used to calculate the service headway that goes into the travel demand model.

Table 6. Master Highway Network Bus Itinerary Attributes

Variable	Description
TRANSIT_LINE	Unique CMAP bus route identifier (6 characters).
ITIN_A	CMAP node number of first node of link bus travels on.
ITIN_B	CMAP node number of second node of link bus travels on.
ABB	Unique ID of the segment's corresponding MHN link.
ITIN_ORDER	Order number of bus segment in itinerary.
LAYOVER	Layover time in minutes applied to itinerary_b. Default=3.
DWELL_CODE	Code for stops (corresponding Emme code), applied to itinerary_b: 0=stop allowed (default time of 0.01 minutes) 1=no stop (#) *available for future use:* *2=alighting only (>)* *3=boarding only (<)* *4=boarding & alighting allowed (+)* *5=dwell time factor (*)*
ZONE_FARE	Incremental zone fare in cents.
LINE_SERV_TIME	Itinerary segment travel time in minutes.
TTF	Emme transit time function code: 0,1=1 2=2 (used for Bus Rapid Transit/Arterial Rapid Transit only)
DEP_TIME	Departure time at beginning of segment from GTFS data (in seconds).
ARR_TIME	Arrival time at end of segment from GTFS data (in seconds).
LINK_STOPS	Number of stop locations from GTFS data that were combined into itinerary segment.
IMPUTED	Flag indicating segment was imputed by shortest path algorithm during import. 0=not applicable. 1=itinerary segment created by shortest path algorithm. 2=segment modified by logic to condense unreasonable vacillation in itinerary.

Table 7 lists the eight time-of-day (TOD) modeling periods used by CMAP. It also includes the selection rules used to determine which TOD period a particular bus run falls in, and shows the number of representative bus routes (from bus_current) used in the travel demand model. An additional TOD bus network (AM peak) is created to generate the transit level-of-service variables used to develop zonal generalized costs for the travel demand model.

The AM peak network is a bit more inclusive than the one included in time period 3, as illustrated by the selection rules. The representative routes comprising each TOD bus network are created "on-the-fly" when the networks are needed. While the regional travel demand model uses the AM peak bus network, the eight individual time-of-day bus networks are used in CMAP's activity-based model.

Table 7. Time-of-Day Bus Routes

Time Period	Selection Rule	Number of Bus Routes
1 – (8 PM – 6 AM)	*Starthour* >=20 or *Starthour* <=5	606
2 – (6 AM – 7 AM)	*Starthour* =6	631
3 – (7 AM – 9 AM)	7<= *Starthour* <=8	698
4 – (9 AM – 10 AM)	*Starthour* =9	497
5 – (10 AM – 2 PM)	10<= *Starthour* <=13	503
6 – (2 PM – 4 PM)	14<= *Starthour* <=15	645
7 – (4 PM – 6 PM)	16<= *Starthour* <=17	653
8 – (6 PM – 8 PM)	18<= *Starthour* <=19	563
AM – (7 AM – 9 AM)	*Am_share* >=0.5	702

Future Bus Coding

While the GTFS data provide for current bus service, future bus route service is also coded in the MHN to represent future planned or programmed service. Consistent with GTFS bus runs, future bus routes are coded as single-direction service. While GTFS routes are coded on existing network links (*baselink*=1), future routes are coded to run on future highway network links (i.e., links that will be in the network in the horizon year of the projects being modeled). Thus it is very convenient to have the highway project coding information stored in the same database as the bus coding.

Table 8 lists the future bus route information stored in the route table. Many of these variables provide the bus route information Emme requires to build transit routes and have the same definition as in the GTFS-based bus coding table. The *notes* field is used to store TIP project numbers or other useful information related to future bus service. The following variables provide instructions on how the future routes are processed:

- *Scenario* – identifies all of the specific modeling scenarios that individual bus routes should be included in.
- *Replace* – identifies the existing GTFS route(s) that will be replaced by the future route coding, if any.
- *TOD* – indicates which time-of-day networks will include the future bus service.

Table 8. MHN Future Bus Route Attributes

Variable	Description
TRANSIT_LINE	Unique CMAP bus route identifier (6 characters).
DESCRIPTION	Real-world description of bus route (20 characters maximum – limit imposed by Emme).
MODE	Bus mode code.
VEHICLE_TYPE	Bus vehicle type code.
HEADWAY	Average bus headway for Peak periods (TOD 3/7/AM) in minutes. This coded value will only be applied during those periods. *A value of zero indicates that the headway for the existing route coding will be used (i.e., there will be no change in service frequency).*
SPEED	Average bus route speed in MPH; default value of 12 used. [Not used in CMAP modeling but a non-zero value is required by Emme.]
SCENARIO	Future scenarios bus line will be used in. Must include ALL scenarios that will contain route. May NOT be blank
REPLACE	Identifier of the existing bus route coding that will be replaced by the future project. A blank indicates the future route represents new service being added. Constructed as: Uppercase mode letter + "-" + route number. *Note: the replacement will only occur in the time periods identified in the TOD field.*
TOD	Time-of-day periods when the new coding will be implemented. As with SCENARIO, all applicable time periods must be listed. The route will be included in the AM network if TOD includes a value of 3. *A value of zero indicates that the new coding will be applied to all time periods.*
NOTES	TIP ID number (and possibly other descriptive information). Entries must be separated by colons. 30 character limit.

As with the highway project coding, CMAP modeling staff maintain a set of scripts that generate scenario-specific TOD transit network input files for Emme. While processing of the base/current year bus routes is relatively straight-forward, the future bus routes require additional logic to process all of the changes correctly. The following rules are used to generate future scenario TOD transit network input files for Emme:

1) New routes only appear in the specific time periods identified in the *TOD* field, or in all periods if *TOD*=0. During processing, every future route with a TOD value that contains "3" will be included in the AM period.
2) The *replace* field identifies current bus routes that will be replaced by the future coding for the time periods in *TOD*. These current routes are deleted from the network. The routes are identified by the letter *Mode* code and the *Route_id* from the route table.
3) A number of potential values are used to determine future headways:
    a. Coded headway: this is the headway coded for future bus routes; it applies only to time periods 3, 7 and AM.
    b. Replaced headway: the TOD headways for the bus routes being replaced by future service (this value is calculated when the bus runs are collapsed into representative routes). To avoid having to apply directional headways to the future service, this value is the minimum of the current directional headways.
    c. Mode headway: the average headway for a time period for a given bus mode (B,E,P,L,Q) based on the existing bus routes, excluding those being replaced.

d. Factored headway: the value is Coded headway (if it's greater than zero) times a TOD multiplier [*2 for periods 2/4/6/8; 3 for period 5; 4 for period 1*]. This reflects a general service frequency reduction from the AM peak.

e. Last chance headway: a final future headway value if all other options fail; set to 60 minutes for periods 2 and 4, and 90 minutes for all other periods.

The logic used to determine the final TOD future headway for each future route is:

- *Priority 1*: Use Coded headway for periods 3, 7 and AM if applicable and the value is greater than zero. If that does not apply, go to Priority 2.
- *Priority 2*: For non-peak periods or instances where the coded future headway=0, use Replaced headway. If that does not apply, go to Priority 3.
- *Priority 3*: The future headway is the maximum of [Mode headway, Factored headway, Last chance headway].

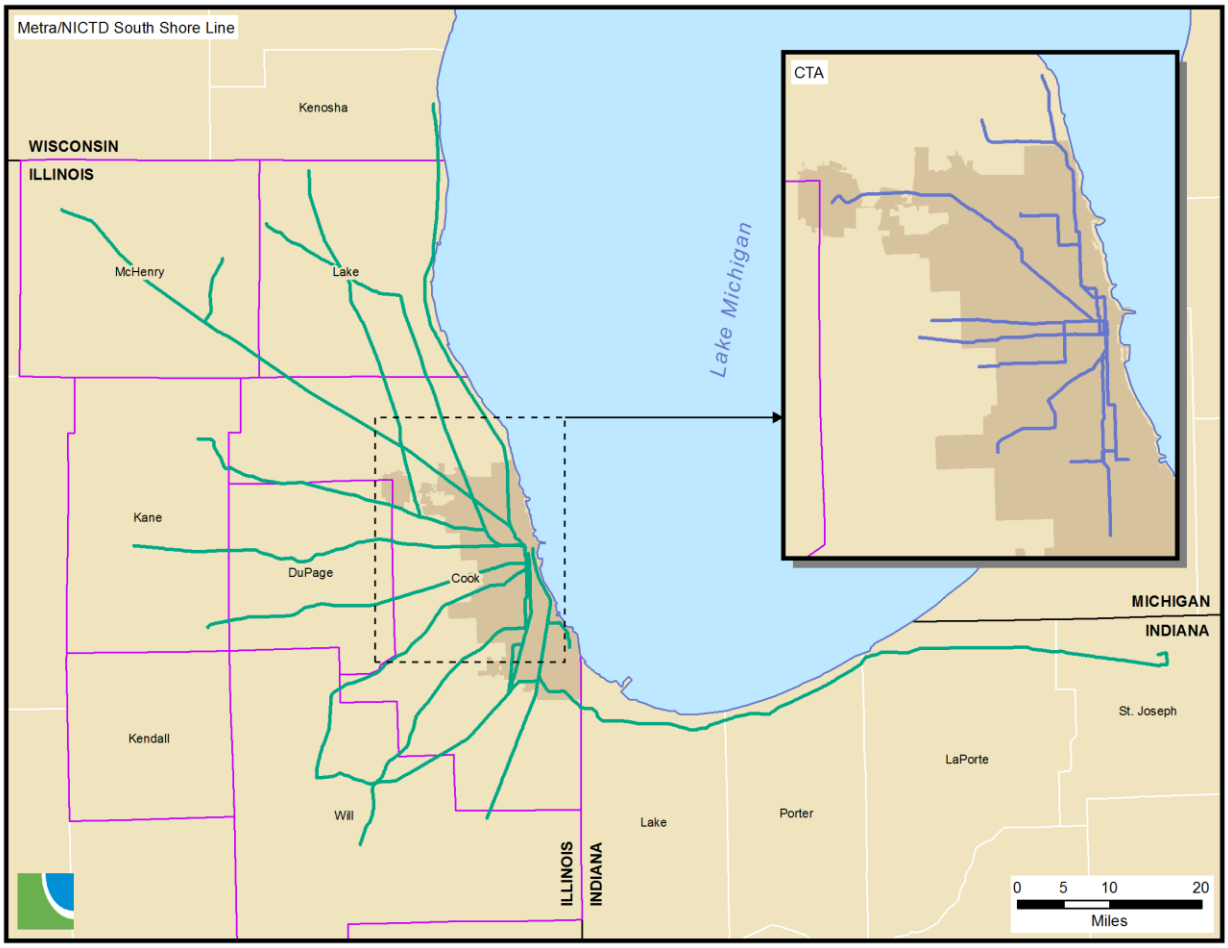
The final outcome is that the future headway for non-peak periods (1, 2, 4, 5, 6 and 8) cannot be less than the headway in the peak periods.

2.4 Rail Network

The Master Rail Network (MRN) is stored in a file geodatabase, which contains all of the rail segments representing heavy and commuter rail service in northeastern Illinois. The geodatabase stores all of the feature class data needed to build rail transit networks for regional analyses: arcs, nodes, rail routes and itineraries. While it would be possible to combine the MHN and MRN into one relational database, the rail network has very few link attributes compared to the highway network and is much smaller in scope than the MHN. Thus it is easier to maintain them separately. The MRN is stored in the same projection as the highway network database so that they work together seamlessly.

In addition to bus service, the CTA operates heavy rail transit within the city of Chicago and several adjacent older suburbs. Suburban commuters are served by Metra's radial rail services, which generally carry passengers from suburban areas to the central area. There are, however, a number of Metra stations within the city of Chicago, and some Metra lines parallel CTA rail lines. Additionally, the Northern Indiana Commuter Transportation District operates commuter rail service between downtown Chicago and South Bend, Indiana. The extent of the MRN is illustrated in Figure 6.

Figure 6. Master Rail Network



Topology rules within the MRN are enforced programmatically by rebuilding the routes each time the network is updated or new routes are imported using the arc geometry. In addition to being an extremely efficient way to process the data, this procedure also ensures that rail routes will always be coincident with the underlying arcs (which is necessary for selecting scenario-specific route coding).

Arc Fields

Table 9 lists the rail network link variables contained in the arc table, which represent the variables required by Emme® in a network batchin file. Most of the arcs represent the rail line segments that connect stations (either mode "C" for CTA rail or mode "M" for Metra). Two other kinds of links are included in the MRN on a limited basis: transfer links connecting different rail service and walk links providing access or egress to the service. These auxiliary links are discussed in further detail in Section 2.6.

Table 9. Master Rail Network Link Attributes

Variable	Description
ANODE	CMAP "From" node.
BNODE	CMAP "To" node.
MILES	Link length in miles.
MODES1	Modes permitted on anode-bnode direction of link (string of mode letters).
MODES2	Modes permitted on bnode-anode direction of link (string of mode letters); blank if link is only 1 direction.
DIRECTIONS	Link directions flag: 1=one-way, 2=two-way.

Node Fields

Node variables are listed in Table 10. The nodes represent rail stations or, in a few instances, rail line junctions that are not actual stations. Rail service does not stop at junction locations. In addition to a unique identifier for each station, the node table contains information on the availability of parking at the rail stations: *pspace* indicates the number of parking spaces available at the station and the cost of parking is stored in *pcost*. Both of these values represent conditions in the base year of the MRN, thus *pspace* equals zero if no parking is available and *pcost* equals zero if there is no fee.

Table 10. Master Rail Network Node Attributes

Variable	Description
NODE	CMAP node number; used to assign ANODE and BNODE values in arc table. • CTA rail: uses range 30000-39999 • Metra: uses range 40000-49999
LABEL	Node label (4-character station name).
PSPACE	Number of parking spaces at node in base scenario; zero if not used in base scenario.
PCOST	Parking cost at node in base scenario; zero if not used in base scenario.
FTR_PSPACE	Number of parking spaces at node in future scenarios. This text string uses the format "s1:p1:s2:p2: …" where s=the hundred's place value from CMAP's scenario numbering scheme and p=the number of parking spaces in the corresponding scenario. Each value must be separated by a colon.
FTR_PCOST	Parking cost at node in future scenarios; same format as *ftr_pspace*.

Future scenario parking information is also stored in the node attribute table in variables *ftr_pspace* and *ftr_pcost*. A *ftr_pspace* value of "4:150:6:200" is interpreted as follows: the node will have 150 parking spaces beginning in scenario 400 and 200 parking spaces beginning in scenario 600. The value is assigned through scenarios until a later scenario is specified, so the node will have 150 parking spaces in scenario 500 as well. While it is easier for the analyst to read this value if the scenarios are coded in chronological order, the processing programs do not require this in order to assign the correct value to each scenario. Values for *ftr_pcost* are coded using the same format.

Rail Route Coding

As with bus coding stored in the MHN, rail service coding in the MRN is built from GTFS data files for a representative weekday (Wednesday). Each individual run of every rail line is stored

in the database, representing a single direction of travel. Processing of the GTFS rail service data into usable model coding follows the same set of procedures and logical reviews as bus route data. Rail service coding is stored in the geodatabase as a pair of related tables containing information on the rail run and its itinerary.

Table 11 lists the variables in the rail route table. As with bus route coding, the variables are a combination of header fields Emme requires when reading in rail itineraries (highlighted in blue) and GTFS fields maintained for clarity. These variables have the same definition in both the bus and rail route tables, although the values may differ. Special attention is given to the transit line name variable (*tr_line*) in the rail coding.

Table 11. Master Rail Network Rail Route Attributes

Variable	Description
TR_LINE	Unique CMAP rail run identifier (6 characters).
DESCRIPTION	Real-world description of rail run (20 characters maximum – limit imposed by Emme).
MODE	Rail mode code: C=CTA rail M=Metra/NICTD
VEHICLE_TYPE	Rail vehicle type code (based on mode code): 7=mode C 8=mode M
HEADWAY	Length of the time-of-day period (in minutes) within which the rail run falls.
SPEED	Average rail route speed in MPH from GTFS data; minimum value of 15 allowed. [Not used in CMAP modeling but a non-zero value is required by Emme.]
FEEDLINE	Unique GTFS identifier for each run.
ROUTE_ID	For CTA: lists line (Blue, Red, etc.). For Metra: lists train run number.
LONGNAME	Lists the proper name of the train line (Blue Line, Union Pacific Northwest, etc.).
DIRECTION	Lists final stop on train run.
START	Start time of train run in seconds.
STARTHOUR	Start hour of train run.
AM_SHARE	Proportion of run that occurs within the AM Peak period (7 AM - 9 AM). Simple count of itinerary segments; full segment must be covered within the time period.
CT_VEH	Extended transit vehicle types used for CT-RAMP.

To allow for simple identification of runs on a specific rail line in Emme®, the following rail route naming scheme is applied to the six-character *tr_line* variable:

- First character - lowercase Mode letter.
- Second and third characters - two letter line identifier (lowercase).
- Fourth through sixth characters - unique counter for each Mode-line combination, starting with '001' for base runs and '401' for current runs (automatically generated).

The three-character rail line coding prefixes are summarized in Table 12.

Table 12. Rail Line Coding Prefixes

Transit Agency	Line	Coding Prefix
CTA	Blue	cbl
	Brown	cbr
	Green (Ashland branch)	cga
	Green (Cottage Grove branch)	cgc
	Orange	cor
	Pink	cpk
	Purple	cpr
	Red	crd
	Yellow	cye
Metra	BNSF	mbn
	Heritage Corridor	mhc
	Metra Electric	mme
	Milwaukee District North	mmn
	Milwaukee District West	mmw
	North Central Service	mnc
	Union Pacific Northwest	mnw
	Rock Island District	mri
	SouthWest Service	msw
	Union Pacific North	mun
	Union Pacific West	muw
NICTD	South Shore	mss

The itinerary information for rail lines is stored in a related data table, and the contents are listed in Table 13. These variables provide the same information as their counterparts in the bus itinerary tables. One variable of interest however is the zone fare variable (*zn_fare*). This value applies to commuter rail lines and is the marginal cost per ride (in cents) for traveling between fare zones. It is calculated as:

> [the difference between monthly pass costs from station zone to zone A] x [100 cents] / [40 (the average number of one-way rides for a monthly pass holder, assuming 20 workdays per month].

For example, a UP-N line monthly pass from Kenilworth (zone D) to Ogilvie (zone A) is $102.60 and a monthly pass from Wilmette (zone C) to Ogilvie is $90.45. The *zn_fare* on the link between Kenilworth and Wilmette is: [(102.60 - 90.45) x (100)]/40 = 30.38.

As with the bus coding, two GTFS-based rail coding route systems exist simultaneously in the geodatabase:

- All_runs_base – GTFS–based coding that corresponds to CMAP's model base year of 2010 (reflecting service at that time).
- All_runs – Coding built from the most recent GTFS data files. This represents up-to-date coding and is used as the basis for future modeling scenarios.

Both of the rail route systems listed above contain over 2,400 rail runs comprised of more than 63,000 itinerary segments, representing one weekday of service. For travel demand modeling purposes, the CTA rail runs are combined into representative rail routes; this is accomplished using the same script and "collapsing" logic that is applied to the bus run coding. All of the

individual commuter rail runs are allowed to pass through to the travel demand model unchanged.

Table 13. Master Rail Network Itinerary Attributes

Variable	Description
TR_LINE	Unique CMAP rail line identifier (6 characters).
ITIN_A	CMAP node number of first node of link rail run travels on.
ITIN_B	CMAP node number of second node of link rail run travels on.
IT_ORDER	Order number of rail segment in itinerary.
LAYOVER	Layover time in minutes applied to *Itin_B*. Default=3.
DWELL_CODE	Code for stops (corresponding Emme code), applied to *Itin_B*: 0=stop allowed (default time of 0.01 minutes) 1=no stop (#) *available for future use:* *2=alighting only (>)* *3=boarding only (<)* *4=boarding & alighting allowed (+)* *5=dwell time factor (*)*
ZN_FARE	Incremental zone fare in cents.
TRV_TIME	Itinerary segment travel time in minutes.
DEP_TIME	Departure time at beginning of segment from GTFS data (in seconds).
ARR_TIME	Arrival time at end of segment from GTFS data (in seconds).
IMPUTED	Flag indicating segment was imputed by shortest path algorithm during import. 0=not applicable. 1=itinerary segment created by shortest path algorithm.

Future Rail Coding

As with the bus coding, there is a need to store future rail project information for use by the travel demand model. The route coding table for future rail service includes the same set of Emme-required fields as the existing coding, as well as a few additional fields shown in Table 14 below. The *scenario* variable identifies all of the specific modeling scenarios that individual bus routes should be included in. The *notes* variable contains the TIP identification number of the project and may include other descriptive information about the project. The *action* variable requires a more detailed explanation.

Table 14. Future Rail Route Additional Attributes

Variable	Description
SCENARIO	Future scenarios rail line will be used in. A string of ALL scenarios (first digit of three-digit code) that will contain route. May NOT be blank.
ACTION	Action code for the route.
NOTES	TIP ID number (and possibly other descriptive information). Entries must be separated by colons. 30 character limit.

Implementation of the GTFS-based rail coding required a reimagining of how future rail project coding would be handled. The desired outcome was to maintain the simple spreadsheet-based future service coding procedures employed at CMAP for years. To achieve this, an *action* code variable was added to the required attributes in the future route table. This value describes

what type of service or improvement is being implemented and instructs the processing scripts on how to handle the data input. A brief description of the future rail *action* codes is provided in Table 15.

Table 15. Future Rail Coding Action Codes

Action Code	Meaning	Discussion
1	New line or service.	The entire itinerary must be coded.
2	Travel time reduction on selected links.	*Itin_A* and *Itin_B* define the nodes between which the travel times will be reduced (only the end points need to be coded). Code both directions of travel if applicable. The *Trv_Time* value represents the % reduction applied to the base year travel time (for instance 0.1 means a 10% reduction). To apply the travel time savings to the entire itinerary, code *Itin_A* and *Itin_B* as the beginning and ending nodes on the line and code *Layover*=99. If the time reduction applies to multiple lines, each must be coded separately.
3	New station.	*Itin_A* and *Itin_B* define the nodes between which the new station will be inserted. Store node number of new station in *Layover*. Code both travel directions if applicable.
4	Line extension.	Itinerary only contains the coding for the additional segments to be added to the base year runs. Code both directions of additional segments if applicable. For extension at ending terminal, code *IT_Order* values beginning with 1001. For extension at beginning station, use negative values.
5	Shift to different downtown station.	The SWS will switch from Union Station to LaSalle Street Station – essentially this is just swapping one link for another at the CBD end of the itinerary. In itinerary coding: • *Itin_A* and *Itin_B* are the original nodes defining the link. • *Layover* holds the new node number. • *IT_Order* is used to identify which node is being replaced by the value in *Layover*: 1=*Itin_A* and 2=*Itin_B*. • Code both travel directions if applicable.
6	Placeholder for TIP identification number.	When a future project reaches its time horizon and is implemented, it gets coded into the current routes. At this point the project could be removed from the future routes, except it is necessary to maintain the project's TIP ID in the future routes. To do this without affecting the network, the project is coded like an action code 2 with a 0% travel time reduction
7	New consolidated rail station.	Two existing rail stations are being consolidated and replaced with a new station. In itinerary coding: • *Itin_A* and *Itin_B* are the remaining nodes between which the new station will be inserted. • *Layover* holds the new station node number. • Code both travel directions if applicable.

When the future rail coding is processed to create scenario transit networks for Emme®, new lines/service (*action*=1) are added to the set of existing ones to increase the total number. For *action* codes 2-5 and 7, the changes described in the coding are applied to the existing transit routes (no actual processing is performed for *action*=6). Additionally, modified unique counters (characters four through six in *tr_line*) are used for future rail lines:

- For *action*=1 – the counter should be a 900 series (i.e., starting with '9' followed by two digits beginning with '01').

- For *action* codes 2-7 – the counter should start with two asterisks (one if the counter requires two digits) followed by a counter. For example, mri**1. This identifies the coding as a general improvement that will apply to all of the runs on the specified line.

Future rail itinerary coding contains the same fields as the existing itinerary coding, with the exception of the GTFS-derived fields. The use of the *action* code allows for a great deal of flexibility in coding the itineraries; CMAP staff uses this flexibility to rely upon one future rail coding template where the definitions of the itinerary fields are dependent upon the *action* code applied to the specific route. The benefit to the analyst of using this coding scheme is that only minimal future rail coding input is required to implement the desired changes; processing scripts perform all of the painstaking work.

2.5 Zone Systems

Three different zone systems are used in the regional travel demand model. Each is a set of polygons representing different geographies. The zone systems all serve different purposes within the regional travel demand model.

Trip Generation Zones

Trip generation zones (or subzones) are the smallest level of geography used in the travel demand model. Subzones are quarter-section sized geographies that CMAP uses for household and employment forecasting. The current edition of the subzones is known as "Subzone09" (identifying the year in which it was developed). This most recent improvement to the subzones included developing the quarter-section sized zones in Kendall County, IL and Aux Sable Township in Grundy County, IL. The entire CMAP modeling region is comprised of 16,819 subzones (shown in Figure 7).

Quarter-sections are based on the Public Lands Survey System (PLSS) subdivision of land into township and range, and then into sections. Two of the major benefits of using this system as the basis for the subzones are:

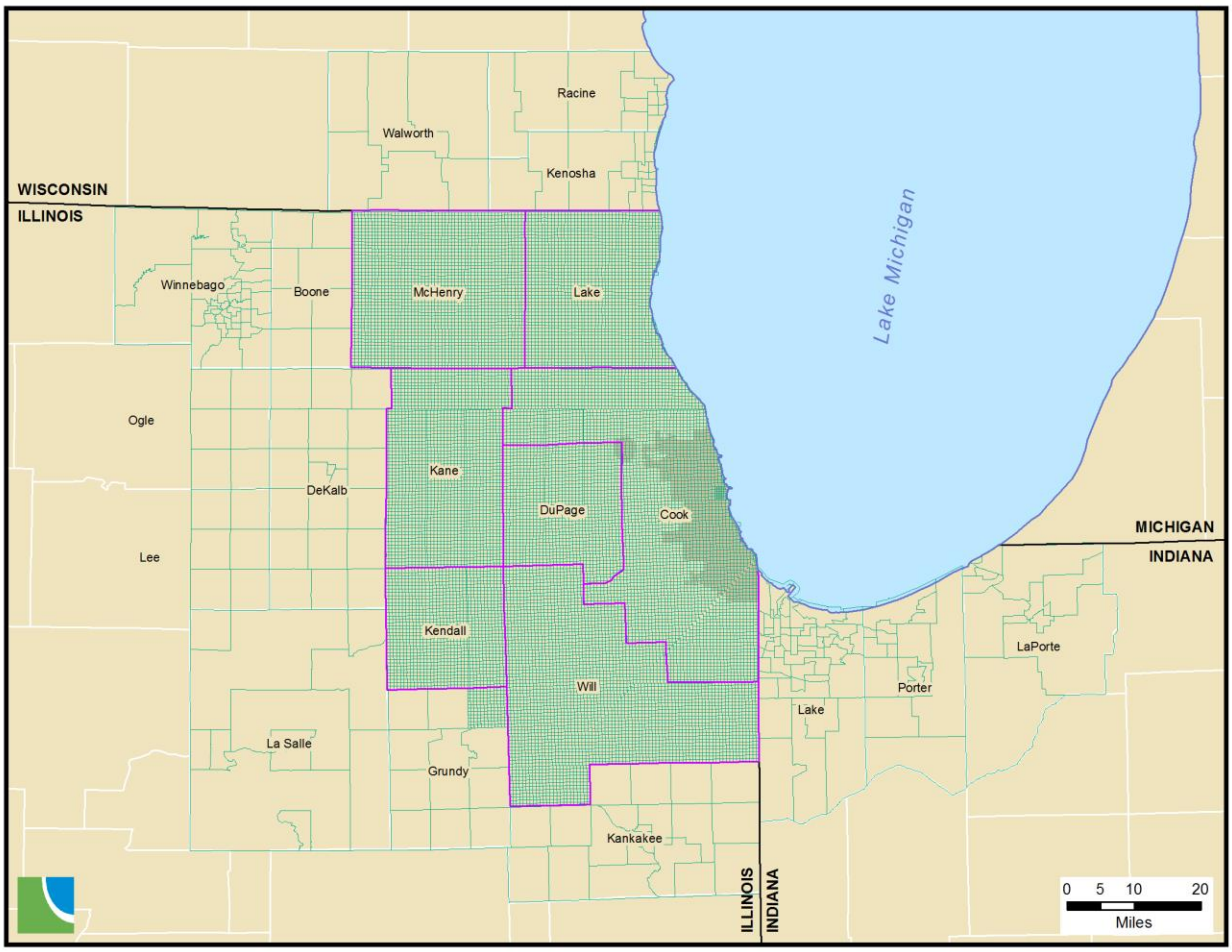
- The geometry does not change (unlike Census-based geography).
- The PLSS sections conform in most cases to state, county, and township boundaries (unlike other referencing systems such as the U.S. National Grid).

As is apparent in Figure 7, subzones outside of the CMAP metropolitan planning area do not follow the same quarter-section based design. Subzones in the external modeling areas (the remainder of Illinois, and the relevant portions of Indiana and Wisconsin) are based on Census geography from the TIGER/Line file and are much larger in scope.

As indicated by their name, the Trip Generation zones are used to aggregate socioeconomic data into geographic units suitable for providing input to the Trip Generation model in order to generate trip productions and attractions. Trip generation zones serve as the base level for

CMAP's modeling zone systems. The two remaining zone systems are created by aggregating the subzones into larger geographies. Thus the subzones always nest perfectly within the other zone systems.

Figure 7. CMAP Trip Generation Zones



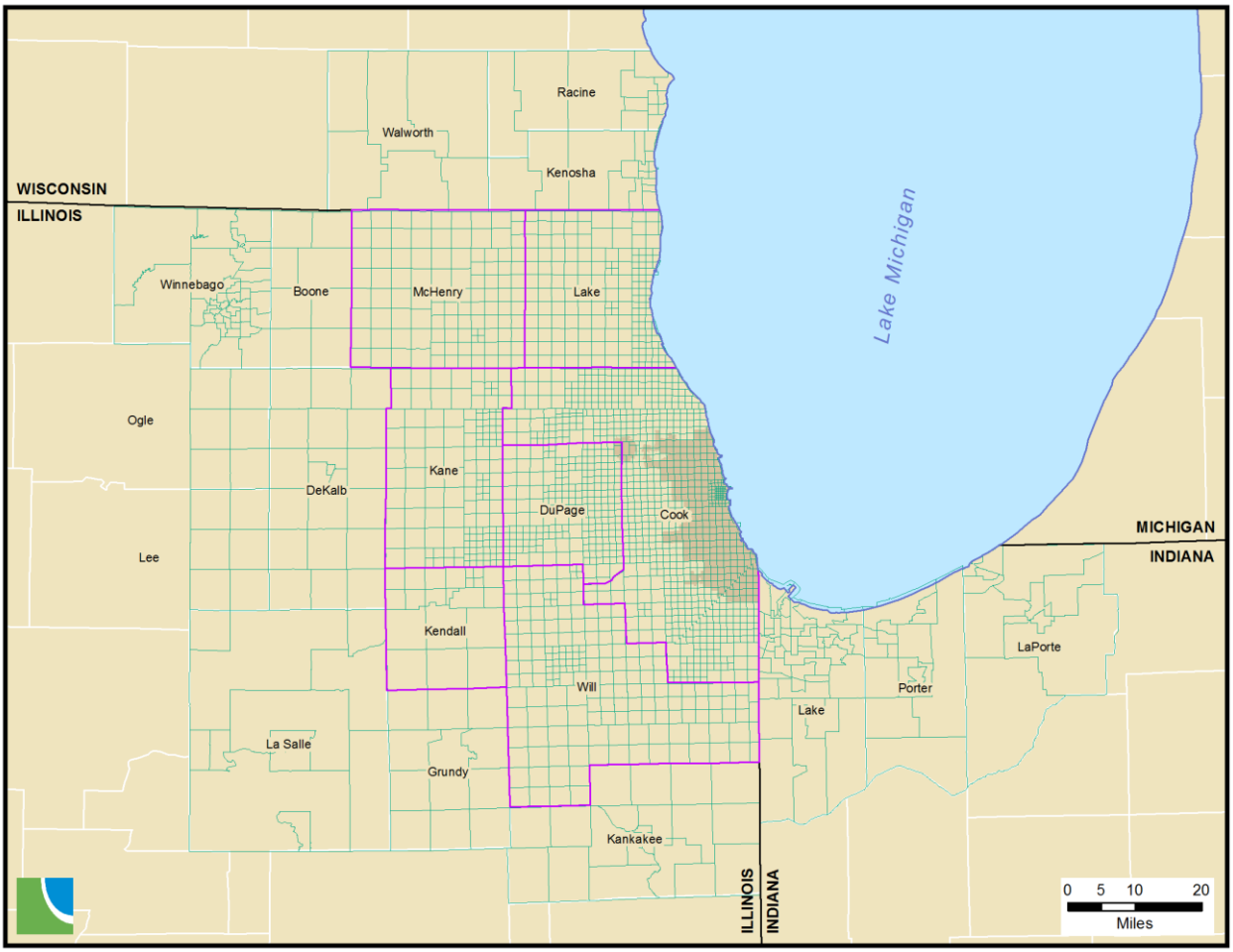
Modeling Zones

While the trip productions and attractions are generated in a zone system based on survey quarter-sections, this level of detail is not used for the remaining modeling processes. At this time, the space and computing capabilities required to complete calculations on matrices composed of nearly 17,000 Trip Generation zone origins and destinations (more than 282 million values) is not available. Therefore, the subzones are aggregated into the CMAP modeling zone system for the remaining three steps of the modeling process (Trip Distribution, Mode Choice, and Highway Assignment).

Figure 8 shows the 1,944 modeling zones (commonly referred to as traffic analysis zones) for the CMAP modeled region. These zones generally follow the survey township geography.

Zones are either sections (approximately one square mile) or regular subdivisions of townships (four-square-mile ninths of townships, nine-square-mile quarters of townships or whole townships). The modeling zones are equivalent to their underlying subzones outside of the CMAP planning area. Additionally, there are seventeen external zones, or points of entry, that are not shown. These are arrayed around the outside of the pictured zone system, representing trips on major highways entering the region.

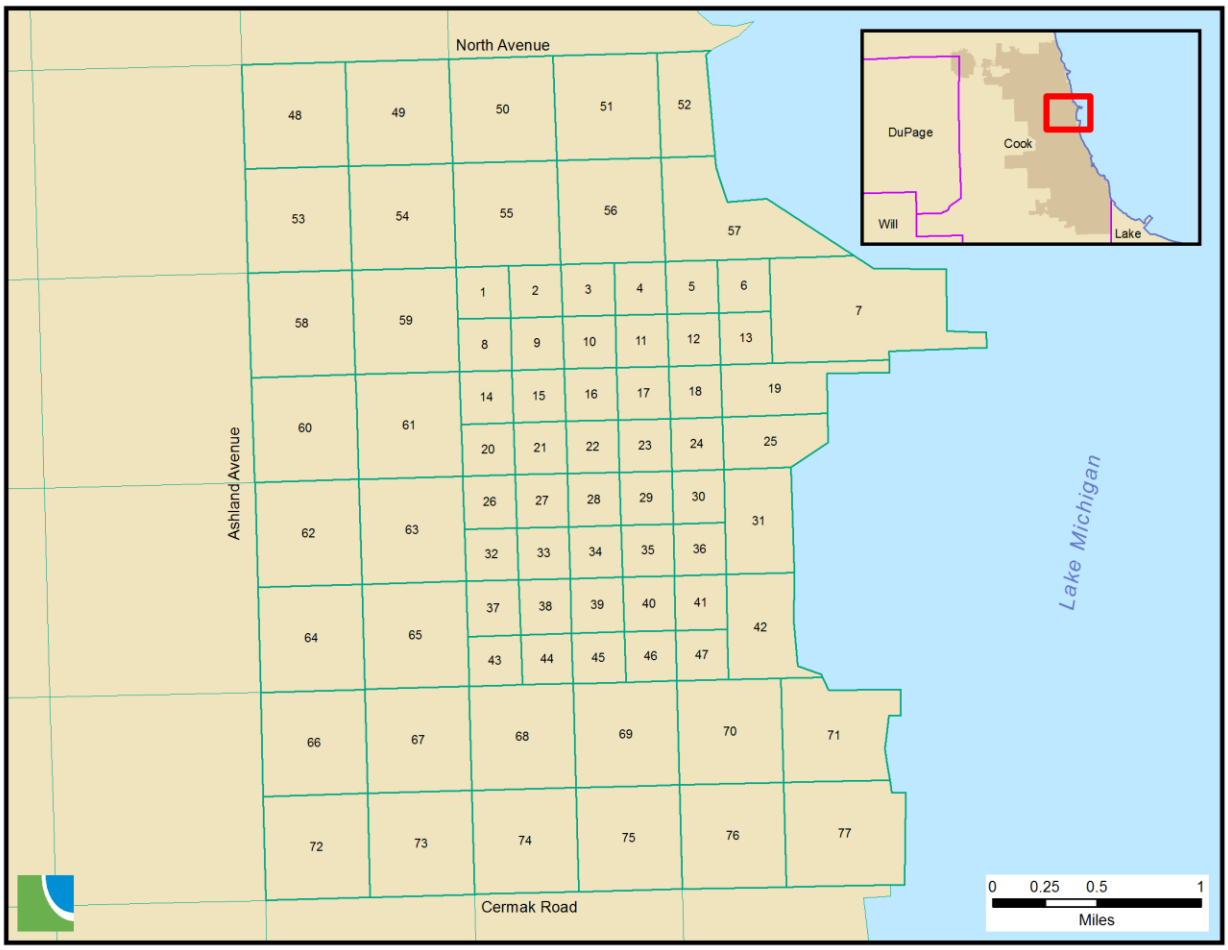
Figure 8. CMAP Modeling Zones



The density of the modeling zones (and by extension the subzones) increases within downtown Chicago. The Chicago Central Business District (CBD) is a pre-GIS convention established by CATS and NIPC based on section boundaries at: Chicago Avenue, Halsted Street and Roosevelt Road. This is represented by modeling zones 1 through 47. The larger Central Area was also established by CATS and NIPC prior to GIS to reflect the high density of trip making in this area and is based on the section boundaries at: North Avenue, Ashland Avenue and Cermak Road. The Chicago Central Area is shown in Figure 9.

The Central Area is defined by modeling zones 1 through 77. Of the seventy-seven zones, thirty are quarter-section sized zones (one-half mile by one-half mile). Most of the remaining modeling zones (representing the CBD) are quarter-quarter-section sized zones (one quarter-mile by one quarter-mile).

Figure 9. CMAP Central Area Zones



In order to simplify selecting discrete geographic areas, the modeling zones are numbered consecutively by County and Township. The City of Chicago is consecutively numbered starting with the CBD (1-47), the Central Area (48-77), the Transit Hub (78-88) which provides a one-mile buffer around the Central Area, and then by townships for zones within the city limit. Table 16 lists the correspondence between subzones, modeling zones and geographic areas.

Table 16. CMAP Subzone-Zone Correspondence

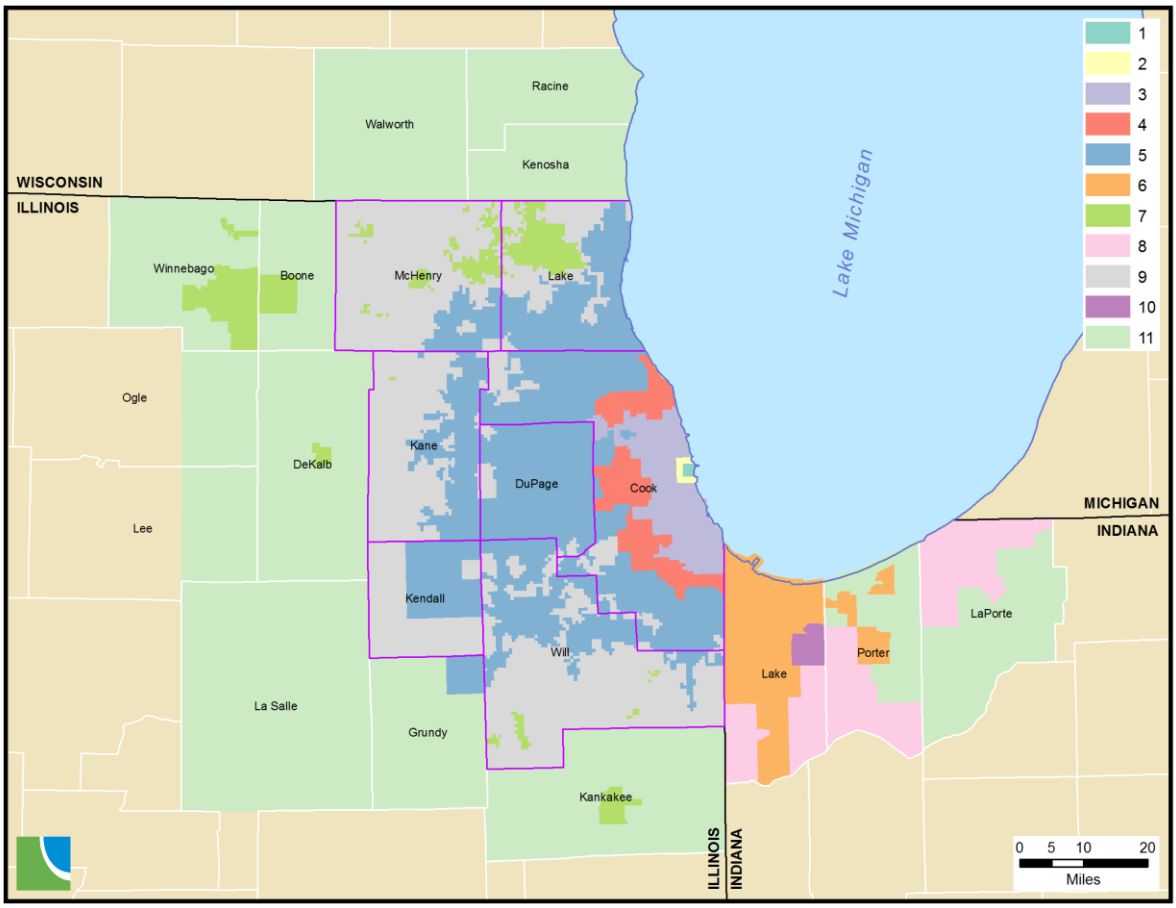
COUNTY		ZONE09		SUBZONE09	
FIPS Code	*Name*	*First*	*Last*	*First*	*Last*
	Chicago	1	309	1	976
	CBD	1	47	1	47
	Chicago Transit Hub	1	88	1	126
17031	Cook	1	854	1	3900
17111	McHenry	855	958	3901	6344
17097	Lake	959	1133	6345	8245
17089	Kane	1134	1278	8246	10405
17043	DuPage	1279	1502	10406	11763
17197	Will	1503	1690	11764	15147
17093	Kendall	1691	1711	15148	16443
17063	Grundy	1712	1723	16444	16598
17007	Boone	1724	1731	16599	16606
17037	DeKalb	1732	1752	16607	16627
17091	Kankakee	1753	1774	16628	16649
17201	Winnebago	1775	1811	16650	16686
17141	Ogle	1812	1817	16687	16692
17103	Lee	1818	1823	16693	16698
17099	La Salle	1824	1835	16699	16710
18089	Lake IN	1836	1882	16711	16757
18127	Porter IN	1883	1897	16758	16772
18091	LaPorte IN	1898	1909	16773	16784
55059	Kenosha WI	1910	1925	16785	16800
55101	Racine WI	1926	1938	16801	16813
55127	Walworth WI	1939	1944	16814	16819

Capacity Zones

The final zone system used in the regional travel demand model is the Capacity Zone system (displayed in Figure 10). As with the modeling zones, these zones are built by aggregating the subzones. The Capacity Zones are used to help estimate general roadway capacity for the highway assignment procedures. Some specific calculations that use the Capacity Zone value include:

- Calculation of an ordinal arterial functional class within the model.
- Calculation of the number of inbound approaches into an intersection.
- Estimation of traffic signal green-to-cycle ratios and signal cycle length for ramps connecting arterials and expressways.

Figure 10. CMAP Capacity Zones



The values of the Capacity Zone system are listed in Table 17 below. Within the travel demand model structure, the Capacity Zone values are stored as a node attribute in the highway network database. Thus the values in the table below correspond to the values of the *areatype* variable in the highway network node table discussed in Section 2.3.

Table 17. CMAP Capacity Zone Codes

Capacity Zone Value	Description
1	Chicago Central Business District (2009 subzones 1-47).
2	Remainder of Chicago Central Area (2009 subzones 48-80).
3	Remainder of City of Chicago (2009 subzones 81-976).
4	Inner ring suburbs where Chicago street grid is generally maintained.
5	Remainder of Illinois portion of the Chicago Urbanized Area.
6	Indiana portion of the Chicago Urbanized Area.
7	Other Urbanized Areas and Urban Clusters within the CMAP Metropolitan Planning Area plus other Urbanized Areas in northeastern Illinois.
8	Other Urbanized Areas and Urban Clusters in northwestern Indiana.
9	Remainder of CMAP Metropolitan Planning Area.
10	Remainder of Lake County, IN (rural).
11	External area.
99	Points of Entry – not defined in the Capacity Zone system.

2.6 Analysis Network Preparation

Preceding sections briefly discussed the procedures used to take the highway network and transit service information from the GIS databases and process it for use in modeling networks. Processing programs export data from the model network databases and update the salient highway network and transit service characteristics based on the scenario network being created. After all characteristics are updated, a set of text files suitable for importing into Emme® (referred to as "batchin" files) is created which contain the data necessary to define the transportation network.

Highway Network

Separate batchin files are created for each of the time-of-day (TOD) highway networks, as well as for one all-inclusive highway network. Recall that the TOD networks contain time-period specific changes to links (time-of-day restrictions, reversal of flow, etc.). Each TOD highway network has a set of four batchin files: two defining link attributes and two defining node attributes. The files contain the standard link and node attributes required by Emme®, as well as extra attributes (denoted by "@") used within the travel demand model. The batchin files are imported into the modeling software to create the TOD highway networks.

Emme® highway network link attributes are shown in Table 18; required attributes are highlighted in blue. Modes on links are defined to enable a multiple vehicle class highway assignment that matches the vehicle types used for emission calculations. Mode "A" is the primary auto mode and all other modes are secondary auto modes. No transit modes are included in the highway network because the transit network exists as a separate entity. This also means that no transit-only links (such as rail links or dedicated busways) are included in the highway network.

Secondary auto modes "S" and "H" allow high occupancy vehicle facilities to be coded in the network. For example, mode "S" would not be coded on HOV links. All links in the network allowing high occupancy vehicles (generally every network link, with the possible exception of truck-only facilities) would have mode "H" coded.

Secondary auto mode "T" is a general truck mode coded on all network links that allow trucks. By excluding truck modes, commercial vehicles can be prohibited from facilities such as Lake Shore Drive, and the Kennedy and Dan Ryan express lanes. The additional truck modes "b", "l", "m" and "h" permit more specialized coding of truck prohibitions to represent local restrictions or the testing of truck-only facilities based on weight classes.

Table 18. Model Highway Network Link Attributes

Variable	Description	Source
i	From node.	Batchin files
j	To node.	
len	Link length in miles.	
mode	Modes on link: A=primary auto S=single occupant auto (SOV) H=high occupancy auto (HOV) T=general truck b= B plate truck l=light truck m=medium truck h=heavy truck	
lanes	Number of driving lanes.	
vdf	Volume-delay function code. 1=arterial street 2=freeway 3=freeway-arterial ramp 4=expressway 5=freeway-freeway ramp 6=zone centroids connector 7=link where toll is collected 8=metered entrance ramp	
@speed	Speed limit or CMAP free speed.	
@parkl	Number of parking lanes along roadway.	
@sigic	Link with interconnected signals.	
@width	Driving lane width in feet.	
@toll	Toll amount in dollars.	
@tollv	Maximum volume on toll link without tolls.	macros
@ftime	Uncongested link travel time in minutes.	
@emcap	Level of Service E lane capacity on link.	
@artfc	Arterial link functional class: 1 = Principal Arterial 2 = Major Arterial 3 = Minor Arterial 4 = Collector	
@gc	Green time to cycle length ratio.	

A link's volume-delay function (vdf) is based upon the five categories in CMAP's link capacity calculations: arterial, freeway, arterial-freeway ramp, expressway, and freeway-to-freeway ramps. Three additional volume-delay functions are included for links connecting zone centroids to the network, links where tolls are collected and metered freeway entrance ramps.

In addition to these standard variables required by Emme®, some additional link attributes are included in the network. Many of these supplemental variables come directly from the MHN database. Other attributes used in the macros include the link's speed limit (or an estimate of the uncongested speed on the link without intersection delay), as well as the number of parking lanes and the average width of driving lanes on the link. For toll collection links, the amount of the toll is also included.

The variable *tollv* is an estimate of the maximum volume that would use a toll collection link if no toll was collected. This value is estimated using the assigned volume from an all-or-nothing assignment without tolls. This variable and the toll amount are used in the toll link volume-delay function. Note that since the introduction of regionwide open-road tolling, the delay associated with toll collection is not currently modeled by CMAP within the traffic assignment procedures. However, the variables associated with tolling are still included in the database for future refinement of the toll volume delay function.

Table 19 lists the highway network node variables that are used. Standard node attributes are the node number and the x- and y-coordinates of the node. Node extra attributes are additional quantities associated with the node, including the zone number and area type (Capacity Zone value) at the node location. Area type definitions are listed in Table 17.

Table 19. Model Highway Network Node Attributes

Variable	Description	Source
i	Node number.	Batchin files
xi	x-coordinate (NAD27 IL East State Plane feet).	
yi	y-coordinate (NAD27 IL East State Plane feet).	
@zone	Modeling zone node resides in.	
@atype	Capacity Zone values (refer to Section 2.5).	
@napp	Number of approach links.	macros
@cycle	Traffic signal cycle length in minutes.	

After the TOD highway networks are generated in Emme®, two macros are submitted to prepare the additional link and node attributes needed for the time period assignments. The first macro (*Ftime.Capacity*) systematically calculates link lane capacities and uncongested speeds based on link characteristics such as functional class, lane width and posted speed limit. The network database also includes variables to flag those links that change characteristics depending on the time period, such as links that have peak period parking restrictions. These factors are also considered when link capacity is calculated.

The calculations in the *Ftime.Capacity* macro are generally consistent with the capacity procedures found in the 1985 Highway Capacity Manual and the 1994 update to the manual. More importantly, the capacities of arterial street links reflect the type of signalized intersection located at the link's j-node (downstream node). The macro first analyzes the links entering a node, and then estimates the capacity for each approach link based on generalized signalized intersection characteristics. Capacities for ramps between freeways and arterial streets ending at signalized intersections are determined in the same manner as arterial streets.

The concept behind this process is that link capacities and uncongested travel times must always be recalculated before an assignment is run, rather than be maintained as static network variables in the database. The capacities and uncongested travel time for links ending at a signalized intersection depend on the characteristics of all approach links into the intersection, not just the link of interest. As a result, link capacities and uncongested travel times depend on network topology. Adding, removing or modifying a link affects the capacities and uncongested travel times of all links that intersect it at a signalized intersection. Calculating these network quantities as part of the assignment procedure ensures that they are current when the assignment is carried out. This approach simplifies the introduction of certain types of improvements into the modeled network. The effects of parking restrictions, traffic control device improvements, signal progression and intersection improvements can be modeled in the macro, eliminating lengthy manual adjustment of capacities and times on a link-by-link basis.

The *Ftime.Capacity* macro develops a couple of extra link attributes, which are briefly described. Link uncongested travel time (@ftime) is calculated and is used in the volume-delay functions. It should be noted that this travel time does not contain any intersection delay, which is calculated separately by the volume-delay functions. Capacity values calculated by the macro (@emcap) are hourly lane capacities at level-of-service E. Link capacity for the time period, which is used within the volume-delay functions, is later obtained by multiplying this quantity times the number of driving lanes on the link and the length of the assignment time period.

The second macro (*Arterial.Delay)* repeats many of the same calculations as *Ftime.Capacity*. It again evaluates approach links at signalized intersections and estimates signal cycle lengths at the j-nodes of arterial street links. It also estimates the proportion of the cycle length allocated to traffic on the link. These two quantities are retained in extra node and link attributes (@cycle and @gc, respectively) for later use in the volume-delay functions that estimate intersection delays. An ad hoc functional class (@artfc) is also assigned to arterial street links based on the location of the link, its speed limit and number of driving lanes. This functional class is only used to allocate green time at signalized intersections, which depends on the cycle length (@cycle stored as a node variable) and the number and types of conflicting approach links. The final link extra attribute in the table is the ratio of green time to cycle length (@gc) at the downstream node of a link. This value is later used in the volume-delay functions.

Transit Network

The coded transit network reflects transit service in the morning peak period (7 AM -9 AM). The base year (2010) transit network contains over 12,000 bus and rail mode links totaling nearly 5,700 miles in length. While the highway network data are all contained within the MHN database, the transit network is comprised of three separate components that must be integrated in order to create complete Emme® transit networks:

1. **Bus route coding** – All current and future bus route coding is stored in the route systems of the MHN geodatabase. This coding includes the following transit modes: B (CTA regular bus service), E (CTA express bus), P (Pace regular service), L (Pace local service) and Q (Pace express service).
2. **Rail route coding** – All current and future rail route coding is stored in the rail route systems of the Master Rail Network (MRN) geodatabase. This coding includes modes C (CTA rail) and M (Metra rail).
3. **Auxiliary links** – In addition to the transit coding itself, model transit networks also require a system of auxiliary links to provide needed connections. These auxiliary links provide: transfer links between different transit modes or lines that do not pass through the same nodes, walk access to transit service from zone centroids (trip beginning), and walk egress from transit service to zone centroids (trip end). A set of auxiliary links is created dynamically when the transit network files are generated. The procedures used to create the auxiliary links are discussed below.

Table 20 lists the twelve auxiliary link modes included in the transit networks. Note that the transit network modes are case sensitive: all transit modes are uppercase and all auxiliary link modes are lowercase. The three types of auxiliary links are transfer (which connect transit lines to one another), access (which are at the beginning of a trip and connect a zone centroid to transit service) and egress (which are at the end of a trip and connect transit service to a zone centroid). The rules used to automatically generate these links are based on the discussion provided in Appendix B of the Conformity Analysis Documentation from Conformity 2000. Transfer links are bi-directional while access and egress links (by definition) only serve one direction of travel.

Table 20. Auxiliary Link Modes

Link Type	Mode	Description
transfer	b	Bus-Bus walk.
	c	Bus-CTA rail walk.
	m	Bus-Metra walk.
	d	Metra-Metra walk.
	r	CTA rail-CTA rail walk.
	t	CTA Rail-Metra walk.
access	u	Home-Bus walk.
	v	Home-CTA rail walk.
	w	Home-Metra walk.
egress	x	Bus-Work walk.
	y	CTA rail-Work walk.
	z	Metra-Work walk.

Transfer links

There are six different transfer link modes, each identifying a connection between different types of transit service. While Metra and CTA rail service are identified separately by the auxiliary links, no such distinction is made between CTA and Pace bus service: all bus service is combined into "Bus". All of the transfer links are bi-directional so that passengers can move in either direction between the transit lines. Transfer links "r", "t" and "d" are hard-coded in the MRN and are read directly into the final Emme transit network via the rail.network file. The remaining transfer links are created as follows:

- Mode b - All highway network arterials (type=1 in the MHN) located in zones 1-78 under the current Zone System (representing an area just slightly larger than Chicago's Central Area), are used as mode "b" links. These links are included in the file bus.network.
- Mode c – The Euclidean distance is calculated between CTA rail stops and all bus stops. A maximum distance of ⅛ mile (660 feet) is allowed between CTA rail stops in the CBD and bus stops. A maximum distance of ½ mile (2,640 feet) is allowed between bus stops and the remaining CTA rail stops. Only the shortest mode "c" link available to connect a CTA rail stop to each bus route is retained. As CTA rail stations may be served by multiple bus routes, there may be instances where more than one mode "c" link connects a bus route to the same CTA rail stop. This only occurs if the shared stop was

not the shortest link from the CTA rail stop for all of the affected bus routes. These auxiliary links are stored in access.network.

- Mode m – Straight-line distances are calculated between Metra stops and all bus stops. Maximum distances of ¼ mile (1,320 feet) and 0.55 miles (2,904 feet) respectively are allowed between Metra stops and CTA bus stops, and Metra stops and Pace bus stops. Mode "m" links are attached to **all** bus stops determined to be within the allowable distance. There are no constraints on connecting a Metra stop to multiple stops on the same bus route, or on connecting a bus stop to multiple Metra stops. These auxiliary links are stored in access.network.

Access and egress links

There are three access modes (each connecting a zone centroid to a different type of transit service) and three complementary egress modes connecting transit service to a centroid. Each of the access and egress modes applies to only one direction. For example, a centroid is connected to a Metra station by one link (mode "w") running from the centroid to the station, and one link (mode "z") running from the station to the centroid. Some walk access and egress links (modes "v", "w", "y", and "z") are hard-coded to ensure that they are present in scenario networks. The access and egress links are created as follows:

- Modes u and x – The Euclidean distance between centroids and transit stops is calculated to determine access and egress link length. Bus stops are separated into CBD and non-CBD stops. A maximum distance of ¼ mile is allowed between centroids and CBD bus stops, while a maximum of 0.55 miles is allowed between centroids and the remaining bus stops. The access/egress links are merged with bus itineraries, thereby connecting multiple links per transit line to the same centroid. This allows for numerous access/egress connections between the same bus route-zone centroid pair if the itinerary varies by direction. Redundant access/egress links are eliminated, and links are grouped by centroid and sorted by link length in ascending order. A maximum of eight mode "x" links are kept for each CBD centroid. No more than two mode "x" links are retained for each non-CBD centroid. A maximum of three mode "u" links are saved per centroid. These auxiliary links are stored in access.network.
- Modes v and y – The straight-line distances are calculated between centroids and CTA rail stops. A maximum distance of 0.55 miles is allowed between CTA rail stops and zone centroids. A set of "forced" links is created to ensure each CTA rail station is connected to the centroid of the zone it resides in, and a distance of 0.55 miles is assigned to those links if they exceed the distance threshold. All of the "forced" links are put into the final transit network. The remaining access links are ranked by shortest distance and are assigned to centroids until the maximum allowable number (in addition to the forced links) is reached. A maximum of three mode "v" links is assigned to each centroid in a zone with a CTA rail station. The same process is used for the egress links: maximums of seven and three mode "y" links are assigned to centroids in the CBD and outside the CBD, respectively, in addition to the forced set. These auxiliary links are stored in access.network.
- Modes w and z - Metra station access and egress links follow the same basic procedures as CTA rail station links. A maximum distance of 0.55 miles is allowed for these links. Metra stations are forced to connect to the centroid of the zone they are contained in,

and a distance of 0.55 miles is given to the link if it exceeds the distance limit. However, unlike with the other access and egress links, there is no constraint on the number of Metra access and egress links per centroid so **all** are put in the final network. These auxiliary links are stored in access.network.

Table 21 summarizes the processing rules used to develop the auxiliary links. When the processing is completed, the result is a set of scenario transit network files that are formatted to be imported by Emme. The final step is importing these files into an Emme databank, where they are combined to create the final transit network.

Table 21. Auxiliary Link Processing Rules

Mode	Maximum Distance	Forced to Connect to Centroid?	Maximum Number of Links per Centroid
c	⅛ mile in CBD ½ mile outside CBD	No	N/A
m	¼ mile for modes BE 0.55 miles for modes PLQ	No	N/A
u, x	¼ mile in CBD 0.55 miles outside CBD	No	u – 3 x – 8 in CBD, 2 outside CBD
v, y	0.55 miles	Yes	v – forced + max. of 3 additional y – forced + max of 7 additional in CBD, forced + max of 3 additional outside CBD
w, z	0.55 miles	Yes	N/A

Zonal Impedances

In the conformity analyses, the primary role of transit networks is to generate transit level of service variables which are needed as input to the generalized cost procedure. For each conformity scenario, impedance matrices are created for zone-to-zone in-vehicle times, fares, first wait time and remaining out-of-vehicle time. In the logic of the CMAP models, the zone-to-zone quantities are all measured from the point where transit service is first boarded, rather than the actual trip origin. Access modes and quantities are generated using Monte Carlo Simulation techniques (discussed later).

Zone-to-zone minimum impedance paths are built using the time and cost (i.e., fare) components of the transit network. Time components are weighted to reflect the relative disutility to the traveler. For instance, walking time is weighted at three times the rate of time spent within a transit vehicle. Similarly fares are weighted so that they can be combined with times to create an overall measure of the impedance of a particular path. The transit paths serve as input to the trip distribution and mode split models.

A multi-path transit assignment is run to provide transit impedances for zones that have walk access to a transit station. The current transit network scenario is used to generate zone groups based on a hierarchy of services present in the zone. This is analogous to CMAP's historic use of first, last and priority mode categorization. The mode matrices are then constructed based

upon the transit services likely to be utilized when moving between these zone groups. For zones with no walk access to a transit station, highway impedances from a complementary highway assignment are used to index the highway centroid to a station zone that minimizes highway and transit impedance to the destination. In this application, a generalized parking cost is calculated to reflect on- and off-street parking availability and cost. Station zones are identified by flagging the walk access centroids within an origin matrix. All cost components are then indexed from the station zone to the highway centroid. The resulting impedances are applied only to zones with no walk access.

The effects of roadway congestion on bus travel times are included in the transit skimming procedures. In the past, the skimmed bus times resulted only from the coded schedule times. Now, the AM peak period congested highway times are included as an extra attribute to the transit scenario. The network is skimmed for the impedance values with the bus travel times calculated as the larger of either the scheduled or congested roadway time for each link traversed. An additional feature allows the schedule time to be retained by coding the travel time function as 2 where congested times should not be considered. This is helpful for scenarios that include bus rapid transit or other similar services that will not be impacted by prevailing traffic conditions.

2.7 Ancillary Data Input Files

In addition to the network datasets there are several ancillary data files that contain information on transit service, park-and-ride availability, CBD parking, and auto operating costs. These files are briefly described in this section.

M01 file

The M01 file is comprised of several arrays of variables that provide the mode choice and distribution models with transit availability and park and ride characteristic parameters regarding a specific zone. Some of the parameters are calculated using transit network characteristics and are specific to each scenario network. The contents of the M01 file are summarized in Table 22.

Two formats of the M01 file are created: one for Home-Based Work (HBW) trips and one for the other trip purposes. The differences between the files are listed in the above table. The Pre Distribution and Mode Choice programs expect M01 files that are specific to the program and the trip type, thus the following pre-distribution (PD) and mode choice (MC) files are created:

Format1	***Format2***
MCHW_M01.TXT	MCHO_M01.TXT
PDHW_M01.TXT	MCNH_M01.TXT
	PDHO_M01.TXT
	PDNH_M01.TXT

Table 22. M01 File Attributes

Field Name and Position	Description
Zone Number (1)	Modeling zone number.
Zone Type (2)	1 – Chicago Central Area zone (1-77) 2 – Chicago zone outside of the Central Area (78-309) 3 – dense suburban CBD zone (more than 5,000 jobs per square mile) 4 – remaining suburban zones
Park and Ride Cost (3)	The cost of parking at the park and ride lot closest to the zone's geographic centroid. This represents the lowest rate of either the daily parking rate or the cost of a monthly parking pass divided by twenty work days.
Median zone household income (4)	The median household income in the zone (in $100s) from the 2007 ACS five percent Public Use Microdata Area data.
Park and ride availability (5)	A binary value indicating that the zone has park and ride access if there is a park and ride location within ten miles of the zone's geographic centroid.
Average waiting time for bus service in zone for home-work trips (6)	The average wait time for bus work trip (in minutes) for modes BEPQ. Calculated as the mean of (headway*0.5) for all bus stops served by selected modes within the zone during the AM peak period. To account for spatial inaccuracy, stops are buffered by 0.1 miles. *For HW files: maximum value is 99, default value of 99 used for zones with no bus service. For HO & NH files: maximum/missing values set to 999.*
Average waiting time for bus service in zone for non-work trips (7)	The average wait time for bus non-work trip (in minutes) for modes BEPQ. Double the wait for bus work trip (as a proxy for midday service). *For HW files: maximum/missing values set to 99. For HO & NH files: maximum/missing values set to 999*.
Average waiting time for feeder bus service in zone for home-work trips (8)	The average wait time for feeder bus work trip (in minutes) for mode L. Calculated as the mean of (headway*0.5) for all bus stops served by mode L within the zone during the AM peak period. To account for spatial inaccuracy, stops are buffered by 0.1 miles. *For HW files: maximum/missing values set to 99. For HO & NH files: maximum/missing values set to 999.*
Average waiting time for feeder bus service in zone for non-work trips (9)	The average wait time for feeder bus non-work trip (in minutes) for mode L. No feeder bus service in off-peak period, so: *For HW files: all values set to 99. For HO & NH files: all values set to 999.*
Home-work trip auto work end auto occupancy (10)	Zone vehicle occupancy rate for commuters (i.e., workers per vehicle), measured at destination (work) location. Calculated using data from Table 2-2 of the 2000 CTPP. *Included in HW M01 files only.*

DISTR file

The DISTR files contain zonal transit approach distribution parameters and are used by the Pre Distribution and Mode Choice models. The parameters are calculated using transit network characteristics and are thus specific to each scenario network. The following table (23) describes the DISTR file fields.

Table 23. DISTR File Attributes

Mode Category	Field Number	Description
	1	CMAP modeling zone number.
Commuter rail (fields 2-4) CTA rail (fields 5-7) Park and Ride (fields 14-16)	2,5,14	Mean distance in miles to station (or park and ride). *Calculation*: A distance calculation is performed to find the rail station closest to each subzone centroid. The closest station distances are then aggregated to the zonal level to determine the mean distance weighted by subzone households. The maximum mean distance is set to 19.95 miles. The analysis is performed separately for the commuter rail stations, rapid transit stations and park and ride locations.
	3,6,15	Standard deviation of distance to station (or park and ride). *Calculation*: The standard deviation is calculated as the square root of the sum of [the zonal variance calculated above and a subzone variance, estimated to be 0.042].
	4,7,16	Type of Mode Choice distribution. 101 (default) = normal distribution. 102 = exponential distribution.
Bus (fields 8-10) Feeder Bus (fields 11-13)	8, 11	Minimum bus stop distance (miles). *Calculation*: A set of bus stop buffers (incremented by 0.1 miles from 0.1 up to 1.1 miles) are created. The buffers are overlaid with the zone system to determine the proportion of each zone covered by each buffer. The minimum bus stop distance is determined by the size of the smallest buffer that covers any part of the zone. The value is set to 999 for zones that are not covered by any portion of the largest buffer. The analysis is performed separately for bus (modes BEPQ) and feeder bus (mode L) stops.
	9, 12	Maximum bus stop distance (miles). *Calculation*: The maximum bus stop distance is determined by the size of the smallest buffer that covers the entire zone (for practical reasons the threshold is 97% of the zone). The value is set to 999 for zones with a minimum distance of 999 or is set to 1.1 if no buffer meets the coverage threshold and the minimum distance is not 999.
	10, 13	Proportion of the zone within minimum walking distance. *Calculation*: This value is calculated as the area of the zone covered by the minimum distance buffer divided by the area of the zone covered by the maximum distance buffer. This value is set to 999 for zones with a minimum distance of 999.

Source: Parsons Brinckerhoff, 2011.

As with the M01 file, two separate formats of the DISTR file are created: one for Home-Based Work trips and one for the other trip purposes. The only difference between the formats is that the feeder bus fields (11-13) are all set to 999 for the Home-Based Other and Non-Home Based files. The DISTR files use the same naming convention as noted above with the M01 files.

Household Vehicle Ownership File

This file (MCHW_HH.TXT) is automatically generated by the Trip Generation model as a fixed-width file and is used as input by the Mode Choice model. Within the Mode Choice model, home-work auto person trips are allocated to drive-alone, two person rideshare and three or more person carpools. The sub-mode choice model includes independent variables for the proportions of households within each zone at differing levels of vehicle ownership. As this

information is already estimated by the Trip Generation model, creation of this file ensures that the Mode Choice model uses internally consistent data. The following table identifies the attributes included in this file.

Table 24. Household Vehicle Ownership File Attributes

Variable	Location in File
CMAP modeling zone	1-5
Households with One or More Low Income Workers	
Share of Households without Vehicles	6-17
Share of Households with One Vehicle	18-29
Share of Households with Two or More Vehicles	30-41
Households with One or More High Income Workers	
Share of Households without Vehicles	42-53
Share of Households with One Vehicle	54-65
Share of Households with Two or More Vehicles	66-77

Source: Parsons Brinckerhoff, 2010

Low income workers are defined as having earnings below the regional median. Conversely, the earnings of high income workers exceed the regional median. Note that the set of household proportions under each income category sums to one.

M023 file

The M023 file contains transit fare and auto operating cost data that are used by the Pre Distribution and Mode Choice models. The cost data reflect 2009 values. Separate files are created for each trip purpose, although the file contents are identical. The file is composed of six records:

1. CTA fares;
2. Pace feeder bus fares;
3. Pace regional bus fares;
4. Auto operating costs in 5 mile per hour increments for speeds between 0-40 miles per hour;
5. Auto operating costs in 5 mile per hour increments for speeds between 40-80 miles per hour;
6. Average auto operating costs per mile by zone type used to estimate transit access/egress costs.

The CTA fares used in the M023 file are:

- Bus boarding fare is $2.00 (Chicago Card or Chicago Card Plus fare).
- Rail transit boarding fare is $2.25 (Chicago Card or Chicago Card Plus fare).

- First transfer is $0.25 (Chicago Card or Chicago Card Plus fare).
- Link-Up pass per ride is $0.95 (approximately equal to $39 monthly cost divided by 40 trips per month).

The Pace fares used in the M023 file are:

- Feeder bus boarding is $0.95 (assumes Link-Up pass).
- CBD feeder bus fare is $0.00 (fare calculations revised and no longer used).
- PACE current regular fare is $1.75.
- PACE first transfer is $0.25.

Auto operating costs were updated to reflect current fuel consumption and the current costs of tires, maintenance, and gasoline. These costs were derived from two sources. A publication by AAA was the source for the per mile costs of auto maintenance and tires (AAA, 2009). Figures on the average gasoline consumption per mile were obtained from an Oak Ridge National Laboratory publication (West et al., 1999). A $3.00 per gallon gasoline cost was assumed to convert the gasoline consumption into a cost per mile. The resulting costs per mile for auto travel are listed in Table 25.

Table 25. M023 File Auto Operating Costs

Miles/Hour	Fuel Used Gallon/Mile	Cents per Mile			
		Gasoline (@$3.00/Gal)	Tires	Maintenance	Total
0-5	0.064	19.17	0.77	4.56	24.50
5-10	0.052	15.67	0.77	4.56	21.00
10-15	0.044	13.25	0.77	4.56	18.58
15-20	0.038	11.47	0.77	4.56	16.80
20-25	0.034	10.27	0.77	4.56	15.60
25-30	0.032	9.65	0.77	4.56	14.98
30-35	0.032	9.54	0.77	4.56	14.87
35-40	0.032	9.65	0.77	4.56	14.98
40-45	0.032	9.58	0.77	4.56	14.91
45-50	0.031	9.38	0.77	4.56	14.71
50-55	0.031	9.26	0.77	4.56	14.59
55-60	0.031	9.40	0.77	4.56	14.73
60-65	0.033	9.90	0.77	4.56	15.23
65-70	0.036	10.71	0.77	4.56	16.04
70-75	0.039	11.63	0.77	4.56	16.96
75-80	0.042	12.71	0.77	4.56	18.04

Source: Parsons Brinckerhoff, 2011.

The last record in the file contains the average per mile auto operating cost for each of the four zone types (defined in the M01 file). All of the M023 data is collapsed into six records, which are shown in Table 26. All of the values are reported in cents.

Table 26. M023 File Layout

	Field Locations							
	1-5	6-10	11-15	16-20	21-25	26-30	31-35	35-40
CTA Fares	200	225	25	95				
Feeder Bus Fares	95		0					
PACE Fares	175		25					
Auto Operating Costs by 5 MPH	2450	2100	1858	1680	1560	1498	1487	1498
	1491	1471	1459	1473	1523	1604	1696	1804
Auto Operating Costs by Zone Type	2000	1700	1500	1500				

CBD Parking File

CBD parking costs are also important to the mode choice and distribution models. A database of selected Central Area parking facilities is used to provide parking cost distribution information to the composite cost and mode choice models. The specification of the variables and fields is described in CATS Working Paper 95-01 and substantially elaborated in an undated memo by Gordon Schultz on the subject "1990 Central Business District Parking Costs." Files are generated for use by both the Pre-Distribution and Mode Choice models. The parking supply database is currently treated as a fixed input, unless a scenario is testing the effect of downtown parking costs on regional mode choice.

Two different sets of records are included in the CBD parking file. The first set identifies the parking supply characteristics of each CBD zone that contains parking. Each zone in this set has five records with the following information:

- CBD parking zone number.
- The probability of finding parking within the zone at the threshold parking cost (this value must be 100 percent in each zone's fifth record).
- The threshold parking cost in cents per hour.
- The savings in parking costs in cents per hour determined by subtracting the threshold parking cost from the maximum parking cost in the zone.
- The amount of time needed to walk one block in the CBD (180 seconds).

A sample of the parking supply records for CBD zone 5 is displayed in Table 27. Note that the maximum cost to park in this zone was identified as $4.13 ($33.00 per eight hour day).

Table 27. CBD Parking File Sample Parking Supply Records

CBD Parking Zone	Parking Probability (0.000)	Threshold Cost (cents/hour)	Cost Savings (cents/hour)	Walk Speed (seconds/block)
5	2222	350	63	180
5	4444	225	188	180
5	6667	200	213	180
5	8889	163	250	180
5	10000	150	263	180

Source: Parsons Brinckerhoff, 2011, p. 22.

The parking supply records were updated using the following procedures. A website for downtown parking availability (chicago.bestparking.com) provided data for these values. Off-street parking facilities were organized by CBD parking zones. The least costly daily rate for each facility was determined using either the daily rate or a monthly rate divided by twenty workdays. Facilities were then ordered by daily rate from most to least expensive and the cost savings compared to the most expensive facility calculated. Each parking facility in a zone was assumed to have the same selection probability. Cumulative probabilities were then totaled, again from most to least expensive parking facility. Five parking supply records were created from the parking probabilities and threshold costs. In zones with many off-street parking locations, threshold costs were selected so as to yield nearly equal probability intervals.

User characteristics are important to the cost paid for parking, and they were updated in 2010 using data from the Travel Tracker survey. These characteristics include the percentage of people who have access to free parking, and the percentage of trips by auto occupancy. Both of these characteristics are stratified by income. While it may seem curious to input quantities that are actually estimated by the models, these travel characteristics are needed in order to compute the free versus pay CBD parking and the parking costs per person. Given their role in the cost calculations they need only be rough estimates based on observed travel.

The user characteristics are included in the second set of records in the CBD parking file – these correspond to the final five records in the file. These records are ordered by household income ranges and include the following variables for CBD commuters:

- The upper value of the household income quintile range (last record is the lower bound of the highest quintile).
- The percentage of CBD auto commuters with free parking.
- The percentage of all CBD workers taking transit to CBD.
- The percentage of CBD auto commuters in single occupant vehicles.
- The percentage of CBD auto commuters ridesharing in two person vehicles
- The percentage of CBD auto commuters carpooling in three person vehicles.
- The percentage of CBD auto commuters carpooling in four or more person vehicles.

The user characteristics are shown in Table 28. Note that most of the values do not change with income – this is due to the limited sample of CBD parkers found in Travel Tracker.

Table 28. CBD Parking File User Characteristics

Income Quintile	Park Free	Transit	Auto Occupancy			
			One	Two	Three	Four or More
22800	77.1	67.3	75.8	20.2	3.0	1.0
43900	77.1	67.3	75.8	20.2	3.0	1.0
68000	77.1	67.3	75.8	20.2	3.0	1.0
104000	67.1	67.3	75.8	20.2	3.0	1.0
104001	67.1	67.3	75.8	20.2	3.0	1.0

3. Trip Generation

Trip generation is the first of the four sequential steps utilized by CMAP to forecast travel behavior. It is the means by which land use planning/zoning quantities such as households and employment are converted into trip origins and destinations that serve as measures of transportation demand. The trip generation process links the region's current and forecasted socioeconomic characteristics, the variables which drive travel demand, with the remaining sequential steps used to estimate choices of a trip destination and its mode and route.

Over the period 2008-2009, many enhancements to the CMAP Trip Generation models were made. This section outlines the revisions to the CMAP household trip generation model that were completed by Parsons Brinckerhoff during this period. A much more detailed discussion of CMAP's Trip Generation model is provided in the consultant documentation included as Appendix A of this report; part of this document is excerpted below.

3.1 Recent Model Revisions

The most critical change made to the model was to update the existing Trip Generation model to reflect current travel behavior. Both the CMAP and the Northwestern Indiana Regional Planning Commission versions of the Travel Tracker survey of more than 14,000 combined households in northeastern Illinois and northwestern Indiana were used to estimate revised trip generation rates. In addition to re-estimating trip generation rates, there are other parts of the model that were re-estimated and/or recalibrated as well. These include the submodels within trip generation that: (1) create small area estimates of households grouped by their composition and income levels; (2) estimate the vehicles available to a household; (3) forecast trip generation by persons in group quarters; (4) estimate trips with one trip end outside the study area, and; (5) separate person trips into trips by motorized and non-motorized modes.

Updating the submodels required the use of additional data beyond that which is available in Travel Tracker, either because the relevant variables were not collected in the survey or because the sample of households is too small for reasonable statistical reliability of estimated model coefficients. The American Community Survey (ACS) is a continuous survey that annually collects long-form data from a smaller annual sample of households (approximately one in forty households annually compared to one in six households in past decennial censuses) than was collected in the past. Since 2006, the ACS also includes a 2.5 percent sample of persons living in group quarters.

The continuous nature of the ACS means that some trip generation model inputs can be updated more frequently than in the past. This has implications for the trip generation model software code. Observed tables of households required by the procedure to disaggregate households inside small areas were normally hard-coded in the program, along with a handful of other parameters for one or more trip generation submodels. This was a sensible approach when the model was originally programmed because these data and parameters could only be

redone at ten year intervals with decennial census data, or even more infrequently, when a regional household travel survey was completed. This approach also reduced the burden on the user for assembling inputs to apply the model. Updating the Trip Generation model provided an opportunity to minimize this practice, facilitating updates based on more frequent ACS and other data sources.

As the Trip Generation model software executes, it creates temporary files of households tabulated by composition, income, and vehicle ownership. These files have value beyond their role in trip generation. For example, these household files might prove useful in studies dealing with issues of social and economic justice related to alternative transportation investments. The code was revised to allow users to save these intermediate datasets.

As stated, CMAP has a ten-year strategy for developing advanced modeling tools. These "state of the art" models focus on individual travel behavior in far more detail than that allowed by the four-step models' limited number of trip types and aggregate trip movements between zones. Updates to the current travel demand models should (whenever practical) complement development of "advanced practice" models at CMAP. With respect to future usefulness of the CMAP Trip Generation model or its submodels, a positive feature of the current model is the disaggregation of households within small areas, which is a component of many "advanced practice" models.

In summary, the update of the Trip Generation model resulted in:

- Revised trip generation rates, input files, parameters, and submodel coefficients based on the CMAP household travel survey and recent ACS person and household data.
- Revised trip generation software with changes included in the model code to improve its flexibility and ease of use.
    - Code revised so that the model can be readily updated as ACS or other new data become available.
    - Code now allows for expansion of the study area or changes in the study area zone system.
    - The code permits more user control over operation of the program to save intermediate datasets.
    - The model's transparency was enhanced by improving model reports and outputs.
- Support CMAP's general model development program. For this updating of the CMAP trip generation model, the model calculations are less aggregate – more trip purposes are considered - so that they more closely resemble the level of detail in "advanced practice" models.

3.2 Model Processing Steps

The revised Trip Generation model has a linear logic identical to past versions of the model. This logic also corresponds to subroutines in the programmed model's code. The main processing steps in the model are briefly summarized:

1. *Read and Load Model Inputs*: These inputs control the operation of the program, define the study area geography, and provide large geographic area tables of cross-classified households that are the basis for the procedure to disaggregate households within small area trip generation subzones.
2. *Disaggregate Households by Subzone*: This step creates a four-way cross-classification table of households for each trip generation subzone from large area household tables and average subzone household characteristics. Households are classified by their number of adults (four categories), their number of workers (five categories), their number of children age fifteen and younger (four categories) and by household income quartile (four categories). This cross-classification results in two hundred twenty-four household categories: note that this is less than the product of multiplying all potential combinations due to the fact that the number of workers cannot exceed the number of adults in a household.
3. *Household Vehicle Availability*: Household vehicle ownership submodels are applied to estimate the vehicle ownership levels for each cell in the four-way household table, effectively adding a fifth dimension (vehicles available in the household) to the table.
4. *Household Trip Generation*: Daily trips per person by trip purpose are generated for the appropriate household members (workers, nonworking adults, and children aged twelve to fifteen). This is done by multiplying each cell of the household table by the trip generation rates appropriate for that individual and household type.
5. *Group Quarters Trip Generation*: Trips for workers and nonworking adults in non-institutionalized group quarters are estimated based on a subzone-level input file that is read by the model.
6. *Allocation of Non-home Trip Ends*: The subzone locations of trip ends that take place away from the household or group quarters are unknown at this point. In this step, a subzone-level file containing employment is first read and then non-home trip ends are allocated to subzones based on households and employment values.
7. *Trip Ends Outside the Study Area*: Some trip ends generated by study area residents are linked to trip ends outside of the CMAP modeling area. These are factored from the total generated person trips, leaving only trips wholly within the modeled study area. A file containing external trip factors is input for this purpose.
8. *Non-motorized Trips*: Following Trip Generation, the remaining steps in the trip-based model only address person trips using motorized modes. However the Trip Generation model does create non-motorized person trips. These pedestrian and cycling person trips are factored from the total generated person trips by submodels that estimate the fraction of non-motorized trips as a function of household and subzone characteristics, leaving only person trips using vehicles.
9. *Create Final Vehicle Trip Reports and Output Trip Files*: This final step of the Trip Generation model is discussed in the next section.

3.3 Model Output

The last step in the Trip Generation model code writes out the trip generation reports and creates an output file for use in the remaining CMAP modeling process. This is a lengthy file that includes a record for each trip generation zone for each trip purpose. The variables included in the output file are listed in Table 29.

Table 29. Trip Generation Model Output File Attributes

Variable	Type	Description
SUBZONE	Integer (I6)	Trip generation subzone (1-25000)
ZONE	Integer (I6)	Modeling zone number (1-5000)
TRIP TYPE	Integer (2)	Trip type code, 1-11 when writing out 11 purposes, or 1-49 when writing out the expanded types
HH PRODS	Real Number (F9.1)	Household trip productions/origins for trips within the modeled study area.
HH ATTRS	Real Number (F9.1)	Household trip attractions/destinations for trips within the modeled study area.

As noted in the table above, there are two options available for the Trip Type code used in the Trip Generation model: the standard eleven trip types recognized by CMAP's travel demand models, or an expanded set of forty-nine trip purposes now available with the current version of the Trip Generation code. The following table (Table 30) shows the correspondence between the two options. The table also identifies the trip purposes that are in "Production-Attraction" format and those that are in "Origin-Destination" format.

CMAP currently writes out the forty-nine purposes and processes the results with a SAS® program to combine the trip purposes and aggregate the trip ends to the modeling zone system used in the remainder of the modeling process. Users of CMAP modeled data will note that the "current trip purpose" trip ends are further aggregated into four purposes for use in the Trip Distribution and Mode Choice models: home-based work low income, home-based work high income, home-based other and non-home based trips.

Table 30. Correspondence between Expanded and Current Trip Purposes

Expanded Trip Purposes			Current CMAP Trip Purposes		
1	**Worker**	Workplace-Low Income (A)	1	Home (P)	Work (A)
2		Workplace-High Income (A)			
3		Work-Related (A)			
4	Home (P)	School (A)			
5		Nonhome/Work at Residence (A)	3		Nonhome/Work (A)
6		Nonhome/Work Not at Residence (A)			
7		Shop (A)	2		Shop (A)
8	Work (P)	Nonhome/Work at Residence (A)	5	Work (P)	Nonhome/Work (A)
9		Nonhome/Work Not at Residence (A)			
10		Shop (A)	4		Shop (A)
11	Work (O)	Work (D)	6	Work (O)	Work (D)
12	Nonhome/Work at Residence (O)	Nonhome/Work at Residence (D)	7	Nonhome/Work (O)	Nonhome/Work (D)
13		Nonhome/Work Not at Residence (D)			
14		Shop (D)			
15	Nonhome/Work Not at Residence (O)	Nonhome/Work at Residence (D)			
16		Nonhome/Work Not at Residence (D)			
17		Shop (D)			
18	Shop (O)	Nonhome/Work at Residence (D)			
19		Nonhome/Work Not at Residence (D)			
20		Shop (D)			
21	**Nonworking Adult**	School (A)	1	Home (P)	Work (A)
22	Home (P)	Nonhome at Residence (A)	9		Nonhome (A)
23		Nonhome Not at Residence (A)	9		
24		Shop (A)	8		Shop (A)
25	Nonhome at Residence (O)	Nonhome at Residence (D)	10	Nonhome (O)	Nonhome (D)
26		Nonhome Not at Residence (D)			
27		Shop (D)			
28	Nonhome Not at Residence (O)	Nonhome at Residence (D)			
29		Nonhome Not at Residence (D)			
30		Shop (D)			
31	Shop (O)	Nonhome at Residence (D)			
32		Nonhome Not at Residence (D)			
33		Shop (D)			
34	**Child 12-15**	School (A)	11	Home (P)	Nonhome (A)
35	Home (P)	Nonhome at Residence (A)			
36		Nonhome Not at Residence (A)			
37		Shop (A)			
38	School (P)	Nonhome at Residence (A)			
39		Nonhome Not at Residence (A)			
40		Shop (A)			
41	Nonhome at Residence (O)	Nonhome at Residence (D)			
42		Nonhome Not at Residence (D)			
43		Shop (D)			
44	Nonhome Not at Residence (O)	Nonhome at Residence (D)			
45		Nonhome Not at Residence (D)			
46		Shop (D)			
47	Shop (O)	Nonhome at Residence (D)			
48		Nonhome Not at Residence (D)			
49		Shop (D)			

4. Trip Distribution

The Trip Distribution model links the trip productions with the trip attractions. The model is applied between Trip Generation and Mode Choice in the trip-based model. The process estimates the destination choices of motorized person trips, regardless of mode, by converting zone trip production and attraction vectors produced by the trip generation model into movements between zones. This results in trip tables which are two dimensional matrices. During this process, the intervening opportunity trip distribution model is used to distribute person trips using composite impedance reflecting the relative ease of travel provided by both the highway and transit networks. The resulting person trip tables are then input into the Mode Choice model.

In addition, the resulting home-based person trip tables (home-based work, home-based other) are in a special format referred to as "Production-Attraction" format. This means that all trips are represented as being produced from the home/production end and attracted to the destination end. The effect is that a trip from home to work and one from work to home again are both represented as trips leaving home to the work destination. Care must be taken to keep this in mind if the trip tables are used for other purposes. One advantage of this format for analysis is that it provides an indication of the direction of daily travel. One knows that the origin side is the home, and the destination is not. For example, if one looked at the daily travel to any location in origin/destination format, one would find that approximately the same number of people traveled to a particular zone as left it, but it would not be possible to determine if that zone was the home or work location.

The CMAP trip distribution takes the form of a gravity model, with the additional consideration of "intervening opportunities" that consider the probability of a traveler selecting a particular destination based on the number of destination opportunities it offers. The inputs needed for this model are the person trip productions and attractions from the trip generation model, an estimate of each zone's accessibility calculated using generalized cost "utility functions," an array of L-values to influence trip length from the origin end, and transit offset value to influence trip length to the CBD. This model is discussed in further detail.

4.1 Doubly-Constrained Intervening Opportunities Model

The intervening opportunity model of trip distribution was originally formulated in the late 1950s. It is based on two simple premises. First, travelers try to minimize travel time and cost, and secondly, there is some constant probability that a traveler will find a potential destination acceptable. To illustrate, a person making a shopping trip does not always stop at the nearest store, they first consider whether the nearest store is acceptable or not; if not, they move on to the next closest store, and so on, until an acceptable destination is found.

These premises can be restated as follows in terms of the analysis zones and trip attractions and trip productions that are built into the model. The probability that a trip production will end in

a particular destination zone is the product of two probabilities, the probability that the trip has not already terminated nearer the origin zone multiplied by the probability that an acceptable attraction exists in the destination zone. Mathematically, this probability can be expressed as:

$$\Delta P = (1 - P) * L * \Delta A$$

Where P equals the probability that the trip is completed before the destination zone is reached; ΔP is the marginal probability of completing the trip due to the added attractions (ΔA) of the destination zone. Finally, L is the constant probability of stopping at any single attraction.

Applying this simple model raises a number of complex questions. What is meant by nearest zone and in what sequence are attractions considered by the traveler? Is proximity determined by the shortest travel time or least cost mode/route, or by some measure that reflects the alternative modes and routes available between origin and destination zones? Even more fundamental model questions are associated with the L-values, including how travel and traveler characteristics affect these quantities, and how they change over time?

The balance of this section discusses how the intervening opportunity trip distribution model is applied by CMAP in the air quality conformity TIP and RTP network evaluations. The major change introduced into the model since its earliest applications is the use of a combined measure of transit and highway cost to rank zones in order of increasing cost from the origin zone.

The model was calibrated to data from the Travel Tracker survey for home-other and non-home based trips; home-based work trips are calibrated using trip lengths from the 2000 CTPP. L-values are calibration constants used in the model that measure how selective travelers are in accepting opportunities (destinations). In general, lower L-values lead to longer trips (because the traveler is more selective), and higher L-values lead to shorter trips. L-values are calculated based on the generalized cost of the transportation system and the available opportunities within a specific cost cutoff. Thus the L-values are responsive to both land use and transportation system changes. The L-values were calibrated and then smoothed into a monotonic function of accessible attractions. This function is used to estimate future L-values. Regression relationships were developed to estimate L-values as a function of the attractions that are accessible within a particular combined transit-highway cost from the origin zone. This approach to L-value calibration allows the cost and time characteristics of the highway and transit networks, as well as trip productions and attractions, to influence the trip distribution.

The intervening opportunity trip distribution model is a member of the gravity model family of trip distribution models. After some algebra, the above relationship indicates that trips between zones are proportional to the trip productions in the origin zone and attractions at the destination zone, and inversely proportional to the difficulty of traveling between the two zones. This is the well-known general formulation of the gravity model. In most gravity models, the difficulty of traveling between zones (i.e., the impedance faced by the traveler) is

related to the travel time or travel cost between zones. However in the intervening opportunity model, impedance also is a function of the attractions, or intervening opportunities, the traveler encounters while journeying between zone pairs.

The doubly constrained intervening opportunity model consists of the following set of equations (Parsons Brinckerhoff, 2011, pps. 26-7). To solve these equations, travel impedance is first determined, and then the remaining equations are simultaneously solved using an iterative matrix balancing algorithm:

$$1.\ T_{ij} = \alpha_i \beta_j F_{ij}$$
$$2.\ P_i = \alpha_i \sum_j \beta_j F_{ij}$$
$$3.\ A_j = \beta_j \sum_i \alpha_i F_{ij}$$
$$4.\ \alpha_i, \beta_j, F_{ij} \geq 0$$

Where: T_{ij} = the estimated trips between a production/origin zone *i* and attraction/destination zone *j*.

P_i = production/origin trip ends in zone *i*.

A_j = attraction/destination trip ends in zone *j*.

α_i = production/origin zone *i* balancing coefficient.

β_j = attraction/destination zone *j* balancing coefficient.

F_{ij} = a measure of the interaction affinity between zones that is inversely related to the difficulty or impedance (time, cost, etc., noted below as I_{ij}) associated with travel between zones *i* and *j*.

The α_is and β_js in these equations are determined through a matrix balancing procedure (also known as iterative proportional fitting) given the P_is, A_js and F_{ij}s. The equations above are the actual trip distribution model that links together trip productions and attractions. Zone trip productions and attractions produced by the trip generation model are converted into movements between zones, or trip tables. There is one distribution equation for every origin zone - destination zone pair.

In MPO practice, a functional relationship between F_{ij} and travel impedance $I_{i,}$ is first assumed, then the coefficients in these relationships are calibrated using observed travel, with the objective of matching modeled travel time/cost trip frequency distributions or average travel times/costs to observed data. The CMAP distribution model is a negative exponential form with the difficulty of travel dependent on the number of closer work attractions.

$$T_{ij} = \alpha_i \beta_j e^{-LVij}$$

Where: L = CMAP distribution model calibration coefficient, which may vary by trip purpose or location.

V_{ij} = intervening attractions/destinations (attractions nearer production/origin zone i than attraction/destination zone j, including those in zone i and but not those in zone j).

Previous model development work at CMAP/CATS estimated relationships between the L value calibration coefficient and the number of attractions within the average travel cost. The general form of these relationships is shown below.

$$L = \frac{\lambda}{(V\$)^{\gamma}}$$

Where: L = CMAP distribution model calibration coefficient.

$V_{\$}$ = intervening attractions/destinations nearer production/origin zone than some predetermined cost.

λ, γ = additional model calibration parameters.

In the current version of the CMAP Trip Distribution model, the above equation is expanded into a gamma function with an added calibration parameter (μ). This revised function can fit a wider range of distributions than the original.

$$L = \frac{\lambda}{(V\$)^{\gamma}} e^{\mu V_{\$}}$$

The practical effect of this change is to establish lower bounds for the L-values. The extra parameter does not, however, change the approach to calibration since the log of the function is still a linear equation that can be fit to observed data with least squares regression. New calibrations of the distribution model were completed and are discussed in the next section.

In the doubly constrained version of the intervening opportunity model, two sets of equations restrict the total trips distributed from an origin zone to the zone's trip productions, and the total trips received by a destination zone to the zone's trip attractions. These equations ensure that the row sums of the trip table equal trip productions and the trip table's column sums equal trip attractions. There is one production constraint equation for each origin zone and one attraction constraint equation for every destination zone.

To gain some sense of the magnitude of the calculations required for trip distribution, consider that there are nearly 7,600,000 equations in the above model that need to be solved for each trip purpose. This figure applies to the 1944 internal modeling zones addressed by Trip Distribution; the 17 external zones are treated separately. The Trip Distribution model is also applied separately for four trip purposes:

- home productions to work attractions for workers earning less than the regional median annual wage (low income workers),
- home productions to work attractions for workers earning more than the regional median annual wage (high income workers),
- home productions to non-work attractions, and
- non-home productions to non-home attractions.

4.2 Model Calibration

Calibration of any trip distribution model usually means fitting the model's average trip lengths, or trip length distribution, to observed trip characteristics. The CMAP Trip Distribution model is calibrated to average trip lengths for outbound trips from subareas in the region, and to the average trip length for trips received by the Central Area. In the calibration process, the L-values primarily control the trip lengths for trips sent, while a transit offset value regulates the length of trips received by the Central Area.

The trip distribution model calibration, therefore, has two stages. L-values are calibrated to average sent trip lengths, and then the relative importance of transit and highway modes in the distribution generalized cost is calibrated from the trip lengths of trips received by the Central Area. In all of the calibration calculations, the trips referred to are person trips made in any vehicle, auto or transit. Non-motorized modes such as walking and bicycling are not included. The calibration calculations are repeated for each of the four trip purposes modeled. As stated, the L-values control the lengths of trips sent from areas while highway and transit offset values are used to control the length of trips to the Central Area. After the final coefficients were determined for the HBW trips, it was necessary to iteratively adjust the highway offset to achieve the desired trip length for work trips to the Central Area.

The calibration steps used for each of the four trip purposes can be summarized as follows (Parsons Brinckerhoff, 2011, p. 28):

1. The average low and high income home-work sent and received straight-line trip distances were tabulated by five percent PUMAs from the 2000 CTPP. This was done using the tract level records of Table 3-7. As Table 3-7 is based on household income rather than worker salaries, workers in households in the lower two categories of household income were assumed to be representative of workers with less than median salaries, and workers in the upper two household income categories were assumed to be high income workers. Trip lengths for "low" and "high" income workers were then estimated from Table 3-7. Data suppression in Table 3-7 was addressed by factoring both worker income trip lengths by the ratio of unsuppressed (Table 3-2) to suppressed (Table 3-7) trip lengths for all workers. All trip distances were calculated using the geographic centroids of tracts, which are roughly similar to the CMAP modeling zones. Comparable average trip lengths for home-other and non-home sent and received trips are obtained from the CMAP survey. These distances were directly calculated from trip end coordinates in the survey.

2. Beginning with an estimate of the average L-value calibration coefficient for each and every PUMA, the zone-level distribution was run with these PUMA averaged L-values and the average PUMA trip lengths were compared to observed values. PUMA L-values were factored by the inverse ratio of observed to simulated trip lengths (as decreased L-values yield increased trip lengths and vice versa) and distribution was rerun until satisfactory closure with the observed trip lengths was attained. An attempt was made to match both sent and received trip lengths; however, priority was given to matching sent trip lengths and Chicago Central Area work received trip lengths. The result is a set of "observed" L-values for PUMAs.
3. A pre-distribution zone-to-zone generalized cost matrix was developed.
4. The median travel costs for all trips was estimated using an historic base year trip distribution and the generalized costs from step 3.
5. The attractions/destinations reachable within the median travel costs were calculated for each zone and averaged by PUMAs (these are the PUMA level $V_{\$}$s).
6. A relationship was estimated between the PUMA "observed" L-values from step 2 and the attractions/destinations within the median cost (the PUMA $V_{\$}$s) from step 5.
7. Trips were distributed at the zonal level using L-values estimated by the "smoothed" relationship from step 6 and the results were evaluated by again comparing simulated and actual trip lengths.

The model was calibrated to develop new coefficients for each of the four trip purposes, which are presented in Table 31.

Table 31. Trip Distribution Calibration Coefficients

Trip Purpose	Median Cost	Fitted Parameters						R^2
		λ	"t" Statistic	γ	"t" Statistic	μ*10^7	"t" Statistic	
Home-Work								
Low Income	3.11	10.065	13.5	-0.739	-11.0	8.661	3.3	0.86
High Income	3.24	11.203	16.5	-0.830	-13.5	8.084	3.4	0.91
Home-Other	2.94	16.192	5.3	-1.211	-4.6	25.93	3.6	0.31
Non-Home	3.06	15.390	9.2	-1.196	-7.6	40.54	4.2	0.68

Source (Parsons Brinckerhoff , 2011, p29)

More on Trip Distribution model trip lengths can be found in the CMAP Travel Demand Model Validation Report.

4.3 Generalized Highway-Transit Cost Estimation

Travel time and cost are not explicitly included in the impedances (F_{ij}s), but they enter the model through the ranking of trip attractions from the origin zone. In the CMAP regional model, a generalized cost of travel across modes is used for ranking zones. This generalized cost reflects the cost and time of travel by both transit and auto, and is calculated in a process referred to as Pre-Distribution.

The generalized highway and transit costs between trip interchanges are key influencers of travel behavior, and are used as inputs to both the Trip Distribution and Mode Choice models. The Pre-Distribution generalized cost calculations use largely the same coefficients as the CMAP Mode Choice model version. While the distribution model uses the combined costs of highway and transit to represent the general difficulty of traveling between zone pairs, the Mode Choice model uses the driving and transit costs separately to compare the relative difficulty of driving to the destination versus using public transportation. Line-haul costs and times for travel by transit and auto are determined by the modeled network paths between zones, but the costs and times required to reach or depart line-haul facilities are simulated through Monte Carlo simulation models which estimate central area parking costs and transit access characteristics.
The cost calculation routine with Monte Carlo simulations is run before applying the Trip Distribution model and estimates the generalized travel cost of driving or transit. One hundred person trips are simulated for each trip interchange between zones, taking advantage of the Monte Carlo simulation's ability to limit common modeling error caused by the use of average values rather than modeling probabilities. The transit and highway costs and times for these trips are estimated in the same manner as in the Mode Choice, but the Mode Choice calculations are not completed. The interchange's transit and highway costs are then calculated from the average of the characteristics of the one hundred trips simulated for each zonal interchange.

Costs used in the Pre-Distribution procedures were previously discounted to 1970 dollars. The current version of the procedures uses current costs (measured in 2010 dollars). The coefficients were adjusted using the Historical Consumer Price Index for all Urban Consumers, which indicated that a 1970 dollar would be worth $5.55 in current dollars. The Pre-Distribution cost coefficients were, therefore, reduced to eighteen percent ($\frac{\$1.00}{\$5.55}$) of their previous levels.

Variables in the generalized cost calculation and their weights are listed in Table 32. This table represents the subset of Mode Choice coefficients used in Pre-Distribution. The work trip high income utility functions are used to estimate costs to Central Area destinations for all trip purpose; the non-work purpose utility functions are not used. For work trips not destined to the Central Area, the low income work utility calculation is used. For all remaining home-based other and non-home based trips, the respective destination utility functions for trips not destined to the Central Area are used.

Note that transit bias is not included in this generalized cost calculation. Transit bias (which is included in the Mode Choice model) is a constant that does not vary with the ease or difficulty of travel between zones. It is thought that this transit bias, while relevant for mode choice, should not enter into destination choice. The transit bias constants are not included in the utility functions, as the relative importance of transit compared to highway is considered when the generalized costs are combined for auto and transit into one term.

The separate auto and transit utility values $\sum_i \omega_i V_i^{auto}$ and $\sum_i \omega_i V_i^{transit} + \tau$ for each zone pair, must be combined into one generalized term. The utilities are combined using the following formula:

$$C^{auto,transit} = -Ln\left\{e^{-\sum_i \omega_i V_i^{auto}} + e^{-\sum_i \omega_i V_i^{transit} + \tau}\right\}$$

The combined multi-mode generalized cost can also be interpreted as the cost belonging to some abstract mode "auto-transit" whose service characteristics are equivalent to those of a joint transit-highway alternative.

Table 32. Pre-Distribution Model Coefficients

Pre-Distribution Variable (V_i)	Weight (w_i)
Home to Central Area Work Trips High Income	
Auto and Transit In-Vehicle Time (in minutes)	0.01590
Auto and Transit Cost (in cents)	0.00153
Auto and Transit Excess Time for Access/Egress (in minutes)	0.04860
Transit Bias	0.00000
Transit Out-of-Vehicle Time (in minutes)	0.02900
Transit First Wait Time (in minutes)	0.01730
Home to Non-Central Area Work Trips Low Income	
Auto and Transit In-Vehicle Time (in minutes)	0.01860
Auto and Transit Cost (in cents)	0.00130
Auto and Transit Excess Time for Access/Egress (in minutes)	0.05840
Transit Bias	0.00000
Transit Out-of-Vehicle Time (in minutes)	0.03990
Transit First Wait Time (in minutes)	0.08110
Home to Other Trips, Non-Central Area Destinations	
Auto and Transit In-Vehicle Time (in minutes)	0.01140
Auto and Transit Cost (in cents)	0.00592
Auto and Transit Excess Time for Access/Egress (in minutes)	0.06630
Transit Bias	0.00000
Transit Out-of-Vehicle Time (in minutes)	0.05890
Transit First Wait Time (in minutes)	0.06100
Non-home to Non-home, Non-Central Area Destinations	
Auto and Transit In-Vehicle Time (in minutes)	0.01140
Auto and Transit Cost (in cents)	0.00592
Auto and Transit Excess Time for Access/Egress (in minutes)	0.06630
Transit Bias	0.00000
Transit Out-of-Vehicle Time (in minutes)	0.05890
Transit First Wait Time (in minutes)	0.06100

In addition to the coefficient updates noted above, several default parameters hard-coded into the Pre-Distribution code were also updated:

- Average auto occupancy rates for home-other and non-home trips were revised to 1.66 and 1.19 respectively, based on the Travel Tracker survey.
- The minimum median household income is now $10,000 per year.
- The household income used to simulate non-home trips (i.e., the home zone is unknown) is $59,300, the 2007 ACS median household income for the Chicago Consolidated Metropolitan Statistical Area.
- The parameters used in the transit access/egress cost were updated: in-vehicle time was set to $0.20 per minute, out-of-vehicle time was set to $0.40 per minute, and kiss and ride auto driver costs were assumed to be double the one-way costs for auto passengers.

4.4 Distribution Model Processing Steps

The CMAP distribution model is unique enough that some find a description of the calculation steps helpful to understand how the model actually works. The following description includes information on several additions to the original CMAP trip distribution macros that were recently implemented: (1) calculations to estimate the number of attractions/destinations within the median travel cost were revised to include partial zones; (2) attractions/destinations that result in very short trips that are inappropriate for motorized travel are not considered, and; (3) intra-zonal trips are now explicitly determined. The following is an annotated outline of the sequence of calculations that implement the CMAP trip distribution models (Parsons Brinckerhoff, 2011); the distribution of each of the four trip purposes is generally similar.

1. Compute the combined auto-transit general cost matrix from the input auto and transit cost matrices. The combined auto-transit cost equals the sum of the individual mode utilities in the CMAP mode choice model.
2. The next set of steps describes the computations used to calculate the L-values.
   2.1. Locate the corners of the receiving zone based on the area of the zone and the x- and y-coordinates of the zone's geographic centroid. Zones are assumed to be approximately square in shape.
   2.2. Estimate the cost to reach each receiving zone corner. This is calculated by:

$$\frac{Dist_{Cent-Cor}(\$_{Auto-Transit})}{Dist_{Zone-Zone}}$$

Where: $Dist_{Cent-Cor}$ = the x-y distance between the zone centroid and a zone corner.
$Dist_{Zone-Zone}$ = the x-y distance between the sending and receiving zone centroids.
$\$_{Auto-Transit}$ = the travel cost between the sending and receiving zone centroids.

These corner costs are trip interchange specific; that is; there are four receiving zone corner costs for each zone to zone interchange.

   2.3. Find the minimum and maximum cost corners for the interchange.

2.4. Compute the opportunities that should not be considered for motorized travel. This is estimated to equal $\frac{0.5(Zone\ Attractions)}{Zone\ Area}$. The 0.5 in this equation is the area that can be reached within 0.5 miles x-y distance from the beginning of the trip.

2.5. Compute trip attractions/destinations within the median cost of all potential destinations. The first part of this calculation can have the following outcomes for each zone:

- The maximum cost corner is less than the median cost and all of the zone's attractions/destinations are included.
- The median cost is between the zone's maximum and minimum cost corners and a cost-prorated portion of the zone's attractions/destination are included.
- The minimum cost corner is greater than the median cost and the zone's attractions/destinations are not included.

After all zones are considered, the excluded opportunities from step 2.4 (.i.e., trips too shot to be motorized) are subtracted from the total attractions/destination inside the median cost.

2.6. Compute the L-values using calibrated relationships and attractions/destinations inside the median cost from step 2.5.

3. Compute the matrix of intervening attractions/destinations. A two stage matrix operation is required. The zones nearer in cost to the sending zone are first identified, and then the attractions/destinations for the subtended zones are added together. The excluded opportunities from step 2.4 are lastly subtracted from the total.

4. Compute the initial matrix of travel impedances $e^{-LV_{ij}}$ with the intervening attractions/destinations from step 3 (includes attractions/destinations within the sending zone).

5. Adjust all zonal attractions/destinations to potential trip attractions/destinations for vehicular travel. Subtract the excluded opportunities calculated in step 2.4 from all attractions/destinations in the zone, leaving attractions/destinations for both intra-zonal and inter-zonal trips for personal vehicular travel.

6. Run the initial trip distribution (matrix balancing) for both inter-zonal and intra-zonal trips. The attractions/destinations equal the zonal attractions/destinations from step 5 and total productions/origins are factored to equal attractions/destinations.

7. Factor the intra-zonal trips from step 6 by the ratio of zone trip productions/origins to sent trips.

8. Adjust the original zone productions/origins and attractions/destinations by removing intra-zonal productions/origins and attractions/destinations.

9. Zero the impedance matrix ($e^{-LV_{ij}}$) for all intra-zonal movements because intra-zonal trips cannot occur in the subsequent redistribution of trips.

10. Redistribute only inter-zonal trips using the zone productions/origins and attractions/destinations calculated in step 8 and the impedance matrix from step 9.

11. Combine the intra-zonal (step 7) and inter-zonal (step 10) trips into the final total trip table.

5. Mode Choice

The CMAP Mode Choice model uses two analysis techniques: the logit model and the Monte Carlo simulation model. Each of these techniques will be described in this section. The Mode Choice model equation is of the logit form. A Monte Carlo simulation of Central Area parking costs, transit access times, and traveler's income is used to provide some of the input to the logit equation. The Monte Carlo simulation decreases the aggregation error found in most other urban mode choice models. The Mode Choice model generates the estimated transit and highway trips originating from each of the analysis areas and destined to each of these areas. The Mode Choice model is applied to the person trips resulting from the Trip Distribution model, and divides the four distributed trip types into eight modal person trip tables:

1. Home-based work high income auto mode
2. Home-based work low income auto mode
3. Home-based work high income transit mode
4. Home-based work low income transit mode
5. Home-based other auto mode
6. Home-based other transit mode
7. Non-home based auto mode
8. Non-home based transit mode

Note that a "submode" model was recently added to the structure providing an estimate of high occupancy vehicle use for home-based work trips, enhancing CMAP's ability to respond to emerging policy questions.

5.1 Logit Model Structure

The multinomial logit formulation is the most commonly used model form for mode choice models in the United States. The multinomial logit model is expressed mathematically as follows:

$$P_{g,i} = \frac{\exp[U_{g,i}(x_{g,i})]}{\sum_{g,m}\exp[U_{g,m}(x_{g,m})]}$$

Where:

$P_{g,i}$	is the probability of a traveler from group g choosing mode i,
$x_{g,m}$	are the attributes of mode i that describe its attractiveness to group g,
$U_{g,m}(x_{g,m})$	is the utility of mode m for travelers in group g, and
$\Sigma_{g,m}$	indicates the summation of utilities over all available alternatives
exp( )	is the exponential function

Typically, the utility function for each alternative takes the form:

$$U_{g,m}(x_{g,m}) = a_m + b_m LOS_m + c_{g,m} SE_g + d_m TRIP$$

Where:

LOS_m	represents the variables describing levels-of-service provided by mode m,
SE_g	represents the variables describing socioeconomic characteristics of group g,
$TRIP$	represents the variables describing characteristics of the trip (e.g., CBD trips)
b_m	is a vector of coefficients describing the importance of LOS_m variables,
$c_{g,m}$	is a vector of coefficients describing the importance of each $SE_{g,m}$ characteristic of group g with respect to mode m,
d_m	is a vector or coefficient describing the importance of each trip characteristic with respect to mode m, and
a_m	is a constant specific to mode m that captures the overall effect of any variables missing from the expression (comfort, safety, and so forth).

The CMAP regional Mode Choice models are applied for four trip purposes:

1. Home Based Work Low Income: Trips from home to work made by workers earning less than the regional median annual wage;
2. Home Based Work High Income: Trips from home to work made by workers earning more than the median regional wage;
3. Home Based Non-Work: Trips made between home and all non-work locations (shopping and other); and
4. Non-Home Based: Trips that neither begin nor end at the traveler's home.

The mode choice models begin with person trips from the distribution model. These person trips tables are composed of all trips made by any "motorized" mode, that is, by transit, or as an automobile driver or passenger. The logit formulation is then used to separate the person trips into transit trips and highway person trips. There is a separate mode choice model for each trip purpose and each is stratified by location at the destination end of the trip. This stratification is between Central Area zones and non-Central Area zones. The work trip model is also stratified by low and high income travelers.

Table 33 presents the coefficients used in each of the Logit models. As noted in the Pre-Distribution discussion, all cost values have been revised from 1970 dollars to 2010 dollars. Different transit bias constants were calibrated for person trips by purpose, and by income level

for home-work trips. Separate coefficients are associated with each of the components of transportation system time and costs:

1. *In-vehicle travel times*. This is the time spent in the vehicle (either auto or transit) for a trip. For transit trips that include auto access to a service, the auto access and transit in-vehicle times are combined.
2. *Cost*. This is the cost of making a trip. For a transit trip, this includes the fare and station parking cost. For an auto trip, this includes the cost of operating the vehicle and parking costs.
3. *Walk time*. The time spent walking to and from transit service and the time spent walking from a parking spot at the destination end of the trip to the ultimate trip destination, if it occurs within the Central Area.
4. *Transit bias*. Constant to reflect relative cost of transit versus highway mode.
5. *Transit out-of-vehicle travel times*. This is the time one would spend transferring between transit routes.
6. *Wait time of first transit line boarded*. This is the time spent waiting to board the first transit vehicle, calculated as one-half of the service headway.

Table 33. Mode Choice Model Coefficients

Mode Choice Variable (V_i)	Weight (w_i)	
Home to Central Area Work Trips	**Low Income**	**High Income**
Auto and Transit In-Vehicle Time (in minutes)	0.01590	0.01590
Auto and Transit Cost (in cents)	0.00153	0.00153
Auto and Transit Excess Time for Access/Egress (in minutes)	0.04860	0.04860
Transit Bias	-0.43640	-0.71210
Transit Out-of-Vehicle Time (in minutes)	0.02900	0.02900
Transit First Wait Time (in minutes)	0.01730	0.01730
Home to Non-Central Area Work Trips	**Low Income**	**High Income**
Auto and Transit In-Vehicle Time (in minutes)	0.01860	0.01860
Auto and Transit Cost (in cents)	0.00130	0.00130
Auto and Transit Excess Time for Access/Egress (in minutes)	0.05840	0.05840
Transit Bias	-0.97300	-2.06070
Transit Out-of-Vehicle Time (in minutes)	0.03990	0.03990
Transit First Wait Time (in minutes)	0.08110	0.08110
Home to Other Trips	**Non-Central Area Destinations**	**Central Area Destinations**
Auto and Transit In-Vehicle Time (in minutes)	0.01140	0.01590
Auto and Transit Cost (in cents)	0.00592	0.00153
Auto and Transit Excess Time for Access/Egress (in minutes)	0.06630	0.04860
Transit Bias	-0.44820	-0.55070
Transit Out-of-Vehicle Time (in minutes)	0.05890	0.02900
Transit First Wait Time (in minutes)	0.06100	0.01730
Non-home to Non-home	**Non-Central Area Destinations**	**Central Area Destinations**
Auto and Transit In-Vehicle Time (in minutes)	0.01140	0.01590

Auto and Transit Cost (in cents)	0.00592	0.00153
Auto and Transit Excess Time for Access/Egress (in minutes)	0.06630	0.04860
Transit Bias	-1.14030	-1.62750
Transit Out-of-Vehicle Time (in minutes)	0.05890	0.02900
Transit First Wait Time (in minutes)	0.06100	0.01730

The Mode Choice model uses the following components of the transportation system to analyze modal costs. These matrices are estimated by the Emme® software transit and highway network assignment algorithms:

1. Transit in-vehicle travel times: The time spent in the vehicle for a transit trip. For transit trips that include auto access to a service, the auto access and transit in vehicle times are combined.
2. Transit out-of-vehicle travel times: This includes walking, waiting and transfer times.
3. Headway of first transit line boarded: This attribute provides information on the level of transit service available at the origin of the trip.
4. Transit fare: Fare paid to ride transit. When cost is calculated in the remainder of the model, the parking cost at the origin is also included if applicable.
5. Highway travel times: This is highway in-vehicle time and is the time spent in the vehicle for a trip.
6. Highway travel distances: This is used to calculate auto operating costs. When auto trip costs are calculated for the model, parking costs at the destination are also included.
7. First transit mode boarded.
8. Last transit mode used.
9. Transit priority mode (ranked in the following order: Metra rail, CTA rail, and bus).

Minimum cost routes are determined between zone centroids using cost component weights that are generally consistent with the pre-distribution and mode choice model coefficients. The quantities in the matrices are obtained by tracing these minimum cost routes. As network travel conditions vary throughout the day due to highway congestion and transit service levels, separate sets of travel characteristics matrices are modeled for the AM peak and midday time periods. The AM peak period is selected because all trips with a home purpose are modeled in pre-distribution, distribution, and mode choice as though the trip is produced at home. Therefore all home-work trips are estimated assuming AM peak period travel conditions to be consistent with the home production of these trips. Home-other and non-home trip purposes are paired with midday travel conditions. A CBD parking sub-model estimates auto parking costs and walking distances for zones; this sub-model is restricted to home-work travel.

The specific logit model formulation for the Chicago model is the binary model formulation that is a derivation of the general logit model formulation. This formulation is as follows:

$$P_t = \frac{e^{C_i V_i}}{1 + e^{C_i V_i}}$$

Where:

P_t is the probability that the trip will be a transit trip
C_i is the coefficient for variable i
V_i is the value of variable i for the movement being investigated

The coefficients for the logit model are reasonable and "correspond" to normal mode choice procedures. The ratio of the out-of-vehicle time coefficients to the in-vehicle time coefficient, for work trips, ranges from 1.09 for travel to the Central Area, to 4.36 for the travel to non-Central Area destinations. While the "classical" value for this ratio is 2.5, the variation in the Chicago model is logical and rational. The Central Area destined trips are more sensitive to the in-vehicle travel time than the non-Central Area destined trips and to transfer time. For Central Area destined trips the walk time and the transfer time is more sensitive (the coefficients are higher) than the initial headway time, while for the non-CBD trips the reverse is true with the first headway being the most sensitive of all variables. For the non-work trips the ratio of out-of-vehicle time to in-vehicle time ranges from 5.17 for transfer time to 5.82 for walk time. It is normal that non-work trips "emphasize" out of vehicle time rather than in-vehicle time. Typically there is minor highway congestion during the time most non-work trips occur (non-peak periods) and the transit service levels, in terms of headways and coverage, tend to be worse during these times.

The implied value of time for work trips range from $1.12 for in-vehicle time to CBD destinations to $6.76 for headways to non-CBD destinations. The value of time for the in-vehicle times ($1.12 and $1.55) are very similar to other urban areas. For example the Los Angeles model has a value of time of $1.12, the Washington region's value of time is $2.08, and Seattle's value of time is $2.09. The value of time for the non-work model is much lower, ranging from twenty-one cents for in-vehicle time to $1.21 for walk time. The sharp decrease in value of time for non-work trips is typical of mode choice models. A summary of the value of time and the out-of-vehicle time to in-vehicle time ratios (OVT/IVT) for the models is shown below:

Value of time and OVT/IVT ratio for Work Trips with CBD destinations				
	In-vehicle time	headway time	transfer time	walk time
Value of time (dollars per hour)	$1.12	$1.22	$2.05	$3.30
OVT/IVT	N/A	1.09	1.82	2.94

Value of time and OVT/IVT ratio for Work Trips with Non-CBD destinations				
	In-vehicle time	headway time	transfer time	walk time
Value of time (dollars per hour)	$1.55	$6.76	$3.32	$4.87
OVT/IVT	N/A	4.36	2.15	3.14

Value of time and OVT/IVT ratio for Non-Work Trips				
	In-vehicle time	headway time	transfer time	walk time
Value of time (dollars per hour)	$0.21	$1.11	$1.07	$1.21
OVT/IVT	N/A	5.35	5.17	5.82

Table 34 presents examples of using the Mode Choice model for work trips for a low income traveler. These examples are presented to illustrate the actual calculations used in the model. The examples also show that for a given set of travel times and costs, there will be a higher usage of transit to the Central Area than to the other areas of the region. This is, again, a logical property of the mode choice model.

Table 34. Example Application of the Home-Based Work Trip Model

Example using Central Area coefficients (Low Income)					
Variable	Highway	Transit	Difference	Coefficient	diff.*coeff.
in-vehicle time	25	45	-20	0.0159	-0.3180
first headway	0	5	-5	0.0173	-0.0865
transfer time	0	10	-10	0.0290	-0.2900
walk time	5	7	-2	0.0468	-0.0936
cost	200	100	100	0.00153	0.1530
Modal Coefficient				-0.4364	-0.4364
Sum Difference of values times the coefficients					-1.0715
exp(equation)					.3425
1+ exp(equation)					1.3425
transit probability	(exp(equation)/ (1.0+exp(equation)				0.2551

Example using non-Central Area coefficients (Low Income)					
Variable	Highway	Transit	Difference	Coefficient	diff.*coeff.
in-vehicle time	25	45	-20	0.0186	-0.3720
first headway	0	5	-5	0.0811	-0.4055
transfer time	0	10	-10	0.0399	-0.3990
walk time	5	7	-2	0.0584	-0.1168
cost	200	100	100	0.0013	0.1300
Modal Coefficient				-0.9730	-0.9730
Sum Difference of values times the coefficients					-2.1363
exp(equation)					0.1181
1+ exp(equation)					1.1181
transit probability	(exp(equation)/ (1.0+exp(equation)				0.1056

5.2 Auto Submode Model for Work Trips

The sequence of CMAP travel demand models includes a mode choice model that allocates auto person trips into drive alone, two persons ride-sharing, and three or more persons carpooling sub-modes. This auto sub-mode choice model contains independent variables for the

proportions of households within a zone at different levels of vehicle ownership. Since the household vehicle ownership sub-model in the CMAP Trip Generation model estimates these proportions (the previously discussed MCHW_HH.TXT file), the same values of household vehicle ownership should be used in both trip generation and mode choice for consistency. The relevant parameters for running the work trip auto sub-model (as read by the FORTRAN code via a Namelist file) are listed in Table 35.

Table 35. Work Trip Auto Submodel Parameters

Variable	Description	Variable Options
HW	Home productions and work attractions are simulated	True/False
HNW	Home productions and non-work attractions are simulated	True/False
OTH	Origins and destinations without a home or work trip end are simulated	True/False
HOV2	Two or more person vehicles are modeled with the HOV travel times and distances	True/False (Valid only if **HW** is true and must be false if **HOV3** is true)
HOV3	Only three or more person vehicles are modeled with the HOV travel times and distances	True/False (Valid only if **HW** is true and must be false if **HOV2** is true)
LOW_INC	Home-work trips for mode split are for low income workers	True/False (Valid on if **HW** is true and must be false if **HI_INC** is true)
HI_INC	Home-work trips for mode split are for high income workers	True/False (Valid on if **HW** is true and must be false if **LOW_INC** is true)
ASM_ZONES	Parameters that control the simulation of distance from trip end to line-haul transit service are input by zone (DISTR input file)	True (Regional defaults are used when **ASM_AREA** and **ASM_ZONES** are both false)
INCOST	Modal travel costs are input by area type and not set to program defaults	True (M023 input file has auto/transit user costs)

Source: Parsons Brinckerhoff, 2011, p. 38

When **HOV2** or **HOV3** is true, an additional **NAMELIST** named **AUTOTAB** is required for home-work trips. It contains the bias constants for the auto sub-mode model and the numbers of the Emme® matrices that are used as the input and output tables needed to split auto trips by occupancy level. These are summarized in Table 36.

Some clarification of how the auto sub-mode bias constants are applied is warranted. The auto sub-mode model first splits auto occupants into drive alone and two or more person auto sub-modes. Two added bias constants are needed. HOV_CBDBIAS(2) and HOV_BIAS(2) are costs tacked onto the two or more person auto choice for this auto sub-mode choice. The two or more person auto occupants are then split into two person and three or more person auto sub-modes.

The HOV_CBDBIAS(1) and HOV_BIAS(1) bias constants increase the cost of the three or more person auto alternative at this choice level.

Table 36. AUTOTAB Variables for Work Trip Auto Sub-Mode Choice

Variable	Description	Values
HOV_CBDBIAS(1)	Three or more persons auto sub-mode bias for CBD work trips	a. 2.51(Low income bias) b. 2.51(High income bias) c. 2.51 (All worker bias)
HOV_CBDBIAS(2)	Two or more persons auto sub-mode bias for CBD work trips	a. 0.499 (Low income bias) b. -0.0448 (High income bias) c. 1.59 (All worker bias)
HOV_BIAS(1)	Three or more persons auto sub-mode bias for non-CBD work trips	a. 2.09 (Low income bias) b. 2.09 (High income bias) c. 2.09 (All worker bias)
HOV_BIAS(2)	Two or more persons auto sub-mode bias for non-CBD work trips	a. 0.247 (Low income bias) b. 0.4430 (High income bias) c. 1.15 (All worker bias).
TABLE_SOV_TIME	Highway travel time	Emme input matrix numbers
TABLE_SOV_DIST	Highway distance traveled	
TABLE_HOV_TIME	Highway travel time	
TABLE_HOV_DIST	Highway distance traveled	
TABLE_SOV1	Drive alone auto person trips	Emme output matrix numbers
TABLE_HOV2	Two occupant auto person trips	
TABLE_HOV3	Three or more occupant auto person trips	

Source: Parsons Brinckerhoff 2011, p. 39.

Two CTPP Part 3 (worker flows) tables were used to estimate these auto sub-mode bias constants. The two or more occupant bias constant (drive alone versus two or more occupants) was based on regional totals from Table 3-7, which cross-tabulates household income and work mode choice. Auto mode choice in this table, however, is restricted to drive alone or two or more persons, only the higher level auto sub-mode choice. The household income ranges in this table allow worker salaries to be roughly approximated, and low income and high income bias constants for this choice can, as a result, be reasonably estimated. The three or more auto occupant bias constant (two persons in vehicle versus three or more) was estimated from the regional totals from Table 3-2, which contains more detailed auto sub-mode details but no household or worker income data. Therefore, the two versus three or more occupant choice model has to be independent of income.

5.3 Monte Carlo Simulation

A major source of the inaccuracy of mode choice models is the use of average values such as the average cost of parking in a traffic analysis zone or the average income of the traveler. The CMAP/CATS travel demand analysts recognized this potential source for inaccuracy very early, perhaps before anyone else was aware of the problems that could be generated by the use of average values. The solution devised was to identify the major areas which are affected by average values and to use a method which would "convert" the average values into individual values. This methodology is called a Monte Carlo simulation technique and, after the Chicago application, the technique was also used in the Dallas-Fort Worth region and the Cleveland region.

A Monte Carlo simulation focuses on selecting a representative value for a measure with this value being selected at random from a distribution of values for the measure. For example, say there are six parking garages in an area with each lot having the following characteristics:

Parking Lot A: 150 spaces with a cost of $3.50 a day
Parking Lot B: 175 spaces with a cost of $3.75 day
Parking Lot C: 275 spaces with a cost of $3.25 a day
Parking Lot D: 75 spaces with a cost of $1.25 day
Parking Lot E: 150 spaces with a cost of $3.50 a day
Parking Lot F: 175 spaces with a cost of $3.25 day

In this case the average parking cost, for the 1000 spaces, is $3.26. But a few "lucky" people (seven and one-half percent) could park for $1.25 and some "unfortunate" people (seventeen and a half percent) have to pay $3.75. The difference between the average cost and the low cost is $2.00 while the difference between the average cost and the high cost is 50 cents. These differences are substantial given that a major determinant of mode usage is the cost of using the mode. In a Monte Carlo simulation a specific parking lot would be "picked" at random. The probability of being "picked" would be a function of a relative parameter, in this case the number of spaces. Therefore in approximately seven percent of the "picks" the inexpensive lot would be selected, while the most expensive lot would be selected about eighteen percent of the time.

In the Chicago Mode Choice model the Monte Carlo simulation technique is used to estimate:

1. The access attributes of the main transit network.
2. The egress attributes from the main transit network.
3. The traveler's annual income.
4. The parking costs and the walk from the parking lot to the person's final destination.
5. The final selection of the mode used by the traveler.

The access and egress attributes are estimated when the trip is made on a subway, elevated or commuter rail mode. These attributes include the mode access used, such as walking, feeder bus, drive or be driven to the station. The attributes also include the time spent walking, driving, riding in the bus and waiting for the bus (if the access/egress mode is feeder bus) and the cost of using the access mode including the cost of parking at the stations. The access/egress attributes are estimated given the number of bus miles in the analysis area (traffic analysis zone), the size of the analysis area, the distance to the rail station, the cost of parking at the rail station, and the type of area.

The income of the traveler is estimated using the average income of the traveler's home area. The parking cost and walk time is estimated given a range of parking costs and spaces for each analysis area in the central business district. This is the information stored in the CBD parking file.

Since the Monte Carlo simulation is applied using random probabilities to obtain specific values of time and cost rather than average values, the procedure must be applied several times to obtain stable and accurate results. For example, mode choice procedures were applied for each estimated person trip. If the distribution model estimated that 50 trips would be made from zone A to zone B, the mode choice model would be applied 50 times for this interchange, one per trip, and the resulting probabilities would be applied to each of the 50 trips. The Monte Carlo technique was also used to make the final mode choice estimate. The mode choice model estimates the probability that a trip would be a transit trip. This probability is then used with a Monte Carlo technique to estimate if the trip is a transit trip. For example if the mode choice model estimates that the probability of a trip being a transit trip is 0.25 then when the random number, generated by the Monte Carlo technique was less than 0.26 the trip would be considered a transit trip, otherwise the trip would be considered a highway trip. Since there are more than 21 million person trips in 2010, this results in a very large set of multiple applications.

6. Traffic Assignment

The final step in the four-step model is Traffic Assignment. This is the step that takes the demand matrices (auto person trips) developed by the Mode Choice model and routes them over the highway network. Prior to actually being assigned over the network, the daily demand matrices are converted from person trips to vehicle trips and are factored into time-of-day demand.

6.1 Special Trip Handling

In addition to auto vehicle trips, several other classes of vehicle trips are included in traffic assignment. These require special data-handling procedures to create the demand matrices.

Commercial Vehicle Trips

CMAP models truck trips for four truck classes: B-plate, light trucks, medium trucks and heavy trucks. B-plate trucks are vans and pickup trucks with performance characteristics similar to passenger cars and carrying "B" license plates. Light trucks are "step vans" and smaller delivery vans which carry weight plates D-J and MD-MJ. Medium trucks are defined as heavy fixed-wheelbase trucks such as concrete mixers, scavenger trucks, double rear axle refrigerator units, etc., and some other lighter weight articulated vehicles carrying weight plates K-T and MK-MT. Finally, heavy trucks comprise the 73,280 and 80,000 pound maximum load vehicles which are tractor-trailer combinations. These carry weight plates of V-Z.

To create truck trip productions and attractions by modeling zone, base year trip totals were estimated by reviewing vehicle registration files for the appropriate classes of trucks. For future years, the base year figures are factored using a growth rate of 10% per decade to represent natural truck traffic growth. Table 37 presents the base trip totals by vehicle class. In order to more accurately represent heavy commercial vehicle traffic, heavy trips grow at the same 10-year rates as smaller vehicles but an additional factor to increase truck volumes within non-CBD Chicago is also applied.

Table 37. Truck Trip Totals by Vehicle Class

Truck Type	Base Year 2000 Total
B-Plate Trucks	1,530,000
Light Trucks	430,000
Medium Trucks	350,000
Heavy Trucks	109,000

Once the total number of trucks per class is determined, the trips are allocated to production and attraction zones based on development patterns. The measure of development is represented by non-home based trip productions, used because they are most closely related to total development with an emphasis on employment density. The process is a simple allocation of trips to zones based on the zonal share of the total regional development. The distribution of

trips is then created based on a trip length distribution of distances ranging from 10 to 13 miles rather than by using congested travel time. This method was validated by applying the regional model and comparing the assigned truck volumes to observed truck counts on the road.

The size and operating characteristics of commercial vehicles require them to be treated differently than automobiles. Prior to the traffic assignment process, truck vehicle trips are converted to trips measured in vehicle equivalents. The truck vehicle trips are converted using the following factors:

- B-plate and light trucks equal one vehicle equivalent.
- Medium trucks equal two vehicle equivalents.
- Heavy trucks equal three vehicle equivalents.

Point-of-Entry Trips

Point-of-entry (POE) trips represent three categories of travel: auto travel entering the modeled region on major expressways, heavy truck travel entering the region on major expressways, and travel to and from the region's airports. POE locations are external zones (numbered 1945 through 1961) and are not modeled in the same way as the rest of the region's travel because there is little knowledge about the traveler, the trip purpose, or the destination. These trips are created based on observed traffic counts at the locations in question and some assumptions about the travel behavior of the trip maker, including an assumption that external travelers are indifferent about the actual length of the trip within the region (i.e., their destination is fixed).

Highway POE base year trip production totals are derived from expressway traffic counts at locations around the region. Airport base year POE trips are based on an analysis of observed enplanements. To create future productions and attractions, the base year number of total trips is factored using the same growth rates as commercial vehicles: 10% per decade. The base year POE productions are presented in Table 38.

Table 38. Point-of-Entry Base Year Productions

Truck Type	Base Year 2010 Total
Auto External	329,000
Truck External	141,000
Air Traveler	67,000

All POE trips are handled at the same time using a gravity model. To begin, an impedance file based on a gamma function was created. To accomplish this, a destination vector of non-work trip attractions plus a weighted number of POE trips was calculated. Again, this information is used as a measure of development density with an emphasis on employment density. The impedance matrix is proportional to the productions multiplied by the attractions and inversely proportional to the square of the midday travel distance (capped at 60 miles):

$$Impedance = \frac{(.0001 * (POE\ Productions * Destination\ Development))}{(60.max.travel\ distance)^2}$$

The impedance matrix is balanced using the original productions at the origin, and trip attractions apportioned to destinations based on zonal shares of non-work attractions and zonal POE totals as the attractions.

At this point, the balanced trip matrix must be separated into its component pieces to be used within the traffic assignment procedures. Trips with origins at the expressway points-of-entry (zones 1945 – 1961) are extracted to a matrix which is summed with its transpose matrix. This represents the total external expressway daily trip table. Thirty percent of the trips in this daily trip table are apportioned as external truck trips. The remaining seventy percent are allocated to external auto trips. To determine air traveler trips, all trips with origins in the region are extracted to another matrix, which is also summed with its transpose matrix. External truck trips are assumed to be heavy commercial vehicles, thus this demand matrix is factored by three vehicle equivalents prior to the traffic assignment.

6.2 Assignment Time Periods

The principal objective behind multiple time period highway assignments is to develop more accurate estimates of vehicle-miles by different speed ranges and vehicle classes for air quality conformity analyses. Separate assignments estimate highway vehicle-miles and travel speeds for eight time periods during the day:

1. The ten hour late evening-early morning off-peak period (8 PM – 6 AM);
2. The shoulder hour preceding the AM peak hour (6 AM – 7 AM);
3. The AM peak two hours (7 AM – 9 AM);
4. The shoulder hour following the AM peak period (9 AM – 10 AM);
5. A five hour midday period (10 AM – 2 PM);
6. The two hour shoulder period preceding the PM peak period (2 PM – 4 PM);
7. The PM peak two hours (4 PM – 6 PM), and;
8. The two hour shoulder period following the PM peak period (6 PM – 8 PM).

Figure 11 is a schematic diagram that shows the sequence of steps in the multiple time period assignment. Nine highway network scenarios are first assembled (eight time-of-day specific networks and a ninth all-inclusive network to hold the sum of daily information). The presence of time-of-day restrictions on highway network links allows for variation between the TOD networks. At present, these restrictions are modeled on the Kennedy Expressway reversible lanes and an on-ramp from eastbound IL 38 to eastbound I-290, as well as on arterials with peak

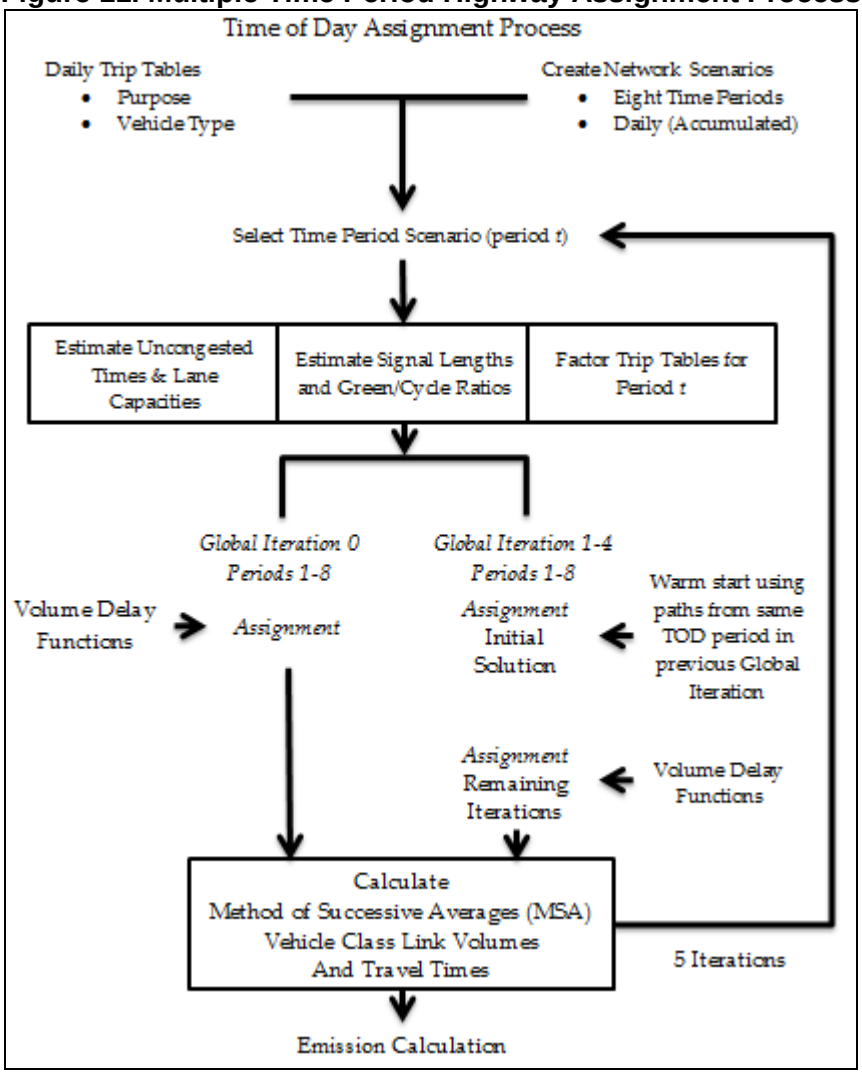
period parking restrictions. In practice the eight TOD periods use a total of four unique highway networks:

- An AM peak network used in the morning peak and its shoulders.
- A midday network used during time period 5.
- A PM peak network used in the evening peak and its shoulders.
- An overnight network used in time period 1.

The travel model proceeds through five global iterations. During each iteration the time period assignments are executed and the assignment results are averaged with the results of the TOD assignment for the same time period from the previous global iteration using the Method of Successive Averages (MSA). This results in a final link volume for each time period; these are used to estimate the AM peak and midday travel times, which are fed back into the rest of the modeling process.

After five passes through the time of day modeling process, the results of the separate MSA period assignments are accumulated into daily volumes, and also tabulated into the vehicle-mile by vehicle type by speed range tables needed for the vehicle emission calculations. The completion and summarizing of the eight time period assignments is highly simplified through the use of Emme® macros for repetitive sequences of control statements.

Figure 11. Multiple Time Period Highway Assignment Process



The current assignment macros account for fifteen TOD trip tables: eight auto driver/passenger tables by trip purpose (one each for HO and NH trips, and HW trips categorized by income level and vehicle occupancy [1,2,3+]), four truck trip tables by vehicle type, two external trip tables for autos and trucks, and a trip table of auto air passenger trips. The assignment macros can be modified to accommodate different trip tables, either additional trip purposes if the trip distribution and mode choice models are revised or to include special trip tables for major developments. The current CMAP practice is to assign the TOD demand as six different vehicle classes.

The actual traffic assignment is accomplished using a path-based algorithm in Emme®. This procedure uses the projected gradient method to reach network equilibrium, in place of the commonly-used linear approximation method (Frank-Wolfe algorithm). The path-based assignment is able to reach finer levels of convergence in a shorter amount of time than the

standard assignment. Another benefit of the path-based assignment is that the paths generated during the assignment are saved (one for each assigned vehicle class) and can be used to conduct detailed analyses after the assignment is finished.

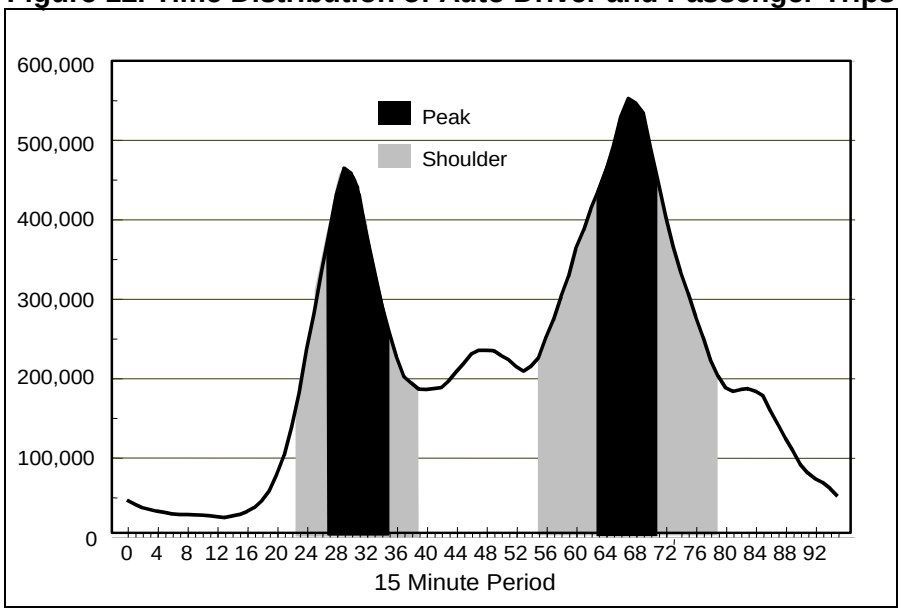
The main macro starts the process by calling the macro for the first off-peak time period assignment. The appropriate network scenario is selected and the matrices used to store the off-peak period trip tables are initialized. The matrices are then filled with the off-peak trip tables factored from the daily trip tables. All period trip tables used for assignment are calculated on-the-fly. The slots used for the time period trip tables are reused, being overwritten by the trip tables from a subsequent period.

For the first time period, the standard set of volume-delay functions (discussed in section 6.4) are loaded, the scenario is prepared for assignment, and a full equilibrium assignment is completed. The logic of the process is slightly altered in subsequent periods. The TOD path files from the previous global iteration are loaded and are used as the starting point for the traffic assignment. This allows the traffic assignment to get a "warm start." The assignment is then readied for additional iterations and the remaining equilibrium assignment iterations are completed.

The procedure repeats through the remaining time periods. When the eight time periods are completed, the link volumes and travel times are successively averaged with the same time periods from previous iterations. This occurs for iterations 1 – 4, since iteration 0 has no previous iteration to be averaged with. The result is a set of eight modeled scenarios representing each time period and containing the final MSA volumes and speeds. From this information, other macros generate the tables needed as input to the emission calculations. (discussed in Chapter 7).

The travel data that led to selecting the eight time periods is illustrated in Figure 12. This is a plot of the auto driver and auto passenger trips in motion reported in CATS' 1990 household travel survey. Trips were accumulated at the end of ninety-six fifteen minute periods throughout the day. The plot shows a moving average of these accumulated trips calculated over four consecutive fifteen minute periods. The moving average smoothes out the irregularities in the plot that are caused by the tendency of surveyed travelers to report trip start and completion times to the nearest quarter-hour or half-hour.

Figure 12. Time Distribution of Auto Driver and Passenger Trips



The plot shows the distinct peaking of auto travel during the morning and evening peak periods. The large number of trips in motion during peak travel periods is due not only to increased trip making during these time periods. Peak period auto trips also stay in motion longer because they are more likely to be lengthy work trips subjected to slower congested peak period travel speeds.

The plot in Figure 12 is not symmetric because the evening peak period is longer and slightly worse than the morning peak. The two peak periods are separated by a midday period that has a fairly uniform number of trips in motion, except for a bulge in trip making around the noon lunch period. Trips in motion plateau between 8:00 PM and 9:00 PM after the evening peak period, and then quickly decline during the late-night period.

The two assignment peak periods are defined differently because of these auto travel characteristics. The shading under the Figure 12 curve shows the peak and shoulder periods used in the multiple time period assignments. A two hour AM peak (7:00 AM to 9:00 AM) and two one hour AM peak shoulder periods (6:00 AM to 7:00 AM and 9:00 AM to 10:00 AM) effectively cover the morning peak period. Six hours are needed to capture the evening peak period: a two hour PM peak (4:00 PM to 6:00 PM) plus two hour PM peak shoulder periods on either side of the PM peak (2:00 PM to 4:00 PM and 6:00 PM to 8:00 PM). This leaves a nearly uniform four hour midday period between the two peaks (10:00 AM to 2:00 PM), and an off-peak period (8:00 PM to 6:00 AM) covering the late evening and early morning hours.

The time period assignments provide a more detailed and accurate picture of congestion effects in the highway network, which is advantageous for several reasons. While daily estimated traffic volumes may just be marginally improved compared to volumes produced by average daily assignments, estimates of network speeds are substantially improved and regional

vehicle-miles of travel agree more closely with state estimates of daily vehicle-miles. Since congestion is more correctly modeled, impacts from proposed highway improvements that reduce congestion are also more accurately reproduced by the time period assignments.

Table 39 shows the number of equilibrium assignment iterations by time period for the base year 2010 scenario of a representative Conformity analysis for global iterations zero and four. This table shows that the feedback incorporated into successive global iterations of the travel demand model results in a much more "stable" set of traffic demand assigned during the final global iteration. Note that the traffic assignment iterations of the path-based algorithm are not directly comparable to those used by the linear approximation method. Average path and link times are equal when network equilibrium is achieved.

Table 39. Assignment Iterations for Convergence, Conformity 2014 1st Quarter

	2010 Scenario	
Time Period	Iteration 0	Iteration 4
1: 8 PM – 6 AM	10	4
2: 6 AM – 7 AM	25	10
3: 7 AM – 9 AM	35	15
4: 9 AM – 10 AM	35	10
5: 10 AM – 2 PM	35	10
6: 2 PM – 4 PM	35	10
7: 4 PM – 6 PM	34	10
8: 6 PM – 8 PM	15	5
Total	**224**	**74**

Table 40 provides an illustration of the number of vehicle equivalents assigned during each of the TOD periods. It offers a comparison of the 2010 base year scenario and the 2040 horizon year of the region's long-range comprehensive plan.

Table 40. Total Vehicle Equivalents Assigned by Time Period, Conformity 2014 1st Quarter

Time Period	2010	2040
1: 8 PM – 6 AM	1,690,885	2,155,550
2: 6 AM – 7 AM	751,327	966,689
3: 7 AM – 9 AM	2,086,162	2,668,286
4: 9 AM – 10 AM	880,547	1,112,761
5: 10 AM – 2 PM	4,329,260	5,467,110
6: 2 PM – 4 PM	2,419,151	3,068,696
7: 4 PM – 6 PM	2,634,686	3,352,872
8: 6 PM – 8 PM	1,580,259	1,999,239
Total	**16,372,277**	**20,791,203**

6.3 Time-of-Day Factors

The person trip tables prepared by the Mode Choice model require some factoring before they can be assigned to the highway network. After Mode Choice, the home-work and home-other

trips are still productions and attractions and not origins and destinations. An initial set of directional factors (shown in Table 41) convert these trip types into origin-destination movements. Time-of-day factors are next applied to convert daily trips into time periods for assignment.

Table 41. Directional Factors

Origin-Destination	Proportion of Productions-Attractions
Home to Work	
CBD Work Trip End	0.498
Non-CBD Work Trip End	0.528
Airport Work Trip End	0.528
Work to Home	
CBD Work Trip End	0.502
Non-CBD Work Trip End	0.472
Airport Work Trip End	0.472
Home to Other	0.489
Other to Home	0.511

Factors to allocate daily auto person trip tables into the eight time period trip tables were derived from the Travel Tracker survey. Expanded survey auto driver and auto passenger trips were allocated to time periods by their start and completion times. Trips spanning two or more periods are apportioned to the separate periods according to time spent traveling in each period. For example, a survey trip with an expansion factor of 100 that spends thirty percent of its time in one time period and seventy percent of its time in a second period would have thirty trips allocated to the first period and seventy to the second period.

Table 42 lists the factors to create the eight time period trip tables from daily auto driver and auto passenger trip tables. Separate factors are applied to work trips with destinations in the Central Area, at the airports and in the remainder of the region. Adding together the home-work and home-other fractions does not total one because the trip tables are in home production and non-home attraction format. The factors sum to the proportion of trips from home and to home. Fractions for non-home/work trips do sum to one, since this trip table is by trip direction.

Table 42. Auto Person Trip Time-of-Day Factors

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
HBW to CBD	0.147	0.197	0.460	0.053	0.077	0.029	0.022	0.015
HBW from CBD	0.128	0.002	0.010	0.002	0.064	0.138	0.459	0.197
HBW to nonCBD	0.142	0.199	0.408	0.054	0.106	0.042	0.030	0.018
HBW from nonCBD	0.121	0.005	0.015	0.007	0.119	0.252	0.374	0.107
HBW to airports	0.245	0.134	0.258	0.043	0.144	0.139	0.023	0.016
HBW from airports	0.302	0.054	0.040	0.003	0.091	0.222	0.196	0.090
HBO to home	0.188	0.004	0.024	0.030	0.236	0.187	0.167	0.163
HBO from home	0.043	0.039	0.211	0.085	0.246	0.101	0.145	0.129
NHB	0.053	0.008	0.055	0.062	0.431	0.173	0.133	0.084

Daily auto driver and auto passenger trip tables (that include auto access to transit trips) are multiplied by the factors in Table 42 to obtain auto person trip matrices (driver or passenger) for the eight time periods. They are then divided by the auto occupancies in Table 43 to produce the auto vehicle trip tables that are assigned. The occupancy rates are calculated by adding auto drivers, auto passengers, and taxi passengers and then dividing the total by auto drivers.

Table 43. Auto Occupancy Rates

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
HBW to CBD	1.05	1.17	1.20	1.48	1.27	1.21	1.14	1.12
HBW from CBD	1.24	1.00	1.00	1.00	1.27	1.14	1.18	1.09
HBW to nonCBD	1.08	1.06	1.06	1.06	1.07	1.08	1.14	1.20
HBW from nonCBD	1.15	1.13	1.03	1.01	1.04	1.07	1.06	1.07
HBO to home	1.70	1.23	1.17	1.33	1.49	1.88	1.76	1.74
HBO from home	1.38	1.94	2.33	1.49	1.49	1.52	1.77	1.68
NHB	1.40	1.10	1.13	1.14	1.17	1.18	1.21	1.34

When the mode split model is run to produce auto sub-modes that create auto HW trips by occupancy, more specific directional and time period factors can be specified by the number of persons per vehicle. Table 44 lists the directional factors to be used with these data. These rates were developed from the Travel Tracker survey.

Table 44. Directional Factors: HW Auto Person Trips by Occupancy

Origin-Destination	Proportion of Productions-Attractions
Single Occupant	
Home to Work	
CBD Work Trip End	0.497
Non-CBD Work Trip End	0.526
Work to Home	
CBD Work Trip End	0.503
Non-CBD Work Trip End	0.474
Two Persons Ridesharing	
Home to Work	
CBD Work Trip End	0.504
Non-CBD Work Trip End	0.545
Work to Home	
CBD Work Trip End	0.496
Non-CBD Work Trip End	0.455
Three or More Persons Carpooling	
Home to Work	
CBD Work Trip End	0.524
Non-CBD Work Trip End	0.559
Work to Home	
CBD Work Trip End	0.476

Non-CBD Work Trip End	0.441

Source: Parsons Brinckerhoff 2011, p. 47

Table 45 contains the time-of-day factors for drive alone, two and three or more persons auto occupancy trips. Since the mode choice model for the auto sub-modes deals only with home-work trips, these factors are calculated for pre-peak, peak, and post-peak periods when most home-work trips take place. These factors are raw figures calculated directly from CMAP survey data, and the effect of the small sample size is evident in the empty cells in the table that have no survey observations. The final quantity needed to develop the three auto trip tables for assignment – single occupant autos, autos with two persons, and autos with three or more persons – is the average vehicle occupancy for three or more person vehicles. This was calculated from the Travel Tracker survey as 3.64 persons per auto.

Table 45. Time-of-Day Factors: HW Auto Person Trips by Occupancy

	Period 2	Period 3	Period 4	Period 6	Period 7	Period 8
Single Occupant						
HBW to CBD	0.204	0.434	0.047	0.030	0.024	0.016
HBW from CBD	0.002	0.012	0.002	0.143	0.448	0.196
HBW to nonCBD	0.201	0.407	0.054	0.042	0.028	0.015
HBW from nonCBD	0.005	0.016	0.008	0.248	0.378	0.109
Two Persons Ridesharing						
HBW to CBD	0.153	0.559	0.094	0.026	0.010	0.010
HBW from CBD				0.130	0.468	0.213
HBW to nonCBD	0.202	0.419	0.045	0.042	0.046	0.019
HBW from nonCBD	0.006	0.011		0.297	0.337	0.101
Three or More Persons Carpooling						
HBW to CBD	0.243	0.757				
HBW from CBD					0.908	0.092
HBW to nonCBD	0.147	0.412	0.096	0.031	0.049	0.126
HBW from nonCBD		0.003		0.232	0.344	0.074

Source: Parsons Brinckerhoff 2011, p. 48

6.4 Volume-Delay Functions

The volume-delay functions are used to represent the congestion that occurs on links as traffic volumes increase. The volume-delay functions include signal characteristics for links that end at signalized intersections. This means that assignments are sensitive to signal characteristics and can reflect major signal modernization programs. In addition to more accurately representing the characteristics of the network, these signal sensitive volume-delay functions allow the emission reductions from signal improvements to be evaluated.

CMAP's volume-delay functions have also been revised from their initial versions because of the previous functions' limitations when they were used for time period assignments. Their most severe limitation was that freeways and expressways tended to be over-assigned in the congested peak time periods. Several factors contributed to this peak period over-assignment including: (1) an unrealistic initial peak period assignment since paths were built using

uncongested travel times; (2) the inability to model bottlenecks in the freeway network that occur during peak periods, and; (3) not restricting freeway on-ramps whose peak period capacities were controlled by metering. The approach taken was to alter the volume-delay functions for freeways, expressway and metered freeway entrance ramps so that travel times increase far more quickly after capacity is reached. The capacities of metered on-ramps are also set to maximum metered flow rates.

Volume-Delay Functions for Links Ending at Signalized Intersections (vdf1 and vdf3)

Intersection delays in the volume-delay functions are based upon the Webster equation.[3] In this equation, intersection delay has uniform and incremental components, and both are fairly complicated to calculate. For the volume-delay functions, simpler regression equations were fit to calculated uniform and incremental delays for a range of signal cycle lengths and green time to cycle length ratios.

The regression equations for uniform and incremental signal delays are combined with link travel time estimates in the first (arterial) and third (freeway exit ramp to arterial) volume-delay functions as follows:

1. Link travel time between intersections is:

$$T_{link} = T_0 * \left(1 + 0.15 * \left(\frac{volau}{capacity}\right)^4\right).$$

   This is the widely used BPR (Bureau of Public Roads) function where T_{link} equals the link's travel time without any intersection delay and T_0 is the uncongested link travel time without intersection delay. The uncongested link travel time is computed using the maximum speed permitted on the link. Quantity *volau* is the link's traffic volume for the time period in auto equivalents. Capacity represented within the link travel time function is approximately the service volume at level of service C. It is calculated as 75 percent of the level of service E time period link capacity. Note that link capacity is calculated by multiplying the hourly lane capacity by the number of lanes and the number of hours in the assignment time period.

2. Uniform intersection delay equals:

$$D_u = 6.0 * \left(\frac{volau}{capacity}\right) - 0.39 * green + 0.35 * cycle - 4.5.$$

   Where D_u is the average uniform intersection delay at the link's j-node in seconds. *Green* is the green time allowed the link at the j-node intersection and *cycle* is the cycle length

[3] F. V. Webster and B. M. Cobbe. *Traffic Signals*. Road Research Laboratory, Ministry of Transport Road Research, Technical Paper No. 56, 1966.

at the intersection. Both quantities are in seconds. The uniform delay is restricted to positive values in the volume-delay functions.

3. Incremental delay at intersections equals:

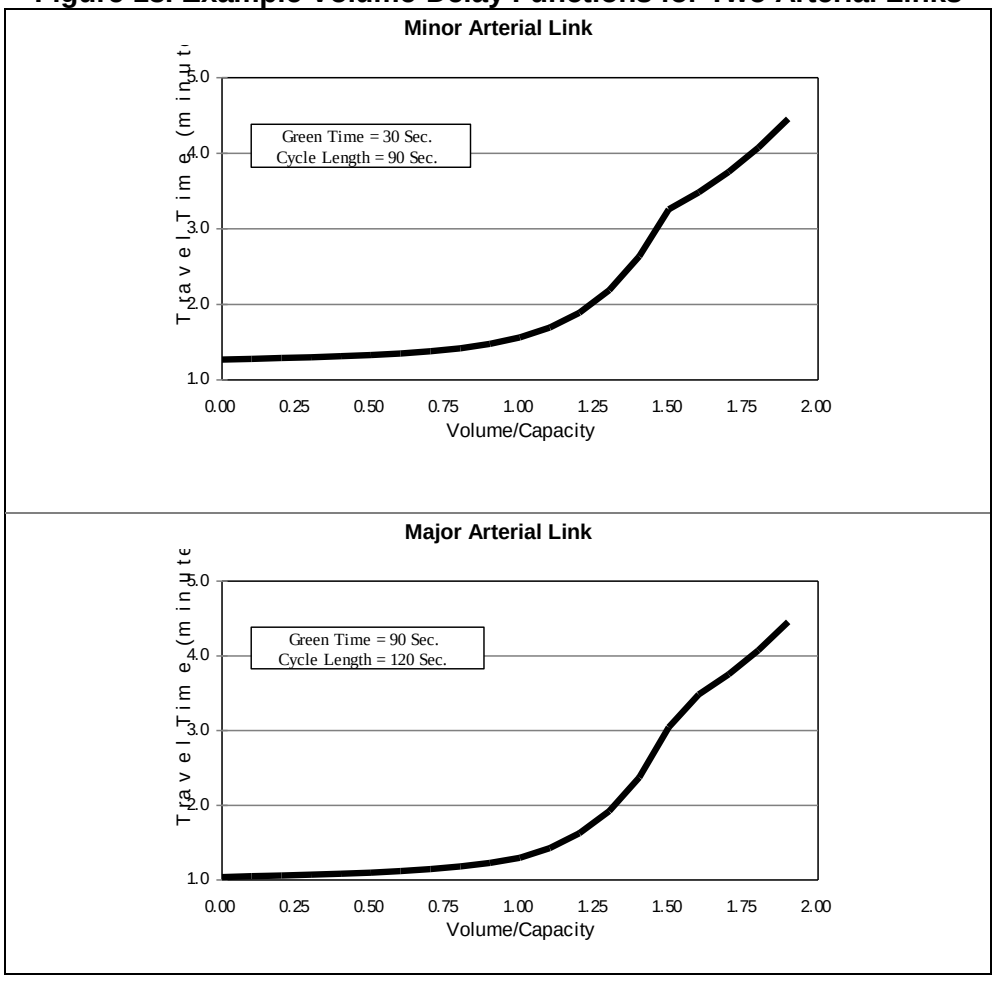
$$D_i = 2.7*\left(\frac{volau}{capacity}\right)^8 - 7.3*\left(\frac{green}{cycle}\right) + 3.4.$$

Where D_i is the average incremental intersection delay at the link's j-node in seconds. Incremental delay is also restricted to positive values in the volume-delay functions.

Figure 13 shows the volume-delay functions with intersection delay for two links. The top graph is for a minor arterial street with an uncongested travel time of one minute between intersections. The cycle length at the j-node is ninety seconds, and the link receives thirty seconds of green time in the cycle.

The bottom graph is for a major arterial street link, which also has an uncongested travel time of one minute between intersections. Cycle length at the downstream node is 120 seconds and the link is allowed ninety seconds of green time. The major arterial link is allowed more green time at the j-node than the minor link and intersection delays on the major link are less than on the minor link at the same link volume to capacity ratios. Both volume-delay relationships have a kink in them because the maximum combined uniform and incremental intersection delay is limited to one cycle length.

Figure 13. Example Volume-Delay Functions for Two Arterial Links



Volume-Delay Functions for Freeways and Expressways (vdf2, vdf4 and vdf5)

The second (freeway), fourth (expressway) and fifth (freeway-freeway ramps) volume-delay functions were adjusted to increase the travel times for volume to capacity ratios greater than one. At the same time, uncongested link travel times on freeway and expressway links were reduced fifteen percent to reflect drivers' tendency to exceed speed limits on high type facilities at low traffic volumes. The quantity T_0 is again determined by the maximum legal speed.

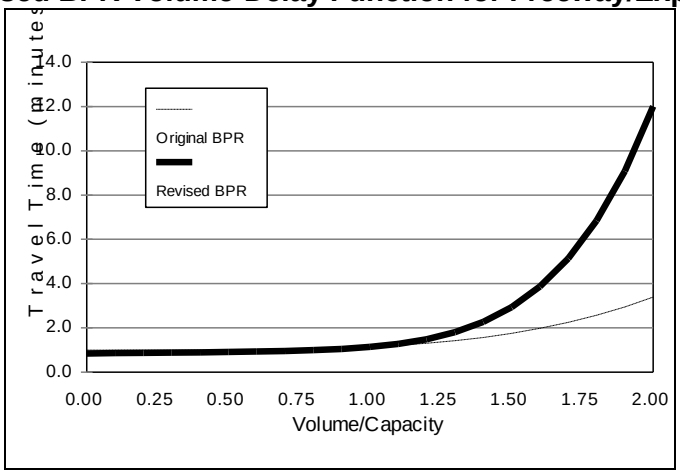
These adjustments were made to the basic BPR volume-delay relationship, as follows:

$$T_{link} = \frac{T_0}{1.15} * \left(1 + 0.15 * \left(\frac{volau}{capacity}\right)\right) * \left(1 + 0.15 * \left(\frac{volau}{capacity}\right)^8\right), \text{ for } \left(\frac{volau}{capacity}\right) \leq 1.$$

$$T_{link} = T_0 * \left(1 + 0.15 * \left(\frac{volau}{capacity}\right)^8\right), \text{ for } \left(\frac{volau}{capacity}\right) > 1.$$

Figure 14 compares the revised BPR volume-delay function with the original BPR function for a one mile link with a maximum speed of 60 miles per hour. At a volume to capacity ratio of one, both functions predict the same link travel times. At lower volume to capacity ratios, the revised function's travel time is slightly less than the original function due to the lower initial uncongested travel time. For volume to capacity ratios greater than one, the travel time predicted by the revised function is higher and rapidly increases because the volume to capacity ratio is exponentiated to a higher power.

Figure 14. Revised BPR Volume-Delay Function for Freeway/Expressway Links



Volume-Delay Function for Metered Freeway Entrance Ramps (vdf8)

For metered freeway entrance ramps, the original BPR function is revised so that travel time greatly increases when the link volume exceeds the maximum metered flow rate. This effectively restricts the ramp's volume to the metered flow rate. The adjusted BPR function is:

$$T_{link} = T_0 * \left(1 + 0.15 * \left(\frac{volau}{metered\ flow}\right)^{10}\right).$$

The maximum metered flow rate is taken as 720 vehicles per hour per lane, or an average vehicle delay at the ramp metering signal of five seconds.

Volume-Delay Function for Links with Tolls (vdf7)

After the volume delay functions were originally developed, the Illinois State Toll Highway Authority implemented electronic tolling along its entire system (completed in 2006). Open road tolling is available at the mainline plazas, and no-stop tolling is available at ramp tollbooths. In 2009, the first all-electronic ramp plaza opened at Eola Road on the Reagan Memorial Tollway (I-88). At most locations, cash booths are available for those without toll transponders. Prices for trucks versus automobiles and for vehicles with transponders and without transponders differ.

The difficulty of representing this complicated scheme led to removing the impact of tolls from the volume delay functions altogether. While the effect of this volume-delay function is currently zeroed out within the trip-based modeling procedures, the volume-delay function itself remains in place as a placeholder for future updates. The impact of tolling and larger operational schemes such as congestion pricing is more suited to testing using CMAP's activity-based model.

Link Speeds

Traffic volume on every link for each time period of the day is one product of the time-of-day network assignment. The speed of travel for each link is calculated by an equation that uses the volume-capacity ratio for the link as the independent variable. The following equations are used to produce the final link speed.

Freeways:

$$S=S_0 \frac{1}{1+.15\,(V/C)} \times \frac{1}{1+.15\,(V/C)^8} \qquad \text{for } V/C \le 1$$

$$S=S_0 \frac{1}{1+.15\,(V/C)^8} \qquad \text{for } V/C > 1$$

Arterials:

$$S=S_0 \frac{1}{(1n(S_0) * .249) + .153\,(V/(C * .75))^{3.98}}$$

Where:

S = Speed on link used for emission calculation
S_0 = Initial Speed on link
V/C = Volume-Capacity ratio for the link

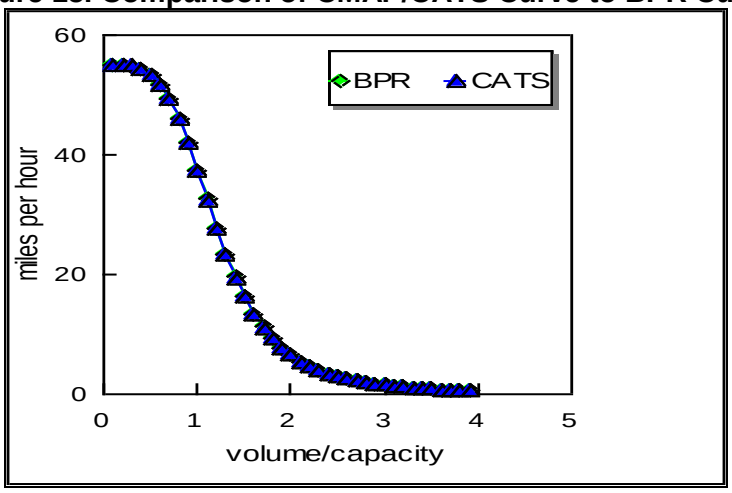
These curves represent modifications to the BPR curves that have been used at CMAP and other agencies for many years. Consistent with a national trend for agencies to use modified curves based on local data, these curves are based on the information gathered from local empirical data. The freeway curve is the same as used in the volume delay functions in the time of day assignment iterations. The arterial curve is slightly modified to better correlate with the empirical data. The data used to develop the modification is from IDOT's traffic sensor system for the expressway system as well as CATS-conducted speed runs for the arterial system. This data base is documented in CATS Working Paper 95-09: Travel Time Database and Structure Chicago Area Expressway System (September 1995), and CATS Working Paper 97-09: 1994, 1995 and 1996 Combined Travel Time Database Documentation: Arterial Highway System (July

1997). The methodology for the curve development is presented in CATS Working Paper 97-12: Method for Adjusting Modeled Speeds Based on Empirical Speed Data (August 1997).

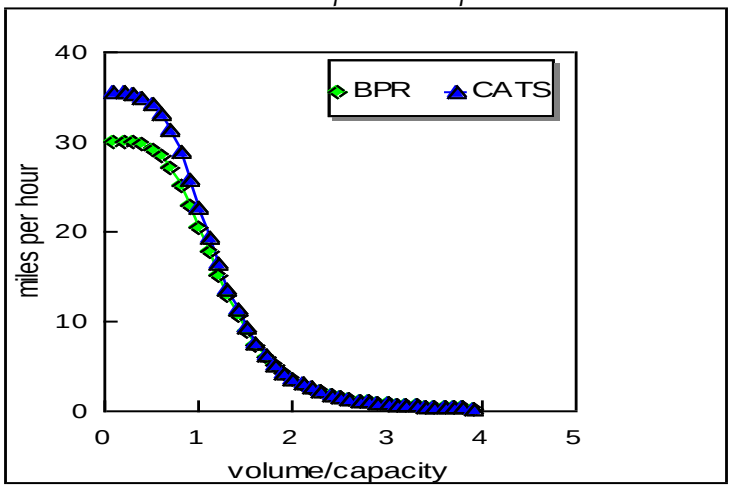
Figure 15 presents a comparison of the CMAP arterial V/C speed curve and the BPR curve for two initial speeds. As can be seen, the curves are similar for an initial speed of 55 miles per hour. For the initial speed of 30 miles per hour, the curves are similar for V/C ratios above one. For lower V/C ratios, the CMAP curve has higher speeds than the BPR curve consistent with observed data.

Current traffic assignment validation results can be found in the CMAP Travel Demand Model Validation Report.

Figure 15. Comparison of CMAP/CATS Curve to BPR Curve



initial speed=55 mph



initial speed=30 mph

7. Emissions Calculation

The conformity analysis consists of a calculation of total emissions for each analysis year required. The current analysis years are given in the main conformity document. The total emissions must be lower than the corresponding approved emission budgets for ozone precursors or for fine particulate matter ($PM_{2.5}$) and its precursor, nitrogen oxides (NOx). The geographic distribution of emissions within the region is not considered in conformity calculations.

When the travel simulation process is complete, several additional steps need to be taken to calculate scenario emissions. The regional model results must be transformed to be compatible with the MOVES model's emission rate structure. The MOVES model must then be run to produce emission rates that match the transportation data available and reflect the region's environmental and vehicular conditions. This chapter explains how the mobile source emission rates are developed and how the total emissions are calculated from the assignment results. The steps completed to compute the scenario network-based mobile source emissions are given below.

7.1 Model Data Processing

Highway networks are built with zone connectors coded to lengths proportional to zone size so connector link volumes represent the amount of "local" travel needed to reach the regional highway system. Thus, this conformity analysis does not have a separate off-network mobile emission component. Mobile source emission estimates based upon the network traffic assignment reflect both specifically coded non-local roadways and local non-coded roadways.

The highway assignment process produces two basic pieces of information essential to calculating emissions: link loads and link speeds. While essential, the information on link loading is not a perfect match for use with the MOVES emission rates. While the assignment model defines vehicles in terms of how much of a roadway's available capacity to carry traffic is used for a given loading, the MOVES model defines vehicles in terms of engine type and size. For assignment, it makes no difference if a vehicle is diesel or gasoline powered, but it does impact the calculation of emission rates. Highway assignment accounts for the different operating characteristics of various vehicle types using the concept of vehicle equivalents[4] (VEQ). In the simplest case a standard passenger auto is one VEQ, while a semi-trailer truck is three VEQs. The truck occupies approximately the same physical space on the roadway as several standard passenger cars and interacts with other traffic in ways akin to multiple standard vehicles. For example, the truck takes more time to reach cruising speed from a stop than an individual standard passenger auto; the amount of time is similar to that needed by several standard passenger cars to reach cruising speed when driver reaction delay and vehicle spacing are considered. However, the emissions from a large truck and several standard autos

[4] Comparable terms also used are passenger car equivalents (pce) and passenger car units (pcu).

are not the same (especially if the truck is diesel powered). During the data processing, the travel model vehicle classes must be converted to the MOVES vehicle classes.
The time-of-day highway assignment process makes use of the additional options assignment procedure to keep track of multiple vehicle classes (as described in the Traffic Assignment chapter). The travel information of fixed route public transportation buses is also included. Table 46 shows the correspondence between the MOVES vehicle types and the travel demand model vehicle classes. It also includes the correspondence with the HPMS (Highway Performance Monitoring System) vehicle types.

Table 46. Correspondence between MOVES and HPMS Vehicle Types

MOVES Vehicle Type & Description	HPMS Vehicle Type & Description	VHT Distribution Source from Travel Model
11: Motorcycle	10: Motorcycles	(use auto distribution)
21: Passenger Car	20: Passenger Cars	autos
31: Passenger Truck	30: Other 2 axle-4 tire vehicles	b-plate trucks
32: Light Commercial Truck	30: Other 2 axle-4 tire vehicles	light duty trucks
41: Intercity Bus	40: Buses	(use transit bus distribution)
42: Transit Bus	40: Buses	transit bus
43: School Bus	40: Buses	(use transit bus distribution)
51: Refuse Truck	50: Single Unit Trucks	(use medium duty trucks under 200 miles distribution)
52: Single Unit Short-haul Truck	50: Single Unit Trucks	medium duty trucks under 200 miles
53: Single Unit Long-haul Truck	50: Single Unit Trucks	medium duty trucks 200+ miles
54: Motor Home	50: Single Unit Trucks	(use medium duty trucks 200+ miles distribution)
61: Combination Short-haul Truck	60: Combination Trucks	heavy duty trucks under 200 miles
62: Combination Long-haul Truck	60: Combination Trucks	heavy duty trucks 200+ miles

Following the completion of a region travel demand model run for an Air Quality Conformity Analysis, the results must be processed and formatted for input into MOVES for emissions calculation. Two scripts are used to first export the relevant information from Emme® and then to process it into the data inputs MOVES requires. In addition to basic network link data (e.g., length and number of lanes), the first script also captures the following information for every link in a scenario network by the TOD highway assignment:

- final loaded speed
- number of autos
- number of b-plate trucks
- number of light trucks
- number of medium truck VEQ
- number of heavy truck VEQ
- number of fixed route public transit buses

- number of long-distance (i.e., traveling at least 200 miles) medium and heavy trucks

After the appropriate data have been extracted from the travel demand model, a second script processes the data for input into MOVES. This script performs a number of functions. First, vehicle equivalents are converted to the actual number of vehicles so that vehicle miles of travel and vehicle hours of travel can be computed for each link in all of the TOD networks. The modeled vehicles are converted into MOVES vehicle categories, as shown in Table 46.

Next, the model network links are converted into the MOVES road types; this correspondence is shown in Table 47. The links are identified based on the volume-delay function they reference. The urban/rural designation is determined by the *areatype* (Capacity zone) value attached to the from-node of each link: a value less than nine is considered urban and a value greater than or equal to nine is rural. Note that "Off-network" in the MOVES model refers to processes that generate emissions but are not associated with being on a road. These include starts, emissions from a parked vehicle, and extended idling by heavy-duty trucks.

Table 47. Correspondence between MOVES Road Types and Model Links

MOVES Road Type & Description	Model Volume-Delay Function
1: Off-Network	N/A
2: Rural Restricted Access	rural 2,3,4,5,7,8
3: Rural Unrestricted Access	rural 1,6
4: Urban Restricted Access	urban 2,3,4,5,7,8
5: Urban Unrestricted Access	urban 1,6

A set of link speed bins is created to store the link data. The lowest bin reflects link speeds under 2.5 miles per hour (MPH). The bins then proceed in 5- mile per hour increments beginning with 2.5<=MPH<7.5 MPH and ending with 67.5<=MPH<72.5. A final bin captures links with speeds of at least 72.5 MPH.

Finally, the vehicle-specific VMT and VHT values are disaggregated from the time period totals into hourly values for each link. The script then produces the following files for use by MOVES:

1. **Average Speed Distribution** – This file contains the share of daily VHT summarized for each vehicle type within each unique combination of [road type – hour of the day – speed bin] category. Within each group of [road type – vehicle type – hour of the day], the values must sum to one. MOVES requires a VHT distribution for all of these categories. If the results of a model run do not provide a distribution for a given category, the following substitutions are made:
    - Bus - when no distribution is available for rural restricted access facilities, the distribution from urban restricted access facilities is used. This applies to vehicle types 41, 42, and 43.
    - Single Unit Long-haul truck - when no distribution is available, the distribution from Single Unit Short-haul truck is used. This applies to vehicle types 53 and 54.

- Combination Long-haul truck - when no distribution is available, the distribution from Combination Short-haul truck is used. This applies to vehicle type 62.

2. **Road Type Distribution –** This file contains the daily share of VMT for each [vehicle type – road type] combination. Within each vehicle type, the VMT shares must sum to one. The same substitution method described above is implemented if necessary.
3. **Ramp Fraction –** This file reports the share of total freeway VHT that occurs on ramps. This value is reported separately for urban and rural restricted access facilities.
4. **Hourly VMT Fraction –** This file contains the hourly share of daily VMT for each [vehicle type – road type – hour of the day] combination for weekdays. The shares within each [vehicle type – road type] category must sum to one. The Average Speed Distribution substitution method is used if necessary.
5. **HPMS Daily VMT –** This file contains total VMT by road type summarized by HPMS vehicle type.

7.2 MOVES Model Emissions Calculation

This conformity analysis used MOVES2010b, the current version of the approved US EPA emissions model. The default database is the October 30, 2012 release. Files used to supply the input to calculate the emissions inventory for each of the emissions types (VOC and NOx for ozone, direct $PM_{2.5}$ and NOx for $PM_{2.5}$) are included on the following pages. Descriptions of the input commands and changes for other scenario years are also given.

For ease of execution, one MOVES run was created for each scenario year. The runs developed inventories for both VOC and NOx ozone precursors, for direct PM emissions, and for the NOx precursor for the annual $PM_{2.5}$ standard.

MOVES allows the user to calculate emissions rates, which can be applied to VMT, or to calculate emissions inventories, which can be compared directly to SIP budgets. Since a limited number of "small" MOVES runs are required for conformity, and the calculation of inventories from emissions rates requires detailed VMT, trip and fleet size breakdowns, CMAP has chosen to run MOVES in inventory mode.

MOVES Model Settings Used in Conformity Analysis

This section describes the various inputs used to obtain emission inventories from MOVES for conformity analysis:

- Navigation Panel input
- County Data Manager input

Navigation Panel Input

Each MOVES run requires completion of the Parameters in the Navigation Panel. CMAP has chosen to make a separate run for each analysis year, mainly to keep down the run time required. In addition, separating the years is seen as a way to more readily distinguish the input for each year. The Parameters in the navigation panels and their inputs are listed below. Unless otherwise indicated the parameters are the same for each year.

Description – a narrative description to identify the run; this varies slightly between analysis years to help distinguish them. It has no effect on emissions.

Scale – The county domain is selected, as recommended for conformity analyses. The inventory calculation type is selected.

Time Spans – The Time Aggregation Level is set to hour, as recommended in the guidance. The year is set to the appropriate analysis year. Both weekdays and weekends are selected, as are all months and all hours. These are required for the annual $PM_{2.5}$ emissions inventory; for ozone precursors, only July weekday data are used from the output database.

Geographic Bounds – The Custom Domain region is selected. Although the choice has no effect on emissions calculations, the County ID is set to 1, and the description is "northeastern Illinois nonattainment area." The GPA fraction is zero, in line with the guidance, and the barometric pressure is set to 29.25, which is the average of the barometric pressures in the MOVES database for the six whole Illinois counties in the nonattainment area (Cook, DuPage, Kane, Lake, McHenry, and Will). Both vapor adjust and spill adjust are set to zero. The Domain Input Database is set to the database created in the County Data Manager.

Vehicles/Equipment – Since there is no expectation that fuel types other than diesel and gasoline will constitute a significant fraction of the region's fleet over the years of the analysis, only those two fuel types are selected. All available vehicle types are selected for each fuel type. (Only motorcycles are not available for diesel fuel; only inter-city buses and combination long-haul trucks are not available for gasoline.)

Road Type – all five road types (Off-Network, Rural Restricted Access, Rural Unrestricted Access, Urban Restricted Access, Urban Unrestricted Access) are selected.

Pollutants and Processes – The following pollutants are selected. In most cases subsidiary pollutants are required; they are listed following each pollutant. In all cases, all applicable processes are selected (achieved by selecting the pollutant check box to the left of the pollutant name in the window):

a. Volatile Organic Compounds – Total Gaseous Hydrocarbons and Non-Methane Hydrocarbons
b. Oxides of Nitrogen (NOx) – no subsidiary pollutants are required
c. Primary Exhaust $PM_{2.5}$ – Total – Primary $PM_{2.5}$ – Organic Carbon, Primary $PM_{2.5}$ – Elemental Carbon, Primary $PM_{2.5}$ – Sulfate Particulate (Sulfate Particulate requires Total Energy Consumption)
d. Primary $PM_{2.5}$ – Brakewear Particulate (combined with Primary Exhaust $PM_{2.5}$ and Tirewear to produce total $PM_{2.5}$)
e. Primary $PM_{2.5}$ – Tirewear Particulate (combined with Primary Exhaust $PM_{2.5}$ and Brakewear to produce total $PM_{2.5}$)
f. CO_2 Equivalent – Total Energy Consumption, Atmospheric CO_2, Nitrous Oxide, Methane, Total Gaseous Hydrocarbons

Manage Input Data Sets – No databases are used for input other than the default MOVES database (give citation), and the run-specific inputs entered through the County Data Manager.

Strategies

a. On-Road Retrofit – This input is not used
b. Rate of Progress – This setting is not used

Output

a. General Output – Each run's output is sent to a separate database. As noted previously, the emissions for ozone and fine particulates are estimated in one run; thus a conformity analysis consists of four MOVES runs and hence there are four output databases. Mass units are specified as grams, energy as millions of BTU, and distance as miles. The only activity output selected is distance traveled.
b. Output Emissions Detail – Time is set to hour, and the location is set to county. No vehicle/equipment categories are selected. Among the On Road/Off Road selections, Road Type is selected.
c. Database – The names follow the convention of tipamendment_yyyymmdd_all_YYYY_out, where yyyymmdd is the date of the Policy Committee consideration, "all" refers to all pollutants, YYYY is the analysis year and "out" means that this is the output file. If other types of analysis are conducted, the "tipamendment" portion of the name is changed appropriately. If only selected pollutants are estimated, then the "all" is changed appropriately.

Advanced Performance Features – These parameters to improve program performance in complex run situations are not used in the conformity analysis.

County Data Manager Inputs

The County Data Manager allows the analyst to include specific data for the geography under consideration and the analysis year in the MOVES dataset. Much of the data comes from the travel demand model.

Database – the input database unique to this MOVES run is created here. CMAP currently creates a separate database for each run. The names follow the convention of tipamendment_yyyymmdd_all_YYYY_in, where yyyymmdd is the date of the Policy Committee consideration, "all" refers to all pollutants, YYYY is the analysis year and "in" means that this is the input file. If other types of analysis are conducted, the "tipamendment" portion of the name is changed appropriately. If only selected pollutants are estimated, then the "all" is changed appropriately. Once the County Data Manager is complete, this database name is selected in the Geographic Bounds section of the Navigation Panel. (The user has to refresh the list of input databases in order to get the newly-created database to appear.)

Ramp Fraction – The fraction of total VMT attributable to expressway ramps is calculated from the results of the travel demand model. Since ramps are represented as links in the network, the total VMT assigned to ramps can be calculated. This computation is done separately for each analysis year.

Road Type Distribution – The fraction of VMT for each vehicle type by road type is calculated from the travel demand model results, based on the classification of each link in the network.

Source Type Population – Data from the Secretary of State's office was examined for suitability in this input. The data yielded inconsistent results, so the default procedure suggested in the Technical Guidance was used. The procedure uses national default values relating vehicles to VMT which are applied to VMT from the travel demand model to estimate populations. The default procedure yielded a motorcycle population that was clearly inconsistent with the region's actual population. Therefore, motorcycle registration data from the Illinois Secretary of State's office was used to create a more realistic estimate.

Vehicle Type VMT

a. Annual VMT by vehicle type is calculated by expanding average weekday VMT resulting from the travel demand model. This takes place in two steps. First, model VMT is summarized by MOVES category vehicle type and facility type. Using vehicle count data from IDOT's monitoring program, average weekday VMT is factored into average daily VMT for all days, including weekends. Again using IDOT monitoring data, daily VMT for each month is adjusted to be a

percentage of annual average daily VMT. The annual average daily VMT (based on the travel demand model) is then adjusted to the monthly daily averages and multiplied by the number of days in the month to obtain monthly VMT. The monthly VMT values are summed to yield annual VMT

b. Monthly – Each month's fraction of annual VMT, by vehicle type, is computed using the same data and factors as the annual VMT described previously. However, the monthly VMT values are converted to fractions of the annual total rather than simply being summed.
c. Daily – Since the travel demand model results are for average weekdays only, IDOT traffic monitoring data were used to estimate the weekday vs. weekend VMT fractions. These observed data are limited because they do not include information by vehicle type. Therefore, the weekday and weekend fractions used to create the MOVES inputs are the same for all vehicle types. Finally, off-network (road type 1) data are not part of the IDOT monitoring system, so the Cook County default values were used.
d. Hourly – The travel demand model results support the calculation of VMT by time of day, road type and vehicle type. A post-processing routine was used to generate this input directly from the model results. The same values were used for both weekday and weekend days.

Zone – This input allows a user to define multiple zones within a larger custom domain region. CMAP does not use this feature, and so a single dummy zone is used with all activity allocated to that zone.

a. Zone – As noted above, a single dummy zone is used with all activity allocated to that zone.
b. Zone Road Type – As noted above, a single dummy zone is used with all activity allocated to that zone.
c. SCC Road Type Distribution – As noted above, a single dummy zone is used with all activity allocated to that zone.

I/M Programs – The inspection and maintenance program description was created by staff at the Illinois Environmental Protection Agency, which administers the program. The same basic file is used for each analysis year. They differ in that the last model year of vehicle inspected depends on the analysis year; this parameter thus varies from year to year (increasing with later years).

Age Distribution – The vehicle age distribution is based on 2013 data compiled by the Illinois Environmental Protection Agency. The same distribution is used for all scenario years; the input file has a year field, which is set to the applicable analysis year.

Average Speed Distribution – The average speed distribution is developed by post-processing the travel demand model results. The travel demand model produces annual

average weekday results, but there are no other sources for weekend speed distributions. Thus, the weekday values from the model were also used for the weekend.

Fuel Type and Technologies – MOVES defaults were used for most vehicles types. However, MOVES has a default percentage of CNG transit buses. Since there are none of these in the CTA and Pace fleets, the values for diesel buses were set to 100%.

Fuel

a. Fuel Supply – The types of fuel supplied to the region were supplied by the Illinois Environmental Protection Agency, as used in SIP development. The input is the same for all analysis years, except that the input file has a year in it, which is set to the analysis year.
b. Fuel Formulation – the formulation of the fuels in the region is also supplied by the Illinois Environmental Protection Agency, as used in SIP development. The input is the same for all analysis years.

Meteorology Data – These data are from climate records at O'Hare Airport, as compiled in the MOVES input format by the Illinois Environmental Protection Agency, as used in SIP development. The input is the same for all analysis years.

At the conclusion of a MOVES run, a summary report is generated using the MOVES interface. This summary report produces daily emissions inventories by month and day type (weekday versus weekend). These inventories are then multiplied by the number of weekdays and weekend days in each month to produce the annual $PM_{2.5}$ emissions inventories. For ozone inventories, the summary results for the July weekday are used directly.

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APPENDIX A

Parsons Brinckerhoff Documentation of CMAP Trip Generation Model Update

UPDATES AND ENHANCEMENTS TO THE CMAP HOUSEHOLD TRIP GENERATION MODEL: APRIL 2009

This report documents the revisions to the Chicago Metropolitan Agency for Planning (CMAP) household trip generation model that were completed by Parsons Brinckerhoff during the period October 2008 through March 2009. It is a narrative of the development process for the updates and enhancements that have been introduced into the CMAP model, and provides guidance for users of the model, both for running the model software and preparing the input files required to apply the model.

Background

Trip generation is the first model in a well-established set of sequential travel forecasting models employed by most Metropolitan Planning Organizations (MPOs). The first generation of these models was developed in the late 1950s and early 1960s for metropolitan transportation studies of that period. Trip generation models for personal travel convert socioeconomic data tabulated within analyses zones – households, employment, land use, floor space, and so forth – into travel demand measured by the person trip ends within the zone. Subsequent models link these trip ends into trip movements and allocate trips to different travel modes and routes.

Although some practitioners consider trip generation to be the most mundane of these travel models, its importance cannot be overstated since remaining models can never rectify a poor forecast of trip ends. How the trip generation model is structured affects what can be accomplished in the remaining models; in particular, only the trip types estimated in trip generation can be carried forward in the succeeding models.

The current CMAP household trip generation model was originally conceived and implemented during the mid-1990s by staff from the Chicago Area Transportation Study, CMAP's predecessor MPO for the northeastern Illinois region. Since that time, it has been maintained internally by CATS and CMAP staff with limited support from consultants. Versions of the model were routinely applied by CATS to prepare travel forecasts for a wide range of planning projects. CMAP primarily applies the model for long-range planning and air quality analyses.

The most critical parts of any person trip generation model are the trip generation rates that convert individual and household characteristics into person trip ends. In the CMAP model these trip generation rates are the daily trips per person. They depend upon the trip purpose, the type of individual (worker, nonworking adult, and child old enough to travel independently), and the characteristics of the household (composition and vehicle availability) where the individual resides. The only way to estimate these rates is to have access to observed data from a household survey that includes the number, purpose, and other attributes of trips made by household members plus individual and household characteristics. CMAP and the Northwestern Indiana Regional Planning Commission (NIRPC) recently completed a large

travel survey of more than 14,000 households in northeastern Illinois and northwestern Indiana that provides suitable local data for estimating trip generation rates ([1]).

Project Objectives

The principle objective for the project is to update the existing trip generation model to reflect current travel behavior based on this newly available data from the CMAP household travel survey. In addition to re-estimating trip generation rates, there are other parts of the model that need to be re-estimated and/or recalibrated as well. These include the submodels within trip generation that: (1) create small area estimates of households grouped by their composition and income levels; (2) estimate the vehicles available to a household; (3) forecast trip generation by persons in group quarters; (4) estimate trips with one trip end outside the study area, and; (5) separate person trips into trips by motorized and nonmotorized modes.

Updating these submodels requires additional data besides that available from the CMAP household survey, either because relevant variables were not collected in the CMAQ survey or because the sample of households is too small for reasonable statistical reliability of estimated model coefficients. The decennial census has historically been a source for much of the data required for updating these submodels. In addition to enumerating the population, the census collected detailed individual and household information from a sample of the nation's households that completed the long-form questionnaire. However, this long-form household sample is no longer part of the decennial census but has been replaced by the American Community Survey (ACS) ([2]). The ACS is a continuous survey that annually collects long-form data from a smaller annual sample of households, approximately one in forty households annually compared to one in six households in past decennial census. Since 2006, the ACS also includes a 2.5 percent sample of persons living in group quarters.

The long-form has several questions regarding journey to work commuting. A special tabulation of the journey to work data, the Census Transportation Planning Package ([3]), is especially useful to MPOs. It includes residence and workplace based tables plus residence to workplace flow tables in transportation analyses zones (TAZs) defined by the MPO; and is the only source of observed travel data for many MPOs. A CTPP based on ACS data is funded and planned. Small area estimates (census tracts, block groups, and TAZs) will be tabulated from a five year accumulation of ACS data ([4]).

The continuous nature of the ACS means that some trip generation model inputs can be updated more frequently than in the past. This has implications for the trip generation model software code. Observed tables of households required by the procedure to disaggregate households inside small areas are presently hard-coded in the program, along with a handful of other parameters for one or more trip generation submodels. This was a sensible approach when the model was originally programmed because these data and parameters could only be redone at ten year intervals with decennial census data, or even more infrequently, when a regional household travel survey was completed. This approach also reduced the burden on

the user for assembling inputs to apply the model. This practice now needs to be minimized to take advantage of more frequent ACS data.

The CMAP area for modeling travel has grown larger over the years and now covers twenty-one counties in northeastern Illinois, northwestern Indiana, and southeastern Wisconsin. The modeled region has even outgrown some of the arrays in the trip generation code that store data for geographic areas. While CMAP staff has been able to work around this problem, the situation is at best an inconvenience and at worst an opportunity to introduce mistakes into tabulations of trip generation results. The regional zone system for the CMAP models has also been altered over the years. Sections of the trip generation code should be rewritten to allow for expansion of the CMAP modeled area and changes in regional zones.

As the trip generation model software executes, it creates temporary files of households tabulated by composition, income, and vehicle ownership. These files might conceivably have value beyond their role in trip generation. For example, these household files might prove useful in studies dealing with issues of social and economic justice related to alternative transportation investments. Users of the model cannot save these files at present. Allowing more control over the operation of the model software, including retaining intermediate data sets could increase the model's usefulness.

As noted, the CMAP models are examples of the traditional four-step sequential travel forecasting models. While these models have become more complex over time and practitioners have increasingly pushed them toward more sophisticated applications, their limitations in dealing with evolving transportation issues are well documented ([5]). Several MPOs have introduced so-called "advanced practice" models and many larger MPOs are considering transitioning from the four-step sequential trip-based models to these new models. These "state of the art" models focus on individual travel behavior in far more detail than that allowed by the four-step models' limited number of trip types and aggregate trip movements between zones.

While it is difficult to foresee the long-term evolution of the CMAP transportation models, one can state with some certainty that the existing models with marginal enhancements will continue to be used for some years. However, updates to current models should - whenever practical - complement development of "advanced practice" models at CMAP. With respect to future usefulness of the CMAP trip generation model or its submodels, a positive feature of the current model is the disaggregation of households within small areas, which is a component of many "advanced practice" models.

The following objectives for the project can be formulated from these comments:

1. Update the model's trip generation rates, input files, parameters, and submodel coefficients based on the CMAP household travel survey and recent ACS person and household data.

2. Introduce these model revisions into the trip generation software and make marginal changes in the model code to improve its flexibility and ease of use.
    a. Revise code so that the model can be readily updated as ACS or other new data become available.
    b. Allow for expansion of the study area or changes in the study area zone system.
    c. Permit more user control over operation of the program.
    d. Increase the model's transparency by improving model reports and outputs.
3. Support CMAP's general model development program. For this updating of the CMAP trip generation model, the model calculations are less aggregate – more trip purposes are considered - so that they more closely resemble the level of detail in "advanced practice" models.

Overview of the CMAP Trip Generation Model

The following discussion refers to the updated CMAP trip generation model as of March 2009. The revised model has a linear logic identical to past versions of the model. This logic also corresponds to subroutines in the programmed model's code.

1. **Read and Load Model Inputs:** These inputs control the operation of the program, define study area geography, and provide large geographic area tables of cross-classified households that are the basis for the procedure to disaggregate households within small area trip generation subzones. The report file **TG_OUTPUT.TXT**, which generates reports as the program executes, is also opened.
2. **Disaggregate Households by Subzone:** This step creates a four-way – households by adults, workers, children, and income quartile – table of households for each trip generation subzone from large area household tables and average subzone household characteristics.
3. **Household Vehicle Availability:** Household vehicle ownership submodels are applied to estimate the vehicle ownership levels for each cell in the four-way household table, effectively adding a fifth dimension (vehicles available in the household) to the table.
4. **Household Trip Generation:** Household members - workers, nonworking adults, and children aged twelve to fifteen - in each cell of the household table are multiplied by trip generation rates – daily trips per person by trip purpose – appropriate for that individual and household type.
5. **Group Quarters Trip Generation:** A trip generation subzone level input file containing workers and nonworking adults in non-institutionalized group quarters is read and then trips by persons in group quarters are estimated.
6. **Allocation of Nonhome Trip Ends:** The subzone locations of trip ends that take place away from the household or group quarters are unknown at this point. In this step, a subzone level file containing employment is first read and then nonhome trip ends are allocated to subzones by households and employment.
7. **Trip Ends Outside the Study Area:** Some trip ends generated by study area residents are linked to trip ends outside the study area. These are factored from the total

generated person trips leaving only trips wholly within the modeled study area. A file containing external trip factors is input for this purpose.

8. **Nonmotorized Trips:** The remaining CMAP models after trip generation only address person trips by vehicles (this may change when the agency's mode choice model is updated). Pedestrian and cycling person trips are factored from total generated person trips by submodels that estimate the fraction of nonmotorized trips as a function of household and subzone characteristics leaving person trips by vehicles.
9. **Create Final Vehicle Trip Reports and Output Trip Files**

Figure 1 is a detailed flowchart of the model's logic, beginning with the loading of program control variables and ending with the final trip generation files. The details required to fully understand this flowchart, including options for running the software and the formats of data files, are discussed in order of the above stepwise model logic.

Read and Load Model Inputs

Three inputs to the CMAP trip generation are read into memory before any calculations are carried out: program control variables, geographic area inputs, and large area cross-classified household tables.

Program Control File. Program control variables are entered in the text file named **TG_INPUT.TXT**. An example is shown in Figure 2.

Figure 2. Sample TG_INPUT.TXT File

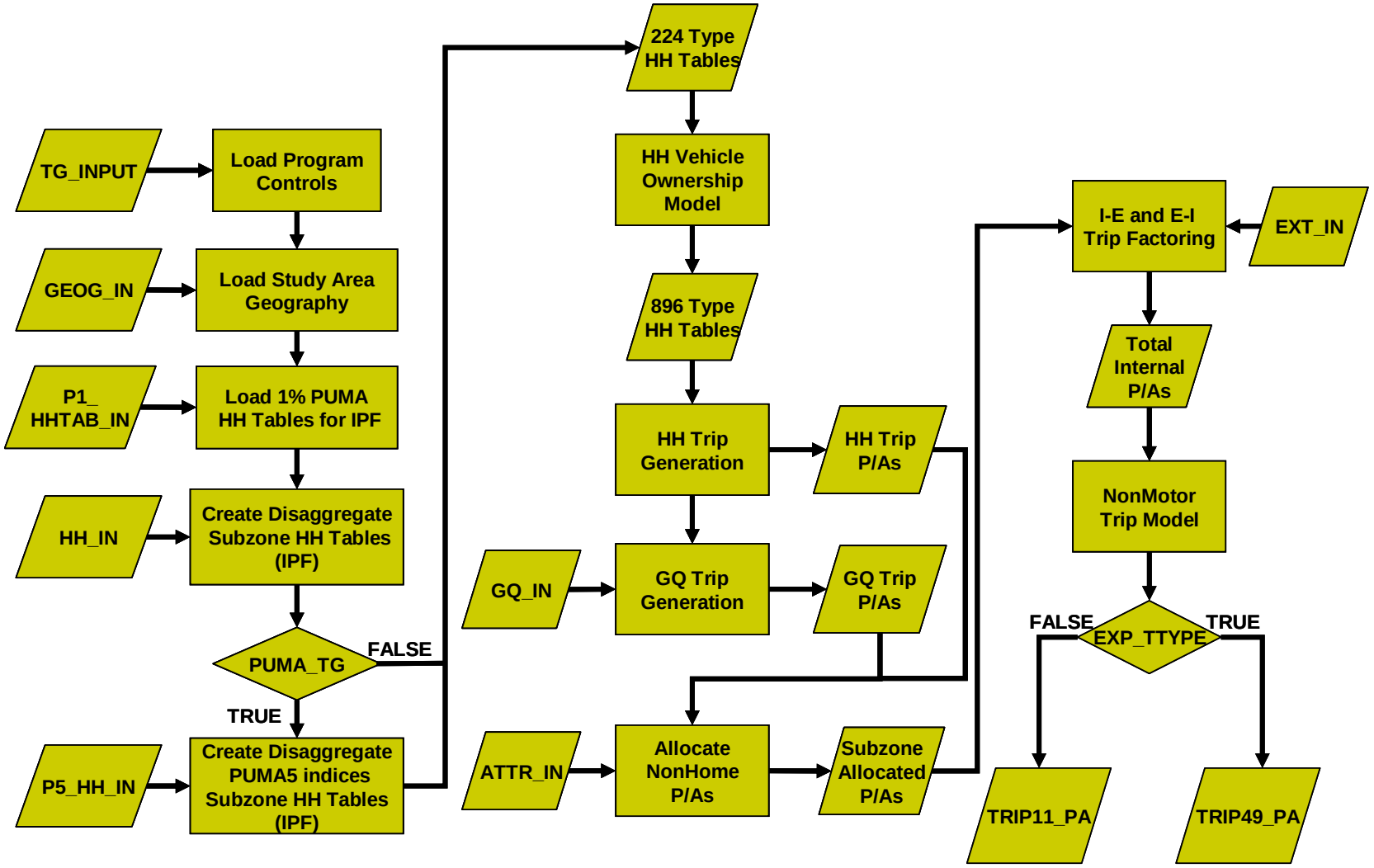
```
&PARAM
  TITLE = 'TEST RUNS FOR CMAP TRIP GENERATION'
  SUBZONES=16819
  PUMA5 = 69
  PUMA1 = 20
  ZONES = 1944
  COUNTIES = 21
  PUMA_TG = .FALSE.
  SAVE_FILE = .TRUE.
  EXP_TTYPE = .TRUE.
  IN_EMPFACT = 1.000
  WI_EMPFACT = 1.000
 &END
```

The **&PARAM** and **&END** statements identify the beginning and end of the NAMELIST input. The variables in the program control file have the following definitions (geographic areas in the model are discussed in the next section):

1. **TITLE**: An 80 character name identifying the model run enclosed in single quotes.
2. **SUBZONES:** Trip generation subzones in the study area.
3. **PUMA5:** Five percent sample Public Use Microdata Areas in the modeled study area.

4. **PUMA1:** One percent sample Public Use Microdata Areas in the modeled study area.
5. **ZONES:** Zones used in the remaining CMAP models for trip distribution (linking of trip ends into trips between zones), mode choice (allocation of trips to travel modes), and assignment (allocation of trips to highway and transit routes).
6. **COUNTIES:** Counties in the study area.
7. **PUMA_TG:** A true/false variable. When true the model's logic includes an optional subroutine that prepares an updated (future) four-way cross-tabulation of households within subzones. This new table is based upon (future) large area average household characteristics and the initial (base year) cross-tabulated household table.

Figure 1. Logic Flow in the CMAP Trip Generation Model



8. **SAVE_FILE:** A true/false variable that causes all intermediate program files to be retained after the model run is completed.
9. **EXP_TTYPE:** A true/false variable. When true, all files and reports include forty-nine trip types based upon trip purposes in the CMAP household travel survey. When false, files and reports have the eleven trip types in the current CMAP trip generation.
10. **IN_EMPFACT:** Employment in Indiana is multiplied by this factor. This variable and the following one for Wisconsin are included to offset possible systematic differences in employment definitions and estimation methods between CMAP and neighboring MPOs.
11. **WI_EMPFACT:** Employment in Wisconsin is factored by this value.

Geographic Areas and Trip Generation. The current subzones for trip generation (referred to as 2009 subzones) are shown in Figure 3. Within the majority of the study area subzones are roughly square areas one-half mile on a side, or a quarter of square mile sections. These are further subdivided into quarter-quarter section subzones in the Chicago CBD, while larger subzones are used in the outlying counties. Indiana and Wisconsin subzones are based on census geography and the zone systems developed by the two MPOs in these adjacent states, NIRPC and the Southeastern Wisconsin Regional Planning Commission. Note that hatched portions of the Illinois counties Lee, Ogle and LaSalle extend beyond the limits of the modeled area.

Although the trip generation model does not perform calculations specifically for the larger zones used by the remaining CMAP models, most output files include this geographic area. Final trip generation estimates are summed into these modeling zones. Current zones (referred to as 2009 zones) are shown in Figure 4. Zones are either combinations of trip generation subzones or the same as subzones.

Two principal census products are used in updating the CMAP trip generation model, pre-tabulated household and person tables of long-form data at various geographic levels and Public Use Microdata Sets (PUMS). The PUMS are not tables but two files of person and household data, and each record in a PUMS file contains data for a single household or person. Detailed tables and PUMS were prepared for the 2000 decennial census and are also available for individual years of the ACS, plus three year (currently) and five year (eventually) ACS averages. Due to census disclosure requirements, a single year ACS household sample limits data tables to geographic areas with a population of 65,000 or more. It is possible to obtain tables for areas with a population of 20,000 or more from three year accumulations of annual ACS data. Five annual ACS surveys must be completed before small area estimates comparable to those available from the 2000 census are available.

Person and household PUMS data sets are somewhat like the household and person data sets created from a household travel survey, but without any activity or travel information other than the journey to work. A household is also not located to any small area geography. PUMS

households are only coded to Public Use Microdata Areas (PUMAs), whose sizes are determined by the household sample rate and disclosure rules. One percent sample PUMAs are very large areas containing 400,000 or more persons. Smaller five percent sample PUMAs have 100,000 or more persons. Both are shown in Figure 5 overlying the trip generation subzones.

Figure 3. CMAP Regional 2009 Trip Generation Subzones

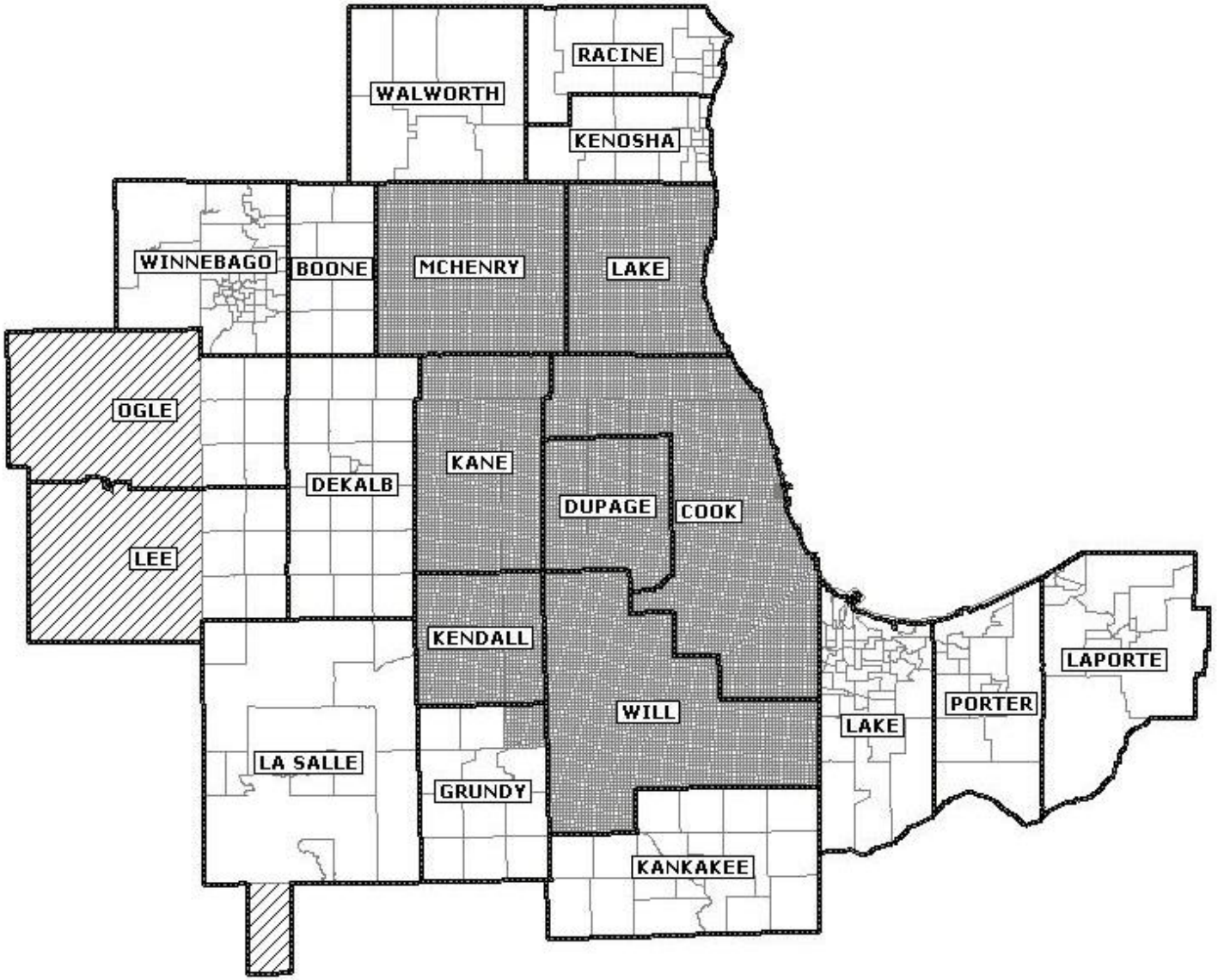


Figure 4. CMAP Regional 2009 Zones

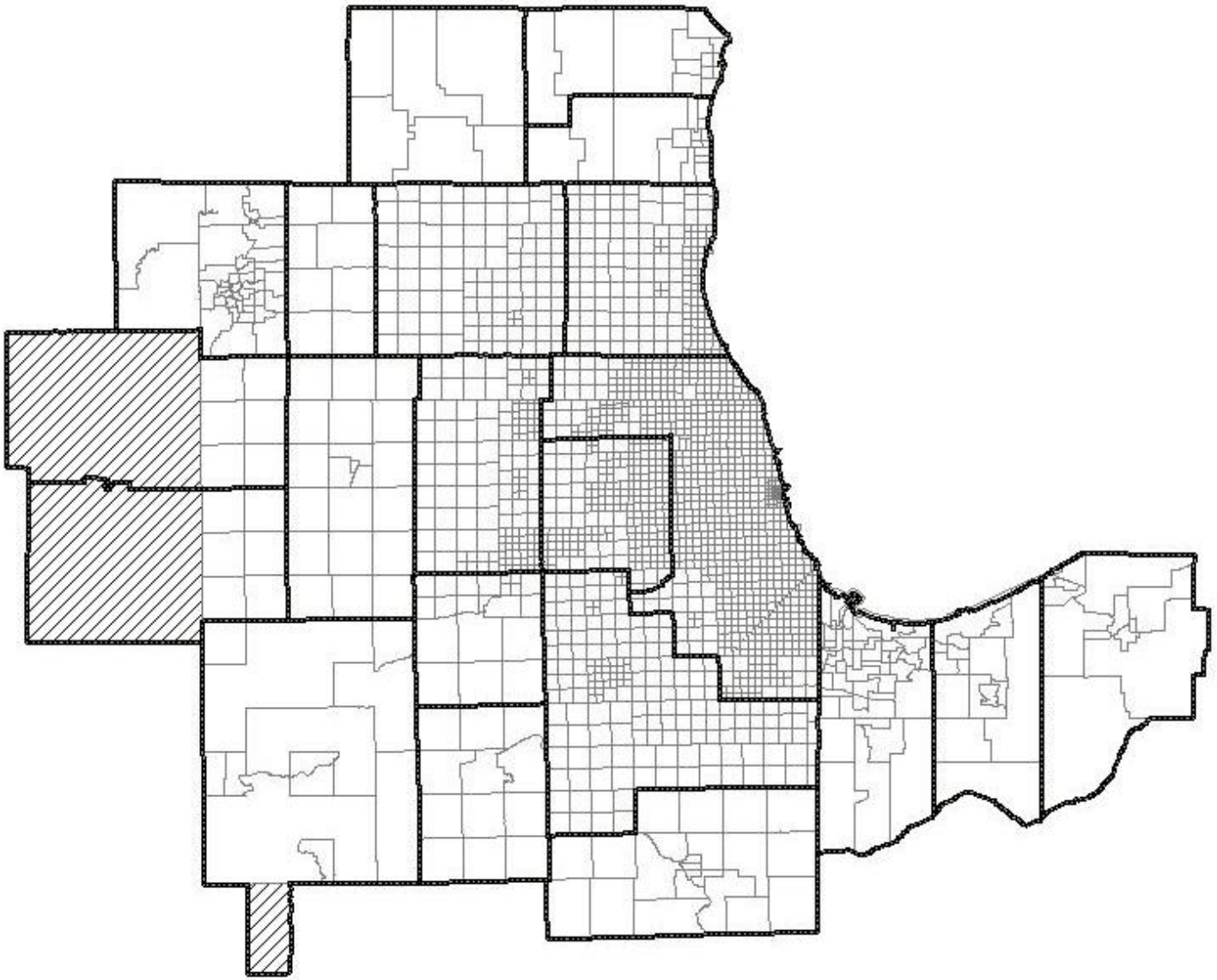


Figure 5a. Public Use Microdata Areas Defined in Census 2000: One Percent Household Sample PUMAs

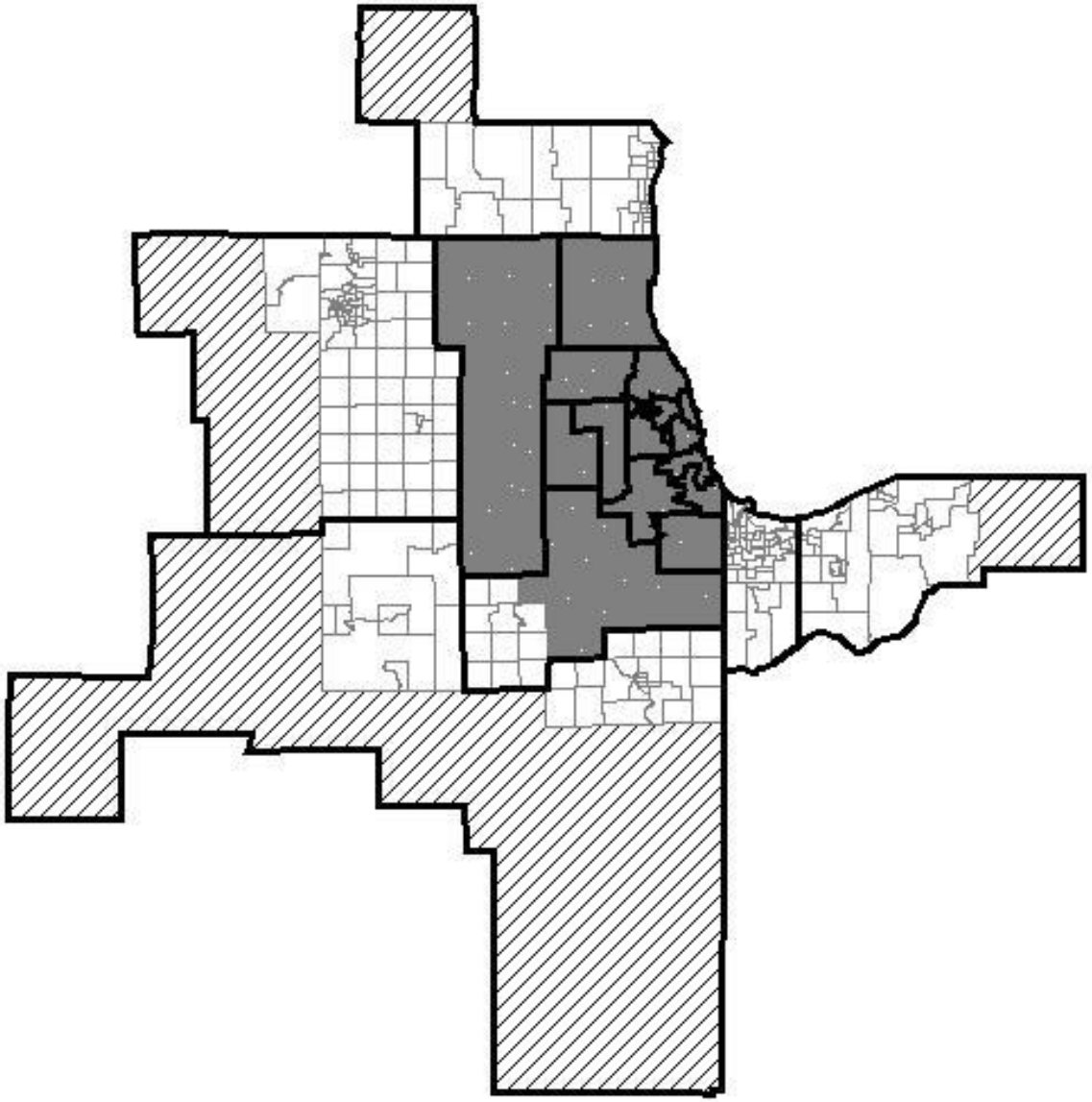
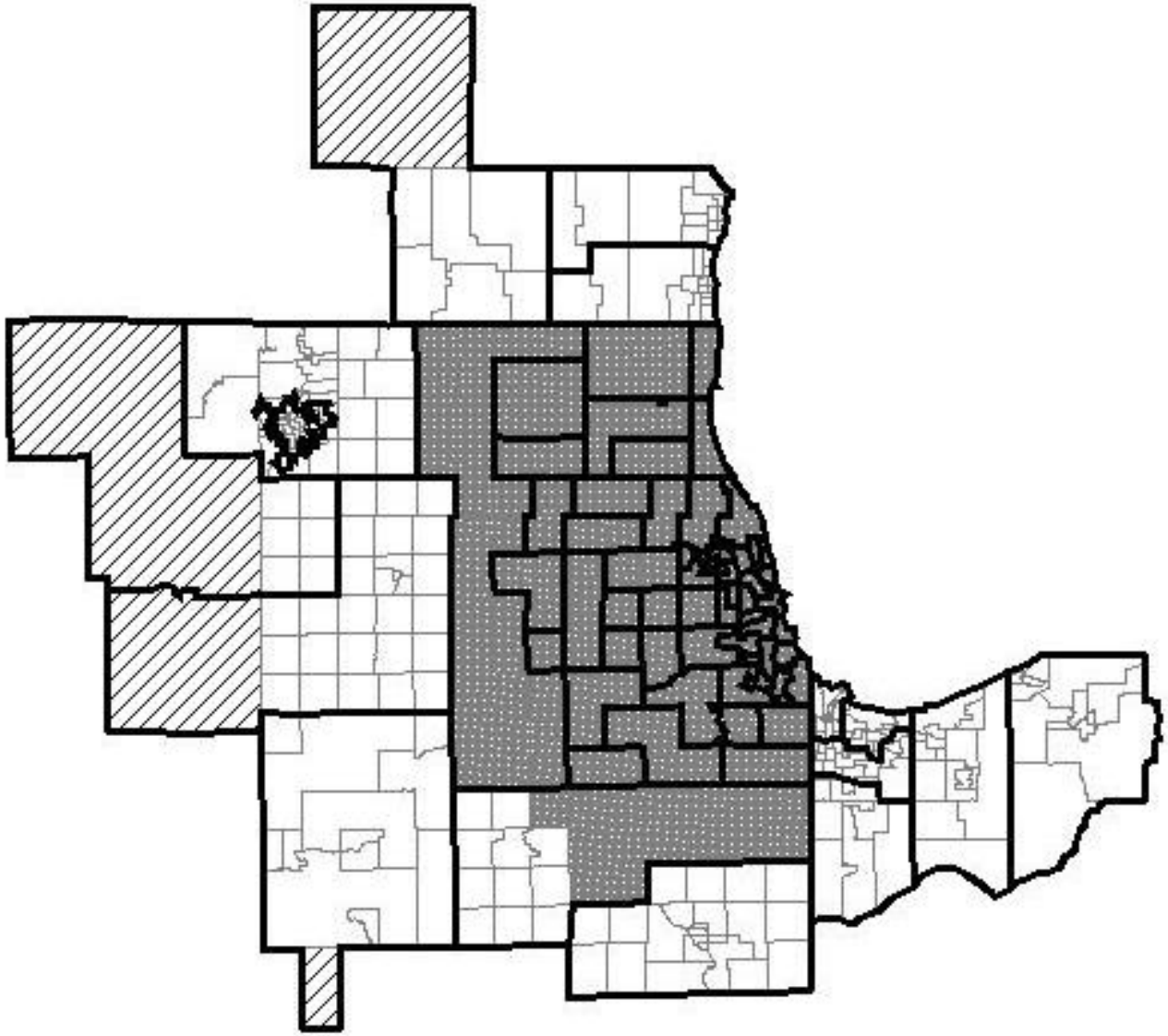


Figure 5b. Public Use Microdata Areas Defined in Census 2000: Five Percent Household Sample PUMAs



Geographic Areas Input File. Geographic areas are entered into the model through a file named **GEOG_IN.TXT.** This input file has one record per trip generation subzone and it is a comma delimited file, a format with variables separated by commas. This is a popular format that can be read and exported by nearly all commercial software for statistical analyses and management of large data sets. As a precaution, successive commas should be avoided in these types of files. The FORTRAN language strictly interprets them as missing values and does not load any value into a variable when encountered, which can have unanticipated consequences.

Variables in the **GEOG_IN.TXT** are listed in Table 1. This version of the trip generation model has been coded to allow for up to 25,000 trip generation subzones, 5000 model zones, 30 counties, 30 one percent PUMAs, and 100 five percent PUMAs.

Table 1. GEOG_IN.TXT Input File

SUBZONE	Integer (1-25000)	The trip generation subzone, which must be in sequence in the file from low to high values.
COUNTY	Integer (1-99999)	A five digit code identifying the county where the subzone is located. The first two digits are the state Federal Information Processing Standards (FIPS) code for the state and the remaining three digits are the county FIPS code. (Example: DuPage County is 17043)
COUNTY NAME	Alphanumeric	Ten character county name enclosed in double quotes.
STATE	Alphanumeric	Two character state code enclosed in double quotes.
ONE PERCENT PUMA	Integer (1-99999)	Five digit numeric code for one percent PUMAs
FIVE PERCENT PUMA	Integer (1-99999)	Five digit numeric code for five percent PUMAs
ZONE	Integer (1-5000)	Modeling zone
CHICAGO	Integer (0 or 1)	Variable is set to 1 when trip generation subzone is inside Chicago; 0 elsewhere.
CBD	Integer (0 or 1)	Variable is set to 1 when trip generation subzone is inside the Chicago CBD; 0 elsewhere. The first forty-seven trip generation subzones presently make up the Chicago CBD.
ROW-COLUMN	Integer (1-4)	Variable identifies the portion of the region that provides the tables of cross-classified households for the procedure to disaggregate households within smaller trip generation subzones. These areas are mapped in Figure 8. 1 = Inner Chicago 2 = Outer Chicago and Inner Suburbs 3 = Mid Suburban 4 = Fringe and External Areas
AREA	Real Number	Area of the trip generation subzone in square miles.

Cross-Classified Household Input Tables. The first substantial calculations in the model are an algorithm that estimates subzone level tables of households cross-classified by: (1) adults (1, 2, 3, 4 or more adults); (2) workers (0, 1, 2, 3, 4 or more workers), (3) children fifteen years and younger (0, 1, 2, 3 or more children), and; (4) income quartiles (four categories). This algorithm is variously known as iterative proportional fitting (IPF) or matrix balancing. Transportation planners know it as the Fratar method for trip table expansion. It is an iterative procedure that takes an initial table (more generally, a multi-dimensioned array since the algorithm is not restricted to two dimensions) and adjusts cell values in the table to equal new row and column totals (again more generally, new vector sums in all dimensions). In the trip generation model, the initial table is an observed table of households in a one percent PUMA cross-classified by the four household characteristics described above.

Figure 6. Household Types

a. Possible Adult-Worker Combinations

Workers \ Adults	1	2	3	4+
0	1	2	3	4
1	5	6	7	8
2		9	10	11
3			12	13
4+				14

b. Numbering of Household Types

Household Type	Children	Income Quartile
1-14	0	0
15-28	1	0
29-42	2	0
43-56	≥ 3	0
57-70	0	1
71-84	1	1
85-98	2	1
99-112	≥ 3	1
113-126	0	2
127-140	1	2
141-154	2	2
155-168	≥ 3	2
169-182	0	≥ 3
183-196	1	≥ 3
197-210	2	≥ 3
211-224	≥ 3	≥ 3

Two hundred twenty-four different types of households result from the above cross-classification scheme. This is fewer than all combinations of the household categories (320) because a household must have more adults than workers, and there are only fourteen possible combinations of adults and workers rather than twenty. The fourteen adult-worker categories are illustrated in Figure 6a.

Figure 6b is a key to the numbering of all 224 household types in the model's code. Households are numbered in increments of fourteen in Figure 6b matching the fourteen adult-worker categories.

The one percent PUMA household tables (the initial tables for the IPF algorithm) are read into the model via the file **P1_HHTAB_IN.TXT**. Table 2 shows the variables in this file with household type referring to the numbering scheme in Figure 6. This input file is also a comma delimited file with one record for each one percent PUMA and household type combination. The records do not have to be ordered but for readability it is preferable to order the file by PUMA and household type. No input record is required when a household type is missing in the sample households in a one percent PUMA.

Table 2. P1_HHTAB_IN.TXT Input File

ONE PERCENT PUMA	Integer (1-99999)	Five digit numeric code for one percent PUMAs.
HOUSEHOLD TYPE	Integer (1-224)	Code indicating cross-classification of household (as per numbering in Figure 6).
ONE PERCENT PUMA HOUSEHOLDS	Integer	Number of households matching household type code in the one percent PUMA.

The input household tables for development and testing of the revised model were total expanded households in the combined 2005, 2006 and 2007 ACS PUMS data for the three-state modeled area. Combining multiple years of PUMS is permitted because the model converts the input tables into proportions since the IPF algorithm operates on the proportions of households rather then the numbers of households.

The combined three year ACS PUMS household tables contained data for more than eighty percent of 4480 possible entries (224 household types for each of twenty PUMAs). However, about a third of all entries had less than five households sampled in the combined three year ACS.

While missing values and limited household samples in a large number of table cells are a concern, these cells match extremely unlikely household categories, such as four or more worker households in the lowest income quartile. Combining more years of ACS PUMS data is desirable from the viewpoint of more complete tables, but there is a tradeoff to consider since the tables are less current as additional years of ACS PUMS are included in the totals.

Household Income Quartiles. Household income quartiles for study area households were also estimated from the combined PUMS household files. Three yearly household-income distributions were tabulated from the three annual files of PUMS household records. Quartile household incomes were identified for each year and they are listed in Table 3.

Table 3. Study Area Household Income Quartiles

	ACS PUMS		
Household Income Quartile	2005	2006	2007
1	≤ $27,000	≤ $28,000	≤ $29,900
2	$27,001 TO $52,300	$28,001 TO $55,000	$29,901 TO $57,000
3	$52,301 TO $89,000	$55,001 TO $92,200	$57,001 TO $96,000
4	> $89,000	> $92,200	> $96,000

Disaggregate Households by Subzone

The initial table in the IPF process that cross-classifies households in a subzone is one of the PUMA tables of households. This initial table is then manipulated to agree with the household

characteristics of the subzone. For the IPF procedure, the households in each of the seventeen categories (four adult categories plus five worker categories plus four children categories plus four income quartiles) must be known. For example, the number of households in the subarea in each of the four income quartiles has to be determined. The calculations then proceed iteratively from household characteristic to household characteristic. During an iteration of the algorithm, the households in the table are factored to sum to the desired households within the categories of one household characteristic. The algorithm iterates until the differences between the desired numbers of households and the table sums become negligible.

Subzone Household Input File. Prior to initiating the subzone by subzone application of the IPF algorithm, a file with average subzone household characteristics is read. Two other quantities that characterize a subzone, the proportion of work trips made by private automobile and the pedestrian environment factor, are also included in this file. These two quantities have been required inputs for the CMAP trip generation model for some years, and procedures for preparing them from regional socioeconomic and census data are well established in the agency.

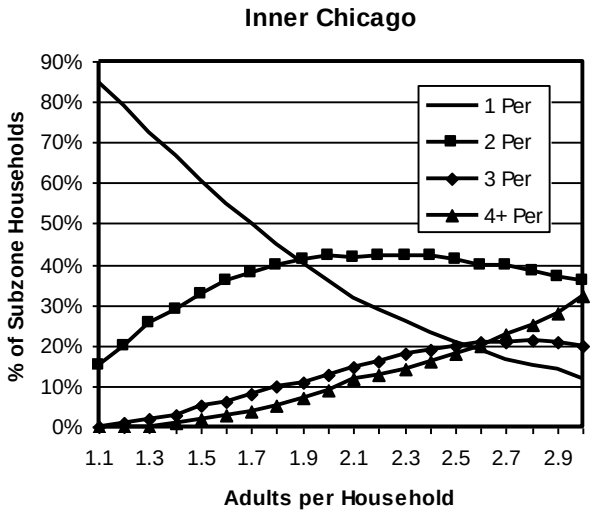
The data are read from a subzone level file named **HH_IN.TXT**, which is again a comma delimited file. The eight variables in the **HH_IN.TXT** are listed in Table 4.

Table 4. HH_IN.TXT Input File

SUBZONE	Integer (1-25000)	The trip generation subzone, which must be in sequence in the file from low to high values.
SUBZONE HOUSEHOLDS	Integer	Households in the trip generation subzone.
AVERAGE ADULTS PER HOUSEHOLD	Real Number	Average adults (sixteen and older) per household in the subzone.
AVERAGE WORKERS PER HOUSEHOLD	Real Number	Average adult workers per household in the subzone.
AVERAGE CHILDREN PER HOUSEHOLD	Real Number	Average children (fifteen and younger) per household in the subzone.
INCOME QUARTILE INDEX	Real Number	This index is defined as the average subzone household income divided by the regional **median** household income.
PRIVATE AUTO COMMUTE MODE SHARE	Real Number	This is the ratio between the workers in the subzone who commute by auto (single occupant vehicles, carpool, and taxi) divided by the workers in the subzone.
PEDESTRIAN ENVIRONMENT FACTOR	Real Number	The average number of census blocks per quarter-square mile. See comments in text for details on how this quantity is calculated.

When the trip generation subzone is a quarter-section or smaller, the pedestrian environment factor is calculated by averaging the census blocks within an area 1.5 mile by 1.5 mile. The area for the average pedestrian environment factor is normally defined by the subzone plus the eight abutting subzones centered on the subzone of interest. For larger subzones on the periphery of the region, a simple subzone average is used.

Figure 7. Sample Household Distribution



Subzone Household Distribution Tables. The link between the average household characteristics in **HH_IN.TXT** and the IPF algorithm are tables that relate average subzone household characteristic to the distribution of households across the four or five categories associated with that characteristic. Figure 7 is a plot of one of these tables. It graphs the relationship between the average adults per household and the distribution of households by adults for subzones within inner city Chicago.

The full set of these tables for a subzone includes three more similar tables for workers, children, and income quartiles

These tables are arduous to prepare and require a significant number of trip generation subzone observations. This means that the same tables must be used for groups of subzones. Four ring-like areas were somewhat arbitrarily defined for this purpose, inner city Chicago, remainder of Chicago and inner suburbs, middle suburbs, and far suburbs-fringe. These areas were developed from five percent PUMAs, and are generally similar in demographic character. They are shown in Figure 8. The ROW-COLUMN variable read from **GEOG_IN.TXT** indicates which area tables are to be used for a subzone.

Appendix C contains the full set of tables that are included in the model code. The adult, worker, and income quartile tables were developed from several 2000 CTPP TAZ level residential tables. After compiling the data, it became obvious that many of these tables could be combined even more. In particular, the same table of households by workers applies for all areas. The middle suburban and fringe tables are also the same for the households by adults table. The table for the distribution of households by children was estimated from the CMAP household travel survey, and the same table for children is used in all areas due to the smaller household sample in the CMAP survey.

Adjustment of Income Quartile Index. The household income distribution table is indexed by the ratio of a subzone's average household income to the median regional household income (a subzone with an index of one has an average household income equal to the regional median household income). Since small area household income figures are difficult to determine and even more difficult to project into the future, it is not surprising that total estimated households within one or more income quartiles rarely equal a quarter of the regional households..

The approach undertaken in the model is to factor the input subzone average household income indices to improve the distribution of households by income quartile. Therefore, the model

determines a new "true" median regional household income given the input subzone households and income indices. All subzone income indices are then adjusted by this factor, which should not be too large.

Figure 8. Areas for Household Distribution Tables

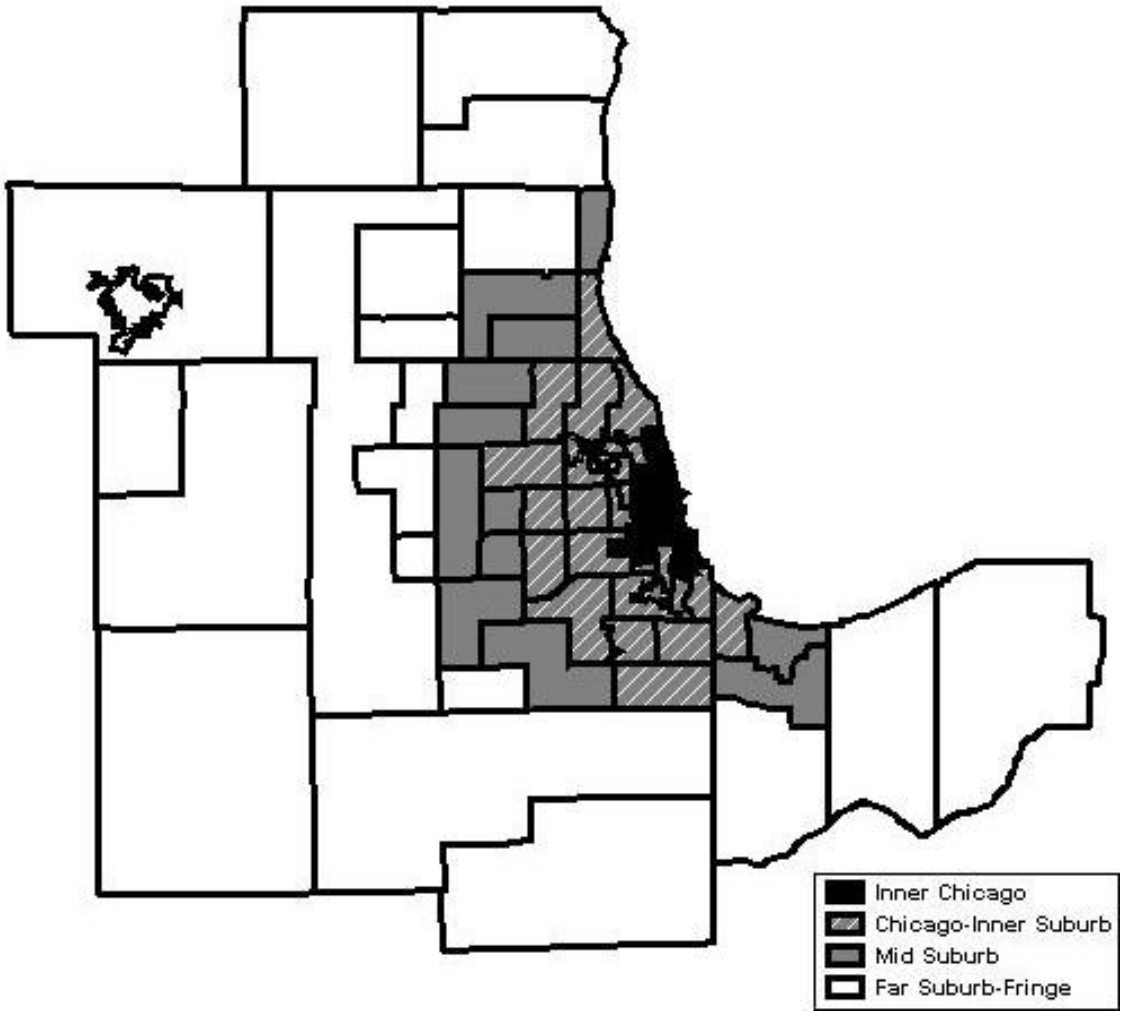


Figure 9. Updating Household Cross-Classification Tables

a. Tabulate Base Table by Five Percent PUMAs

Adults/ HH	TG Subzones in 5% PUMA: 28	29	30	.....	45	Total HHs
1						
2						
3						
4+						
Total HHs						

Workers/ HH	TG Subzones in 5% PUMA: 28	29	30	.....	45	Total HHs
0						
1						
2						
3						
4+						
Total HHs						

Children/ HH	TG Subzones in 5% PUMA: 28	29	30	.....	45	Total HHs
0						
1						
2						
3+						
Total HHs						

Income Quartile	TG Subzones in 5% PUMA: 28	29	30	.....	45	Total HHs
1						
2						
3						
4						
Total HHs						

b. Add New Row-Column Totals

Adults/ HH	TG Subzones in 5% PUMA: 28	29	30	.....	45	Total HHs
1						
2						
3						
4+						
Total HHs						

5% PUMA HHs

From Household Distribution Tables

New Total HHs					

From P5_HH_IN.TXT Input File

c. IPF Balance Five Percent PUMA Tables

d. New Totals for Subzone Cross-Classified Tables

Adults/ HH	TG Subzones in 5% PUMA: 28	29	30	.....	45	Total HHs
1						
2						
3						
4+						
Total HHs						

Adults/ HH	Sub-Zone 28
1	
2	
3	
4+	

Optional Updating of Subzone Household Cross-Classification Tables. Figure 9 illustrates the logic of a program option that was added to allow updated or future household cross-classification tables to be created from average five percent PUMA household characteristics. This option means that base year household tables can be readily updated with annual or three year average ACS data. It also permits future household tables to be created without estimating household characteristics for small subzones, arguably an unreasonable and impractical forecasting exercise.

When the program control variable **PUMA_TG** is true, an additional step is added to the program. It occurs after base year households have been cross-classified within subzones (see Figure 1). The future household cross-classification tables are then effectively a rebalancing of the base tables to new - albeit more aggregate - row-column totals. After completion the updated subzone household cross-classification tables are substituted for the original base household table in the remaining steps of the model.

The base household table is first created in the standard fashion. It is then reorganized into a set of new tables by five percent PUMAs. There are four tables for each PUMA one for each of the four household characteristics. Each column in one of these PUMA tables corresponds to a trip generation subzone located in the PUMA (illustrated in Figure 9a).

Row-column totals are then determined for each of these PUMA tables. Total households for each subzone (the column totals in Figure 9b) are read from a new input file **P5_HH_IN.TXT.** This file has the same variables as the original **HH_IN.TXT** file except that the average

household characteristics are now five percent PUMA averages. The row totals illustrated in Figure 9b are obtained from the subzone household distribution tables using the PUMA average household characteristics in **P5_HH_IN.TXT**.

The five percent PUMA tables are next IPFed to these row-column totals. Cells in the columns in the rebalanced PUMA tables correspond to revised row-column sums for the base subzone cross-classified household tables (illustrated in Figure 9d). The final step is to IPF the original base subzone household tables to these new totals.

Temporary File FIRST_HHTEMP.TXT. The subroutines that disaggregate households write out scratch files that are passed to the next subroutine. This file is named **FIRST_HHTEMP.TXT** and it has the fixed format in Table 5. If the control variable **PUMA_TG** is true, a second file **FIRST_P5_HHTEMP.TXT** is also written, which has the identical format. Both files are retained at the end of the model run when control variable **SAVE_FILE** is true.

Table 5. FIRST_HHTEMP.TXT and FIRST_P5_HHTEMP.TXT Temporary Files

SUBZONE	Integer (I6)	Trip generation subzone (6 characters)
HH TYPE 1	Real Number (F12.4)	Type 1 households (12 characters, 4 decimal places)
HH TYPE 2	Real Number (F12.4)	Type 2 households (12 characters, 4 decimal places)
. . . .	. . . .	. . . .
HH TYPE 224	Real Number (F12.4)	Type 224 households (12 characters, 4 decimal places)

Validation of the Procedure to Disaggregate Households. Validation of the results from disaggregating the households is something of a problem. Summarizing the results in one dimension - county summaries of the households by workers, for example - only allows an evaluation of the input data from **HH_IN.TXT**, not of the process itself. At the same time, it is difficult to display results from the procedure in more than two dimensions.

The CMAP trip generation model was first run for the base year using household data directly from CMAP. Households in this base year data have been extrapolated by CMAP staff to represent the region in 2010. As a result, the regional households modeled in the trip generation should be slightly greater than the number in the average 2005-2007 PUMS data used for comparison.

The conclusion drawn from the first evaluation of the updated household allocation procedure was that results were not nearly as acceptable as earlier versions of the procedure developed from the 2000 decennial Census and 1990 CATS household travel survey. After some analyses, it was clear that the average household characteristics in the base year household input file were somewhat different from the PUMS data. For the purposes of comparison, the base year

household input file was factored so that average household characteristics in the input data matched those of PUMS households within five percent PUMAs. This is not any implied criticism of the input data since the purpose of this comparison is to make sure that the household allocation within the model is working, and the only way this can be accomplished is to have the model input data match observed households.

The resulting comparison between modeled households based upon the factored household input data and PUMS households showed substantial agreement between the two with the exception of the distribution of households by children. Tables in the model's code matching subzone average children per household with the proportion of households by children were again investigated. The tables were initially estimated using weighted households tabulated from the CMAP household travel survey. It was suspected that some exceptionally large household weights may have overly affected results and the arrays were re-estimated using unexpanded households from the CMAP survey.

After incorporating these changes the household allocation part of the model was again evaluated. These results are listed in Tables 6-8. Households are cross-tabulated by adults and workers, adults and children, and workers and income so that the four characteristics by which households are disaggregated are represented. Results are listed by parts of the regions that can be summarized from five percent PUMAs, the smallest geography in the PUMS data. Several counties are combined because of larger than county PUMAs, and some counties on the edges of the modeled area are omitted because PUMAs extend beyond area boundaries. The percentages shown in these tables are the percents of total households in an area.

The PUMS households in the tables are the average (one-third) of total weighted households from the three annual ACS. Even though the PUMS figures in these tables haven't been rounded to larger increments, it should be emphasized that they are estimates from a sample of households and subject to sampling error.

The main conclusion from these tables is that the IPF procedure to disaggregate households seems to work quite well, especially in light of the differing years for the trip generation run and averaged PUMS data. But it must be emphasized that this observation applies to the mechanics of the procedure - selection of an initial household table for the IPF algorithm, the appropriateness of the tables to estimate the distribution of households across categories of household characteristics, and the implementation of the IPF algorithm in the software – since the tables compare the same PUMS household data before and after application of the IPF. One would expect them to match closely if the procedure is implemented correctly since subzone average household characteristics input to the IPF procedure have been factored to those of the initial PUMS source table.

Table 6. Disaggregated Households: Adults and Workers

		Workers per Household											
		0 Worker				1 Worker				2 or More Workers			
	Adults/ Household	PUMS	%	Trip Generation	%	PUMS	%	Trip Generation	%	PUMS	%	Trip Generation	%
Chicago	1	162,650	16.0	200,881	17.9	246,911	24.2	244,935	21.8				
	2	75,143	7.4	94,983	8.5	150,624	14.8	155,985	13.9	176,527	17.3	225,640	20.1
	≥ 3	20,184	2.0	20,008	1.8	53,628	5.3	47,108	4.2	132,827	13.0	132,723	11.8
Suburban Cook	1	119,273	13.0	123,866	13.2	160,670	17.5	167,989	17.9				
	2	78,612	8.6	80,640	8.6	157,857	17.2	161,590	17.2	196,899	21.5	208,190	22.2
	≥ 3	10,402	1.1	10,934	1.2	40,310	4.4	40,709	4.3	151,768	16.6	143,107	15.3
DuPage	1	31,593	9.4	36,801	10.9	60,478	18.1	60,032	17.8				
	2	21,979	6.6	25,128	7.4	59,644	17.8	55,213	16.3	88,672	26.5	88,089	26.1
	≥ 3	2,682	0.8	3,559	1.1	12,425	3.7	11,905	3.5	57,209	17.1	57,210	16.9
Lake-IL	1	21,787	9.3	26,359	10.9	38,292	16.4	38,250	15.8				
	2	15,447	6.6	19,881	8.2	45,248	19.4	42,695	17.7	64,771	27.8	63,377	26.2
	≥ 3	1,802	0.8	2,960	1.2	9,238	4.0	9,643	4.0	36,547	15.7	38,386	15.9
Will, Grundy	1	19,681	7.6	28,338	11.5	32,179	12.5	35,012	14.2				
	2	45,302	17.6	19,661	8.0	45,419	17.6	43,701	17.7	65,097	25.3	63,751	25.9
	≥ 3	1,965	0.8	3,736	1.5	8,273	3.2	9,280	3.8	39,508	15.3	42,863	17.4
Kane, Kendall, McHenry	1	23,902	8.1	32,868	10.4	44,911	15.2	45,913	14.5				
	2	22,193	7.5	25,757	8.1	59,184	20.0	55,732	17.6	82,804	28.0	84,108	26.5
	≥ 3	1,454	0.5	2,751	0.9	9,270	3.1	11,436	3.6	51,561	17.5	58,334	18.4
Lake-IN	1	28,789	15.6	24,874	13.1	34,528	18.7	32,645	17.2				
	2	19,964	10.8	24,338	12.8	28,301	15.3	36,313	19.1	36,348	19.7	38,235	20.2
	≥ 3	2,936	1.6	2,980	1.6	8,398	4.5	8,487	4.5	25,565	13.8	21,761	11.5
Kenosha	1	8,034	13.4	6,519	11.0	10,082	16.9	10,120	17.0				
	2	4,967	8.3	5,924	10.0	10,281	17.2	11,815	19.9	15,228	25.5	14,343	24.1
	≥ 3	139	0.2	293	0.5	2,039	3.4	2,159	3.6	9,046	15.1	8,226	13.8

Table 7. Disaggregated Households: Adults and Children

		Children per Household											
		0 Children				1 Child				2 or More Children			
	Adults/ Household	PUMS	%	Trip Generation	%	PUMS	%	Trip Generation	%	PUMS	%	Trip Generation	%
Chicago	1	596,852	30.9	643,588	31.3	45,290	2.3	46,840	2.3	47,362	2.4	47,242	2.3
	2	512,274	26.5	563,930	27.4	122,029	6.3	136,094	6.6	201,361	10.4	227,003	11.0
	≥ 3	225,076	11.6	207,128	10.1	93,105	4.8	85,525	4.2	90,938	4.7	101,937	5.0
Suburban Cook	1	351,538	34.5	387,128	34.5	26,641	2.6	27,326	2.4	31,383	3.1	31,362	2.8
	2	255,762	25.1	297,483	26.5	59,536	5.8	70,418	6.3	86,996	8.5	108,707	9.7
	≥ 3	110,703	10.9	100,928	9.0	46,992	4.6	42,199	3.8	48,945	4.8	56,712	5.1
DuPage	1	245,314	26.8	256,460	27.4	18,650	2.0	19,514	2.1	15,979	1.7	15,880	1.7
	2	256,511	28.0	266,447	28.4	62,493	6.8	65,676	7.0	114,365	12.5	118,296	12.6
	≥ 3	114,373	12.5	106,200	11.3	46,113	5.0	43,326	4.6	41,994	4.6	45,225	4.8
Lake-IL	1	82,297	24.6	87,240	25.8	4,979	1.5	5,090	1.5	4,794	1.4	4,503	1.3
	2	94,959	28.4	94,181	27.9	25,095	7.5	25,066	7.4	50,241	15.0	49,182	14.6
	≥ 3	44,216	13.2	42,921	12.7	16,716	5.0	16,225	4.8	11,384	3.4	13,529	4.0
Will, Grundy	1	51,022	21.9	55,563	23.0	4,686	2.0	4,526	1.9	4,372	1.9	4,520	1.9
	2	66,045	28.3	68,455	28.3	19,287	8.3	17,130	7.1	40,133	17.2	40,368	16.7
	≥ 3	25,883	11.1	27,296	11.3	11,451	4.9	10,721	4.4	10,253	4.4	12,972	5.4
Kane, Kendall, McHenry	1	43,569	19.1	53,730	21.8	3,948	1.7	4,419	1.8	4,342	1.9	5,201	2.1
	2	61,970	27.2	66,827	27.1	21,049	9.2	16,462	6.7	43,016	18.9	43,825	17.8
	≥ 3	26,491	11.6	31,012	12.6	12,478	5.5	10,506	4.3	10,778	4.7	14,362	5.8
Lake-IN	1	57,678	19.5	66,599	21.0	5,237	1.8	5,733	1.8	5,898	2.0	6,450	2.0
	2	84,959	28.8	89,212	28.2	25,344	8.6	20,952	6.6	53,879	18.2	55,433	17.5
	≥ 3	32,050	10.9	38,140	12.0	16,086	5.4	15,072	4.8	14,149	4.8	19,308	6.1
Kenosha	1	51,582	27.9	46,576	24.6	5,601	3.0	5,445	2.9	6,134	3.3	5,498	2.9
	2	53,906	29.2	63,362	33.4	11,537	6.2	14,035	7.4	19,171	10.4	21,488	11.3
	≥ 3	21,155	11.4	18,848	9.9	9,232	5.0	8,593	4.5	6,512	3.5	5,786	3.1

Table 8. Disaggregated Households: Workers and Income

		Income Quartile 1				Income Quartile 2				Income Quartile 3				Income Quartile 4			
	Workers/ Household	PUMS	%	Trip Generation	%	PUMS	%	Trip Generation	%	PUMS	%	Trip Generation	%	PUMS	%	Trip Generation	%
Chicago	0	301,637	15.6	339,761	16.5	99,038	5.1	106,382	5.2	39,861	2.1	49,182	2.4	25,729	1.3	35,987	1.7
	1	203,120	10.5	216,490	10.5	265,359	13.7	265,604	12.9	201,689	10.4	204,106	9.9	139,832	7.2	132,115	6.4
	2	30,860	1.6	46,524	2.3	95,094	4.9	119,358	5.8	161,052	8.3	182,563	8.9	229,308	11.9	221,200	10.7
	≥ 3	2,911	0.2	4,427	0.2	17,086	0.9	22,141	1.1	44,233	2.3	47,941	2.3	77,478	4.0	65,507	3.2
Suburban Cook	0	191,067	18.8	227,015	20.2	41,925	4.1	52,987	4.7	15,868	1.6	21,794	1.9	9,118	0.9	14,077	1.3
	1	137,152	13.5	141,242	12.6	147,374	14.5	148,466	13.2	101,665	10.0	100,668	9.0	64,973	6.4	57,651	5.1
	2	21,836	2.1	32,863	2.9	53,701	5.3	70,744	6.3	71,930	7.1	85,805	7.6	97,119	9.5	101,296	9.0
	≥ 3	1,507	0.1	2,510	0.2	11,065	1.1	14,898	1.3	22,550	2.2	24,349	2.2	29,646	2.9	25,899	2.3
DuPage	0	110,570	12.1	112,747	12.0	57,113	6.2	53,394	5.7	23,993	2.6	27,389	2.9	16,611	1.8	21,910	2.3
	1	65,968	7.2	75,249	8.0	117,985	12.9	117,138	12.5	100,024	10.9	103,437	11.0	74,859	8.2	74,464	7.9
	2	9,024	1.0	13,661	1.5	41,393	4.5	48,615	5.2	89,121	9.7	96,758	10.3	132,189	14.4	119,904	12.8
	≥ 3	1,404	0.2	1,918	0.2	6,021	0.7	7,243	0.8	21,683	2.4	23,591	2.5	47,833	5.2	39,609	4.2
Lake-IL	0	25,074	7.5	26,973	8.0	15,451	4.6	16,191	4.8	9,105	2.7	11,776	3.5	6,623	2.0	10,548	3.1
	1	17,322	5.2	17,598	5.2	38,204	11.4	35,550	10.5	39,212	11.7	37,981	11.2	37,808	11.3	36,021	10.7
	2	2,736	0.8	4,087	1.2	13,994	4.2	15,156	4.5	34,722	10.4	37,225	11.0	64,700	19.3	56,265	16.6
	≥ 3	384	0.1	708	0.2	1,892	0.6	3,219	1.0	6,455	1.9	8,204	2.4	20,998	6.3	20,435	6.0
Will, Grundy	0	18,814	8.1	18,949	7.8	9,024	3.9	10,602	4.4	5,595	2.4	8,743	3.6	5,603	2.4	10,906	4.5
	1	15,129	6.5	14,707	6.1	26,999	11.6	24,739	10.2	23,541	10.1	24,458	10.1	27,110	11.6	26,684	11.0
	2	1,537	0.7	2,688	1.1	9,408	4.0	11,220	4.6	24,029	10.3	25,992	10.8	47,695	20.5	39,021	16.2
	≥ 3	218	0.1	843	0.3	1,891	0.8	3,052	1.3	5,304	2.3	7,332	3.0	11,237	4.8	11,615	4.8
Kane, Kendall, McHenry	0	17,726	7.8	22,203	9.0	11,582	5.1	14,660	6.0	5,197	2.3	7,908	3.2	2,660	1.2	6,964	2.8
	1	11,902	5.2	15,064	6.1	25,649	11.3	26,813	10.9	28,024	12.3	27,268	11.1	20,296	8.9	18,848	7.7
	2	2,270	1.0	3,883	1.6	10,347	4.5	13,892	5.6	30,062	13.2	29,705	12.1	40,340	17.7	33,535	13.6
	≥ 3	215	0.1	535	0.2	1,137	0.5	1,978	0.8	5,942	2.6	7,998	3.2	14,291	6.3	15,089	6.1
Lake-IN	0	23,621	8.0	25,384	8.0	13,289	4.5	15,798	5.0	5,950	2.0	10,364	3.3	4,689	1.6	9,830	3.1
	1	18,779	6.4	20,931	6.6	34,149	11.6	32,144	10.1	34,088	11.5	35,911	11.3	26,349	8.9	24,095	7.6
	2	3,060	1.0	5,768	1.8	15,493	5.2	20,330	6.4	34,895	11.8	39,301	12.4	50,839	17.2	43,194	13.6
	≥ 3	336	0.1	847	0.3	2,548	0.9	4,294	1.4	7,992	2.7	10,914	3.4	19,201	6.5	17,794	5.6
Kenosha	0	33,893	18.3	33,660	17.8	11,299	6.1	11,864	6.3	4,687	2.5	4,608	2.4	1,809	1.0	2,059	1.1
	1	20,361	11.0	22,836	12.0	25,765	13.9	28,653	15.1	17,881	9.7	18,683	9.9	7,221	3.9	7,272	3.8
	2	2,819	1.5	3,492	1.8	8,941	4.8	10,699	5.6	20,851	11.3	19,942	10.5	17,172	9.3	14,702	7.8
	≥ 3	76	0.0	85	0.0	1,032	0.6	1,221	0.6	4,595	2.5	4,309	2.3	6,427	3.5	5,546	2.9

Household Vehicle Availability Submodels

The household vehicle availability submodel is a discrete choice logit model similar to choice models to predict mode choice behavior. There are three or four possible vehicle level choices for each household depending on the adults (workers plus nonworking adults) in the household. Single adult households may have none, one, or two or more vehicles; larger households have the alternatives of none, one, two, or three or more vehicles.

Each vehicle availability level has an associated utility. In these logit models, utilities are weighted linear combinations of household and subzone variables that have been entered or developed in earlier steps of the model. Model estimation consists of determining which variables best explain observed vehicle availability levels and the relative importance of these variables in the utility expressions. The utilities may also include bias constants that indicate preferences toward certain vehicle availability levels that are not otherwise accounted for by the utility expressions.

Re-Estimation of Vehicle Availability Submodels. The vehicle availability submodels have the following general form:

$$\text{Prob\{Vehicle Availability Level } i\} = \frac{e^{u_i}}{\sum_i e^{u_i}}.$$

Where u_i is the utility of household vehicle availability level i, which is computed by the linear equation:

$$u_i = \sum_j \alpha_{ij} H_j + \beta_i.$$

For these utility equations:

1. The model coefficient α_{ij} is the weight attached to the j'th independent household variable for household vehicle availability level i.
2. H_j is the j'th independent household variable (number of workers in household, household income quartile, etc).
3. The constant β_i is the bias toward vehicle availability level i, and it must equal zero for at least one alternative.

Model coefficients for the existing submodels were re-estimating with data from the CMAP household travel survey. After completing this re-estimation, several incremental changes to the submodels were introduced: (1) some model coefficients in the re-estimation were similar for different levels of vehicle availability and the utility equations were modified to replace these multiple coefficients with a single coefficient across utility equations; (2) a few previously

marginally significant model coefficients became insignificant and were dropped, and; (3) a complete set of bias coefficients were estimated.

ALOGIT software ([6]) was used for this model re-estimation. The following work sequence describes the "ESTIMATION" mode of applying the ALOGIT software.

1. Prepare ALOGIT base data file from the CMAP household travel survey. A data set of household characteristics prepared as part of the previous CMAP project to create survey based model estimation and calibration data sets provided the source data.
2. Prepare ALOGIT control file. The control statements are essentially the same as those used in the original estimation of the submodels.
3. Re-estimate the existing submodels' coefficients while maintaining the same equations for the utility equations associated with different levels of vehicle ownership.
4. Evaluate significance of estimation results.
5. Test alternative formulations for the submodels' utility expressions by combining model coefficients and shuffling variables in and out of the utility expressions as indicated by intermediate results and statistical measures of the importance of the coefficients in the estimated utility expressions.
6. Specify final model.

ALOGIT was then rerun in the "APPLY" mode, which applies the specified model to predict the vehicle levels of households given their characteristics in the estimation data set. The "APPLY" results were compared with the actual levels in the estimation data set, and model calibration was completed by adjusting bias coefficients so that estimated and observed levels of household vehicle ownership matched within the parts of the region defined for the household distribution tables (the geographic areas shown in Figure 8). The re-estimated vehicle availability submodels were finally coded into the CMAP trip generation model code.

Vehicle Availability Utilities. Table 9 lists the coefficients in the logit equation utilities that comprise the household vehicle availability submodel. Separate models were estimated and calibrated for three different sized households defined by the total adults (workers plus nonworking adults) in the household. Each line in the table lists the model coefficients for estimating the utility attached to that level of vehicle availability for one of the three household type models.

Temporary File SECOND_HHTEMP.TXT. The household vehicle availability subroutine writes a temporary file with households by type and vehicle availability. Note that the three or more vehicles value in the file is always zero for single person households. When the control variable **PUMA_TG** is turned on the file is named **SECOND_P5_HHTEMP.TXT.** This is a fixed format file as shown in Table 10, and it is retained when the control variable **SAVE_FILE** is true.

Validation. Household vehicle availability estimated by the submodels was compared against data from the 2007 ACS. This comparison is shown in Table 11. Given that the PUMS figures are themselves estimates surrounded by confidence intervals, the model estimates appear reasonable. The lowest vehicle availabilities are slightly overestimated while the highest levels are slightly underestimated. The great majority of households in the region have one and two vehicles available, and these two levels are generally modeled quite well.

Table 9. Vehicle Availability Submodel Coefficients

	One Adult Household Vehicle Availability			Two Adult Household Vehicle Availability				Three or More Adult Household Vehicle Availability			
Variable	0	1	≥ 2	0	1	2	≥ 3	0	1	2	≥ 3
Pedestrian Environment Factor (Maximum=40)	0.06165	0.03188		0.1280	0.06309	0.03359		0.1703	0.06586	0.06586	
Workers? ≥ 1 (0/1) ≥ 2 (0/1) ≥ 3 (0/1)		0.4731	0.4731			0.6940 0.5198	0.6940 0.5198		1.114	1.114 0.7934	1.114 0.7934 1.389
Income Quartile? ≥ 2 (0/1) ≥ 3 (0/1) = 4 (0/1)		1.182 0.9910	1.766 1.690 0.4668		1.702	2.466 0.8650 0.4517	2.466 0.8650 0.8827		0.9492	1.487 0.8723 1.390	1.487 1.571 1.834
Commute Auto Mode Share		4.677	4.677			5.284	5.284			4.959	4.959
Nonworking Adults											0.1491
Children? ≥ 1 (0/1)						0.2218					
Bias 1. Inner Chicago 2. Rest of Chicago and Inner Suburbs 3. Mid-Suburbs 4. Far Suburbs and Fringe		-2.600 -2.676 -2.869 -3.082	-5.077 -4.823 -4.914 -4.984		2.018 2.259 2.151 1.925	-2.827 -2.637 -2.728 -3.144	-4.393 -3.944 -4.126 -4.302		2.806 2.552 1.547 2.272	-1.836 -2.139 -2.783 -2.430	-1.631 -1.789 -2.668 -2.278
Goodness of Fit Measures											
ρ^2 with respect to zero	0.384			0.391				0.448			
ρ^2 with respect to constants	0.169			0.166				0.222			

Table 10. SECOND_HHTEMP.TXT and SECOND _P5_HHTEMP.TXT Temporary Files

SUBZONE	Integer (I6)	Trip generation subzone (6 characters)
HH TYPE 1, 0 VEH	Real Number (F12.4)	Type 1 households without vehicles (12 characters, 4 decimal places)
HH TYPE 1, 1 VEH	Real Number (F12.4)	Type 1 households with one vehicle (12 characters, 4 decimal places)
HH TYPE 1, 2 VEH	Real Number (F12.4)	Type 1 households with two vehicles (12 characters, 4 decimal places)
HH TYPE 1, ≥ 3 VEH	Real Number (F12.4)	Type 1 households with three or more vehicles (12 characters, 4 decimal places)
HH TYPE 2, 0 VEH	Real Number (F12.4)	Type 2 households without vehicles (12 characters, 4 decimal places)
HH TYPE 2, 1 VEH	Real Number (F12.4)	Type 2 households with one vehicle (12 characters, 4 decimal places)
HH TYPE 2, 2 VEH	Real Number (F12.4)	Type 2 households with two vehicles (12 characters, 4 decimal places)
HH TYPE 2, ≥ 3 VEH	Real Number (F12.4)	Type 2 households with three or more vehicles (12 characters, 4 decimal places)
. . . .	. . . .	. . . .
HH TYPE 224, 0 VEH	Real Number (F12.4)	Type 224 households without vehicles (12 characters, 4 decimal places)
HH TYPE 224, 1 VEH	Real Number (F12.4)	Type 224 households with one vehicle (12 characters, 4 decimal places)
HH TYPE 224, 2 VEH	Real Number (F12.4)	Type 224 households with two vehicles (12 characters, 4 decimal places)
HH TYPE 224, ≥ 3 VEH	Real Number (F12.4)	Type 224 households with three or more vehicles (12 characters, 4 decimal places)

Table 11. Household Vehicle Availability: 2007 ACS and Base Year Trip Generation

	0 Vehicles				1 Vehicle				2 Vehicles				3 or More Vehicles			
	PUMS	%	Trip Generation	%	PUMS	%	Trip Gen.	%	PUMS	%	Trip Gen.	%	PUMS	%	Trip Gen.	%
Chicago	323,943	16.7	369,832	18.0	774,561	40.0	818,407	39.7	604,843	31.2	646,078	31.4	232,417	12.0	224,970	10.9
Sub Cook	259,754	25.6	300,177	26.7	443,303	43.7	486,767	43.4	235,644	23.2	262,929	23.4	75,419	7.4	72,390	6.5
DuPage	64,189	7.0	69,655	7.4	331,258	35.9	331,640	35.4	369,199	40.1	383,149	40.9	156,998	17.0	152,580	16.3
Kane	11,214	3.3	15,383	4.6	103,245	30.8	102,905	30.5	150,008	44.7	151,887	44.9	70,825	21.1	67,762	20.1
Kendall	7,705	4.8	9,653	5.7	43,279	27.0	47,747	28.0	72,468	45.2	75,787	44.4	36,950	23.0	37,326	21.9
Lake	777	2.7	945	2.8	5,971	20.7	6,912	20.2	14,574	50.6	16,266	47.6	7,471	25.9	10,067	29.4
McHenry	8,995	3.9	10,281	4.3	62,925	26.9	67,510	27.9	110,833	47.4	111,269	46.1	50,864	21.8	52,490	21.7
Will	3,363	3.2	4,360	3.9	23,228	21.9	29,661	26.4	52,256	49.3	51,001	45.5	27,054	25.5	27,174	24.2
Grundy	6,476	3.1	10,052	4.4	49,862	23.6	59,997	26.2	103,358	49.0	104,326	45.6	51,193	24.3	54,283	23.7
Boone	947	5.7	815	2.6	3,852	23.2	6,243	20.0	7,857	47.2	13,744	44.0	3,976	23.9	10,449	33.4
DeKalb	1,417	4.0	2,093	5.7	10,659	30.1	11,834	32.1	15,358	43.3	15,060	40.8	8,017	22.6	7,935	21.5
Kankakee	2,881	7.2	2,737	6.5	12,735	31.6	13,754	32.5	16,316	40.5	17,590	41.5	8,317	20.7	8,277	19.5
Winnebago	8,226	7.5	6,373	5.2	37,713	34.2	43,144	35.2	42,169	38.3	50,497	41.2	22,054	20.0	22,420	18.3
Lake	16,732	9.1	12,283	6.5	64,697	35.1	65,186	34.4	68,377	37.1	79,446	41.9	34,448	18.7	32,716	17.3
Porter	1,756	2.9	2,709	4.3	17,952	29.4	18,415	28.9	26,889	44.1	28,115	44.1	14,427	23.6	14,490	22.7
LaPorte	2,274	5.5	2,585	6.2	13,775	33.0	13,543	32.5	16,983	40.7	17,282	41.5	8,662	20.8	8,241	19.8
Kenosha	3,931	6.6	4,732	8.0	19,091	31.9	17,982	30.3	25,277	42.2	25,562	43.0	11,539	19.3	11,125	18.7
Racine	4,545	6.0	5,972	8.0	24,457	32.5	24,629	32.8	31,283	41.6	31,040	41.4	14,855	19.8	13,406	17.9
Walworth	1,538	4.0	1,617	4.4	11,659	30.2	11,074	30.3	16,328	42.3	15,414	42.1	9,054	23.5	8,477	23.2
Total	407,209	11.0	463,062	11.9	1,284,476	34.8	1,364,036	35.0	1,382,105	37.5	1,458,162	37.4	616,587	16.7	615,762	15.8

Household Trip Generation

With these preliminary steps completed, the model starts the estimation of trip ends. Trip ends generated by persons living in households are estimated first, followed by trip ends generated by persons living in non-institutional group quarters.

Although a data file for estimating household trip rates was recently prepared from the CMAP household travel survey as part of an earlier CMAP project, it proved advantageous to recreate this data set. Final survey data files were not available when the earlier household trip rate file was prepared, and a few additional households were added to the final files. Second, the original linking of trips – to eliminate change mode and serve passenger trip purposes, as well as incidental stops that occur during commuting trips - maintained only the summary trip purposes (home, work, shop, and nonhome/work) used in the existing CMAP models rather than the twenty-one trip purposes collected in the survey. It was soon apparent that additional trip purposes would be useful for trip linking and in the allocation of trip productions and attractions to trip generation subzones.

Trip Linking. The trip linking program was modified to take advantage of these added trip purposes and survey trips relinked. Three changes were introduced into the linking program: (1) the added survey trip purposes were carried into the linked trip records; (2) beginning and ending trip records for a linked trip record were recorded, and (3) minor changes were made in the logic for trip linking within work commutes.

Rules for eliminating intermediate stops during work commutes were altered to the following.

1. Intermediate trip purposes of: (1) attending class; (2) major purchase shopping; (3) eat meal outside home; (4) health care; and (5) civic religious activities within home-work trips were not considered incidental trip purposes and were not linked.
2. If the time spent at intermediate destinations during the commute trip is greater than thirty minutes than the intermediate destinations are retained.
3. The extra distance (total distance traveled minus the home-workplace distance) traveled to reach intermediate destinations during the home-workplace commute must be less than home-workplace distance for linking to occur. All distances are measured as straight line distances based on latitude-longitude coordinates.

After linking trips, several more variables were added to complete the file for estimating household trip generation rates. The type of person making the trip – worker, nonworking adult, or child between twelve and fifteen – and the household category (the 224 household types as per Figure 6) were added. Non-purposeful trips – mainly home to home or work to work nonmotorized movements – were also eliminated since the remaining models cannot model these types of movements.

Weighting of Households. Preliminary household trip generation rates were first calculated by summing trips by trip purpose into tables dimensioned by person type and household trip generation category. These rates were estimated without weighting survey households; but after reviewing these initial trip rates, they were recalculated because of known biases in the CMAP household sample. Trip rates were next re-estimated with households weighted by the expansion factors in the CMAP survey.

The CMAP household expansion factors also yielded suspicious trip rates due to some very large household factors, and it was decided to weight households with expansion factors developed from the combined and averaged three year (2005, 2006, and 2007) ACS PUMS household data. Control totals for each of the 224 household categories were determined from the combined and averaged PUMS annual data. Households in the trip generation data sets were then weighted to equal these control totals. This method for weighting households was selected primarily because of the large sample in the three year PUMS (more than 104,000 households).

Day of Survey. The CMAP survey collected two consecutive days of trip data from some surveyed households, and some two-day households reported trip data for a weekend day. Since the trip rates are for travel on a typical weekday, it was necessary to weight multiple day trips and eliminate weekend trips. For estimating average daily trip rates, trips reported by households submitting two weekday trip reports were weighted by 0.5.

Trip Purposes. A large spreadsheet containing multiple worksheets – the same calculations are repeated for workers, nonworking adults, and children - was developed to estimate household trip generation rates for nearly all trip purposes in the CMAP survey. These large tables were next collapsed into the trip purposes by person type listed in Table 12. The aggregation of trip purposes was largely determined by the number of observations available for estimating each trip rate. The end result is forty-eight different trip purposes; nineteen for workers, thirteen for nonworking adults, and sixteen for children between the ages of twelve and fifteen.

1. Rather than a single home-work trip type, home-workplace and home-related to work trip types (attendance at meetings away from workplace, for example) are differentiated because trips to workplaces tend to be longer. Home-workplace trips are also similar to the journey to work trips in the ACS so they can be compared more directly. Home-workplace trips are eventually divided into trips by low income workers earning less than regional median earnings and high income workers earning more than median earnings.
2. The trip purposes in the CMAP survey allow nonhome/work (workers) and nonhome (nonworkers) trip ends to be separated by whether the trip end is based at households (visits to the households of friends or relative) or not.
3. The school purpose is included recognizing that CMAP presently does not forecast school locations or the students in a subzone. This is thought to be a fairly straightforward enhancement of the model, and it makes sense to allow for school trip

ends in the revised model's code. Maintaining school trip ends may also prove beneficial for trip distribution since school trip lengths likely differ from those of other nonhome/work or nonhome purposes.

4. Home, work and school trip ends are identified as trip productions in this order of relative importance. Consider these examples. A home to workplace trip in the survey and the return workplace to home movement are counted as two home productions and two

Table 12. Trip Rates Tabulated from CMAP Survey

Worker		Nonworking Adults		Child 12 through 15	
Production or Origin	Attraction or Destination	Production or Origin	Attraction or Destination	Production or Origin	Attraction or Destination
Home (P)	Workplace (A) Work-Related (A) School (A) Nonhome/Work at Residence (A) Nonhome/Work Not at Residence (A) Shop (A)				
		Home (P)	School (A) Nonhome at Residence (A) Nonhome Not at Residence (A) Shop (A)	Home (P)	School (A) Nonhome at Residence (A) Nonhome Not at Residence (A) Shop (A)
Work (P)	Nonhome/Work at Residence (A) Nonhome/Work Not at Residence (A) Shop (A)			School (P)	Nonhome at Residence (A) Nonhome Not at Residence (A) Shop (A)
Work (O)	Work (D)				
Nonhome/Work at Residence (O)	Nonhome/Work at Residence (D) Nonhome/Work Not at Residence (D) Shop (D)	Nonhome at Residence (O)	Nonhome at Residence (D) Nonhome Not at Residence (D) Shop (D)	Nonhome at Residence (O)	Nonhome at Residence (D) Nonhome Not at Residence (D) Shop (D)
Nonhome/Work Not at Residence (O)	Nonhome/Work at Residence (D) Nonhome/Work Not at Residence (D) Shop (D)	Nonhome Not at Residence (O)	Nonhome at Residence (D) Nonhome Not at Residence (D) Shop (D)	Nonhome Not at Residence (O)	Nonhome at Residence (D) Nonhome Not at Residence (D) Shop (D)
Shop (O)	Nonhome/Work at Residence (D) Nonhome/Work Not at Residence (D) Shop (D)	Shop (O)	Nonhome at Residence (D) Nonhome Not at Residence (D) Shop (D)	Shop (O)	Nonhome at Residence (D) Nonhome Not at Residence (D) Shop (D)

workplace attractions. Work (both workplace and work-related) trips are productions except when the other end of the trip is at home. Productions and attractions for work-work trips are equivalent. School trips by children are productions except when the other trip end is home. Trip ends for all remaining trip categories are directional by origin and destination.

Table 13. Grouped Households for Rates

Household Types for Worker Trip Rates

Children	Vehicles	Nonworkers
No	No	No
No	No	Yes
No	Vehicles < Workers	No
No	Vehicles < Workers	Yes
No	Vehicles Workers	No
No	Vehicles Workers	Yes
Yes	No	Yes or No
Yes	Vehicles < Workers	No
Yes	Vehicles < Workers	Yes
Yes	Vehicles Workers	No
Yes	Vehicles Workers	Yes

Household Types for Nonworking Adult Trip Rates

Children	Vehicles	Workers
No	No	No
No	No	Yes
No	Vehicles Workers	Yes
No	Vehicles > 0	No
No	Vehicles > Workers	Yes
Yes	No	Yes or No
Yes	Vehicles Workers	Yes
Yes	Vehicles > 0	No
Yes	Vehicles > Workers	Yes

Household Types for Children 12 - 15

Vehicles
No
Vehicles Workers
Vehicles > Workers

Trip Rate Aggregation by Household Types. The spreadsheet's completed worksheets (one for each person type) are trip rates tabulated by household trip generation category and the above trip purposes. The observations (persons from the CMAP survey) contributing to each rate were again examined. Trip rates that still had too few observations were identified and trip rates were averaged across households with comparable trip generation properties. The scheme for combining households resulted in eleven household categories of trip generation rates for workers, nine household categories for nonworking adults, and three categories for children aged twelve to fifteen as shown in Table 13.

Fraction of Children 12 through 15. To recapitulate, the trip generation model code considers all children in the household when categorizing households, but only children between twelve and fifteen are included in household trip generation. Earlier versions of the model required the fraction of children aged twelve to fifteen in a subzone to be input on the **HH_IN.TXT** file. This is a difficult quantity to determine let alone estimate, and the model code was rewritten to replace the input value with an internal calculation. The three-year ACS PUMS data was again used as source data and an array was added to the code containing the observed fraction of children aged twelve to fifteen for each of the household types that include children.

Home-Workplace Productions by Earnings. It has long been argued that modeling work travel in the CMAP models could be improved by categorizing workers and employment. This would link different types of workers with appropriate employment opportunities, either by earnings or by type of employment. This revision of the trip generation code takes a first step toward that objective.

The revised model code incorporates an array that contains the fraction of workers in a household earning above the median regional worker earnings. Values in the array depend on the type of household (the 224 household types in the model), which distinguishes households by income quartile and number of workers. This array allocates home to workplace productions to workers earning above and below median regional earnings. The three-year regional ACS PUMS data files were summarized to estimate these values.

Trip Rates. The household trip generation rates for workers, nonworking adults, and children aged twelve to fifteen are in Tables 14 through 16. All rates are weekday trips per person. Household categories matching those in Table 13 are in the top rows of the tables. These rates were calculated from sample observations and have some implied confidence intervals around them. Even though they are shown with three decimal places, most of the rates are reasonably accurate only to one or two significant figures. Trip purposes are numbered as they are in the model code. Trip purpose number two in the worker tables is a row reserved for splitting home-workplace trips by worker earnings.

Table 17. 1990 and Current Trip Rates

	1990 CATS Survey	2007-2008 CMAP Survey
Worker		
Home-Work	1.62	1.37
Home-Shop	0.33	0.35
Home-Other	0.77	0.91
Work-Shop	0.08	0.07
Work-Other	0.34	0.29
Work-Work	0.25	0.44
Other-Other	0.28	0.46
All Types	3.67	3.88
Nonworker		
Home-Shop	0.71	0.56
Home-Other	1.40	1.48
Other-Other	0.60	0.77
All Types	2.71	2.81
Child 12-15		
Home-Other	1.45	1.77

Stability of Trip Rates. It has long been assumed that trip generation rates are fairly stable. Table 17 is a comparison of household trip generation rates estimated from the 1990 CATS household travel survey ([7]) versus rates from the 2007-2008 CMAP survey. The trip categories in the table are the eleven trip categories in the existing CMAP models. It should be noted that the figures in the table are averaged across all types of households, so changes in rates between 1990 and the present reflect changes in household composition as well as travel behavior. Rates for the 1990 survey are also not the product of weighted households since household types were not combined to calculate these earlier rates.

In spite of the differences between the two sets of trip rates, the general impression is that the new CMAP survey based trip rates are somewhat larger but still roughly comparable to those estimated from the 1990 CATS survey. The most important change appears to be in home-work travel. Possible reasons for this include more persons working at home or a tendency away from the traditional home-workplace commute trip to more complex trip making whereby several trip purposes are linked during travel between work and home. Additional trips by nonworking adults are probably the result of increased household vehicle ownership, which means that nonworkers are increasingly likely to have access to vehicles. Additional trips by children are also probably at least partly the result of increased auto availability. However, increased travel by children in 2007-2008 may just reflect the timing of the two surveys. The

CMAP survey was taken in the fall and winter during the school term while the 1990 survey was taken at different times throughout the year.

Table 14a. Trip Generation Rates for Workers: Households Without Children

			Trip Generation Rate Household Types					
			Children = 0					
			Vehicles = 0		Vehicles < Workers		Vehicles □ Workers	
No.	Production or Origin	Attraction or Destination	Nonworkers = 0	Nonworkers > 0	Nonworkers = 0	Nonworkers > 0	Nonworkers = 0	Nonworkers > 0
1	Home (P)	Workplace (A)	1.055	1.083	1.080	1.126	1.147	1.187
3		Work-Related (A)	0.113	0.076	0.145	0.132	0.179	0.151
4		School (A)	0.016	0.030	0.046	0.096	0.029	0.073
5		Nonhome/Work at Residence (A)	0.159	0.089	0.133	0.149	0.144	0.149
6		Nonhome/Work Not at Residence (A)	0.684	0.440	0.821	0.494	0.804	0.740
7		Shop (A)	0.295	0.349	0.342	0.334	0.335	0.349
8	Work (P)	Nonhome/Work at Residence (A)	0.032	0.009	0.014	0.012	0.026	0.020
9		Nonhome/Work Not at Residence (A)	0.273	0.056	0.257	0.082	0.320	0.233
10		Shop (A)	0.081	0.038	0.068	0.045	0.097	0.065
11	Work (O)	Work (D)	0.072	0.047	0.087	0.101	0.181	0.139
12	Nonhome/Work at Residence (O)	Nonhome/Work at Residence (D)	0.007	0.000	0.004	0.004	0.012	0.009
13		Nonhome/Work Not at Residence (D)	0.022	0.009	0.025	0.011	0.025	0.024
14		Shop (D)	0.008	0.005	0.007	0.013	0.015	0.011
15	Nonhome/Work Not at Residence (O)	Nonhome/Work at Residence (D)	0.019	0.010	0.031	0.030	0.036	0.031
16		Nonhome/Work Not at Residence (D)	0.175	0.109	0.150	0.114	0.193	0.146
17		Shop (D)	0.088	0.084	0.104	0.064	0.116	0.080
18	Shop (O)	Nonhome/Work at Residence (D)	0.012	0.009	0.010	0.000	0.015	0.011
19		Nonhome/Work Not at Residence (D)	0.050	0.033	0.046	0.048	0.069	0.056
20		Shop (D)	0.044	0.009	0.079	0.068	0.092	0.071

Table 14b. Trip Generation Rates for Workers: Households With Children

			Trip Generation Rate Household Types				
			Children > 0				
			Vehicles = 0	Vehicles < Workers		Vehicles ≥ Workers	
No.	Production or Origin	Attraction or Destination	Nonworkers ≥ 0	Nonworkers = 0	Nonworkers > 0	Nonworkers = 0	Nonworkers > 0
1	Home (P)	Workplace (A)	0.954	1.149	1.052	1.133	1.236
3		Work-Related (A)	0.080	0.110	0.213	0.173	0.145
4		School (A)	0.060	0.094	0.159	0.041	0.072
5		Nonhome/Work at Residence (A)	0.118	0.149	0.129	0.134	0.107
6		Nonhome/Work Not at Residence (A)	0.494	0.840	0.707	0.844	0.745
7		Shop (A)	0.401	0.369	0.265	0.382	0.331
8	Work (P)	Nonhome/Work at Residence (A)	0.035	0.024	0.026	0.017	0.018
9		Nonhome/Work Not at Residence (A)	0.106	0.253	0.045	0.280	0.258
10		Shop (A)	0.067	0.061	0.010	0.084	0.051
11	Work (O)	Work (D)	0.019	0.111	0.106	0.143	0.136
12	Nonhome/Work at Residence (O)	Nonhome/Work at Residence (D)	0.009	0.010	0.030	0.003	0.004
13		Nonhome/Work Not at Residence (D)	0.019	0.018	0.033	0.027	0.016
14		Shop (D)	0.000	0.001	0.022	0.013	0.004
15	Nonhome/Work Not at Residence (O)	Nonhome/Work at Residence (D)	0.025	0.021	0.034	0.027	0.019
16		Nonhome/Work Not at Residence (D)	0.088	0.120	0.051	0.158	0.130
17		Shop (D)	0.057	0.061	0.105	0.091	0.073
18	Shop (O)	Nonhome/Work at Residence (D)	0.000	0.006	0.042	0.014	0.007
19		Nonhome/Work Not at Residence (D)	0.063	0.040	0.020	0.045	0.043
20		Shop (D)	0.139	0.055	0.069	0.081	0.049

Table 15a. Trip Generation Rates for Nonworking Adults: Households Without Children

			Trip Generation Rate Household Types				
			Children = 0				
			Vehicles = 0		Vehicles > Workers	Vehicles = Workers	Vehicles > 0
No.	Production or Origin	Attraction or Destination	Workers = 0	Workers > 0	Workers > 0	Workers = 0	Workers > 0
21	Home (P)	School (A)	0.034	0.164	0.244	0.016	0.251
22		Nonhome at Residence (A)	0.147	0.072	0.171	0.213	0.228
23		Nonhome Not at Residence (A)	0.884	0.719	0.808	1.366	1.009
24		Shop (A)	0.506	0.332	0.462	0.684	0.539
25	Nonhome at Residence (O)	Nonhome at Residence (D)	0.013	0.004	0.003	0.012	0.010
26		Nonhome Not at Residence (D)	0.018	0.005	0.021	0.038	0.039
27		Shop (D)	0.010	0.000	0.016	0.031	0.021
28	Nonhome Not at Residence (O)	Nonhome at Residence (D)	0.026	0.018	0.026	0.049	0.044
29		Nonhome Not at Residence (D)	0.112	0.082	0.147	0.342	0.233
30		Shop (D)	0.094	0.063	0.076	0.257	0.156
31	Shop (O)	Nonhome at Residence (D)	0.014	0.004	0.006	0.028	0.027
32		Nonhome Not at Residence (D)	0.059	0.040	0.052	0.137	0.085
33		Shop (D)	0.097	0.077	0.120	0.195	0.137

Table 15b. Trip Generation Rates for Nonworking Adults: Households With Children

			Trip Generation Rate Household Types			
			Children > 0			
			Vehicles = 0	Vehicles □ Workers	Vehicles > 0	Vehicles > Workers
No.	Production or Origin	Attraction or Destination	Workers □ 0	Workers > 0	Workers = 0	Workers > 0
21	Home (P)	School (A)	0.306	0.464	0.105	0.334
22		Nonhome at Residence (A)	0.181	0.174	0.325	0.219
23		Nonhome Not at Residence (A)	0.601	0.789	1.056	1.201
24		Shop (A)	0.479	0.340	0.742	0.553
25	Nonhome at Residence (O)	Nonhome at Residence (D)	0.017	0.013	0.026	0.007
26		Nonhome Not at Residence (D)	0.015	0.020	0.035	0.036
27		Shop (D)	0.025	0.009	0.033	0.014
28	Nonhome Not at Residence (O)	Nonhome at Residence (D)	0.008	0.030	0.048	0.039
29		Nonhome Not at Residence (D)	0.082	0.144	0.400	0.275
30		Shop (D)	0.116	0.096	0.187	0.157
31	Shop (O)	Nonhome at Residence (D)	0.012	0.012	0.024	0.012
32		Nonhome Not at Residence (D)	0.069	0.043	0.144	0.074
33		Shop (D)	0.078	0.060	0.120	0.104

Table 16. Trip Generation Rates for Children 12 Through 15

No.	Production or Origin	Attraction or Destination	Trip Generation Rate Household Types		
			Vehicles = 0	Vehicles □ Workers	Vehicles > Workers
34	Home (P)	School (A)	1.026	0.874	0.818
35		Nonhome at Residence (A)	0.217	0.178	0.178
36		Nonhome Not at Residence (A)	0.228	0.546	0.664
37		Shop (A)	0.150	0.110	0.193
38	School (P)	Nonhome at Residence (A)	0.078	0.042	0.028
39		Nonhome Not at Residence (A)	0.032	0.067	0.095
40		Shop (A)	0.016	0.013	0.027
41	Nonhome at Residence (O)	Nonhome at Residence (D)	0.014	0.012	0.008
42		Nonhome Not at Residence (D)	0.000	0.018	0.027
43		Shop (D)	0.040	0.005	0.007
44	Nonhome Not at Residence (O)	Nonhome at Residence (D)	0.000	0.032	0.017
45		Nonhome Not at Residence (D)	0.029	0.094	0.100
46		Shop (D)	0.056	0.018	0.042
47	Shop (O)	Nonhome at Residence (D)	0.008	0.008	0.007
48		Nonhome Not at Residence (D)	0.030	0.013	0.021
49		Shop (D)	0.046	0.018	0.021

Temporary File PRODS_HH.TXT. The subroutine that does the household trip generation writes a temporary file named **PRODS.HH.TXT** or **PRODS_P5_HH.TXT** when the control variable **PUMA_TG** is true. This file is kept after the model run is completed when the control variable **SAVE_FILE** is true, otherwise it is deleted.

There are forty-nine trip categories in this file, which are carried forward for the remaining calculations. The added trip category is due to the factoring of home-workplace trips into home-workplace trips for workers with less than median regional earnings and workers with greater than median earnings. Home-workplace trips are generated first using a single home-workplace rate. Then, the home-workplace trips by household type are factored using the proportion of high income workers by household type.

The format for this temporary file is listed in Table 18. This is a fixed format file with variables formatted as shown. The file contains four subzone household summaries varying with vehicle availability and the presence of children. These are followed by the worker trip categories, then trips for nonworkers, and finally trips made by children aged twelve through fifteen. The trip purposes are in order as listed in Tables 14 through 16.

Group Quarters Trip Generation

The CMAP survey did not gather travel data from any group quarters residences. The ACS does collect some limited information on persons in group quarters, including institutionalized and non-institutionalized persons. For trip generation, it is assumed that institutionalized persons do not travel independently, which means that group quarters trip generation applies only to individuals in dormitories, military barracks, group homes, and the like. A second assumption is that all children in group quarters are in institutions and do not travel independently.

Trip Generation Rates. Since group quarters trip generation rates could not be obtained from the CMAP survey, it is necessary to assume that they are similar to those of persons in households who resemble persons in group quarters. Rates for workers or nonworking adults in single person households without children or vehicles are thought to most closely match the rates for workers and nonworkers in group quarters. For these calculations, all workers in group quarters are assumed to be in the low income category.

Single person household rates are used for group quarters trip generation rates with the exception of the home-workplace trip. Journey to work data from 2006 and 2007 ACS PUMS data are available for non-institutionalized group quarters workers in the ACS household and person files for these two years. Persons in group quarters ACS PUMS data were tabulated by five percent PUMS to estimate the weekday home-workplace trips per group quarters worker. The fraction of PUMS group quarters workers commuting was doubled to approximate a trip rate for weekday home-workplace trips.

The fraction of all group quarters workers' commuting trips completed by nonmotorized modes was also obtained from the group quarters person records in the two years of ACS PUMS. These factors were also estimated at the level of five percent PUMAs. .

Table 18. PRODS_HH.TXT and PRODS_P5_HH.TXT Temporary Files

SUBZONE	Integer (I6)	Trip generation subzone (6 characters)
HH 0 CHILD, 0 VEH	Real Number (F12.4)	Households without children and without vehicles (12 characters, 4 decimal places)
HH CHILD, 0 VEH	Real Number (F12.4)	Households with children and without vehicles (12 characters, 4 decimal places)
HH 0 CHILD, VEH	Real Number (F12.4)	Households without children and with vehicles (12 characters, 4 decimal places)
HH CHILD, VEH	Real Number (F12.4)	Households without children and with vehicles (12 characters, 4 decimal places)
WORKER TRIP PURPOSE 1	Real Number (F12.4)	Home-workplace trips by workers with low earnings (12 characters, 4 decimal places)
WORKER TRIP PURPOSE 2	Real Number (F12.4)	Home-workplace trips by workers with high earnings (12 characters, 4 decimal places)
WORKER TRIP PURPOSE 3	Real Number (F12.4)	Home-work related trips by workers (12 characters, 4 decimal places)
. . . .	. . . .	. . . .
WORKER TRIP PURPOSE 19	Real Number (F12.4)	Shop-shop trips made by workers (12 characters, 4 decimal places)
NONWORKER TRIP PURPOSE 20	Real Number (F12.4)	Home-nonhome trips at residences by nonworking adults (12 characters, 4 decimal places)
NONWORKER TRIP PURPOSE 21	Real Number (F12.4)	Home-nonhome trips not at residences by nonworking adults (12 characters, 4 decimal places)
. . . .	. . . .	. . . .
NONWORKER TRIP PURPOSE 33	Real Number (F12.4)	Shop-shop trips made by nonworking adults (12 characters, 4 decimal places)
CHILD TRIP PURPOSE 34	Real Number (F12.4)	Home-nonhome trips at residences by children 12-15 (12 characters, 4 decimal places)
CHILD TRIP PURPOSE 35	Real Number (F12.4)	Home-nonhome trips not at residences by children 12-15 (12 characters, 4 decimal places)
. . . .	. . . .	. . . .
CHILD TRIP PURPOSE 49	Real Number (F12.4)	Shop-shop trips by children 12-15 (12 characters, 4 decimal places)

Group Quarters Input File. The subroutine that estimates group quarters trip generation reads an input file named **GQ_IN.TXT**. This is a comma delimited file with the format listed in Table 19. The group quarters home-workplace trip rates and fractions of group quarters persons commuting by nonmotorized means are entered into the model via this file. They were calculated within five percent PUMAs and the same values are repeated for all trip generation subzones in a PUMA. The nonmotorized fraction is the ratio of nonmotorized group quarters home-workplace commute trips to all group quarters home-workplace commute trips (a different definition than the auto mode share variable for household workers), and it is later used in the calculations that separate vehicular and nonmotorized trip ends.

Table 19. GQ_IN.TXT Input File

SUBZONE	Integer (1-25000)	The trip generation subzone, which must be in sequence in the file from low to high values.
GQ WORDERS	Integer	Non-institutionalized group quarters workers in the trip generation subzone.
GQ NONWORKERS	Integer	Non-institutionalized group quarters nonworkers in the trip generation subzone.
GQ WORKER WORK TRIP RATE	Real Number	Home-workplace trip generation rate for workers in group quarters.
GQ WORKER NON-MOTOR COMMUTE	Real Number	Fraction of all group quarters worker commute trips (excludes work at home) by nonmotorized modes.

Temporary File PRODS_GQ.TXT. The group quarters subroutine writes a temporary file named **PRODS_GQ.TXT**, which can be retained after the model run by setting the control variable **SAVE_FILE** to true. This file is nearly the same as **PRODS_HH.TXT** except it has fewer trip purposes because it lacks trips for children. For compatibility with the household file, a zero is placed in the second trip purpose for no group quarters high income home-workplace trips. The variables in this file are listed in Table 20.

ACS Journey to Work and Modeled Home-Workplace Trips. Since the CMAP survey was used to estimate the rates, it cannot be used to validate the resulting trip estimates. The other major source of data for the project, the ACS, has information only on the journey to work. Unfortunately, the journey to work questions on the census long-form deal with typical commuting during a week, which is not the same as reporting one's commute during a specific day. Table 21 compares the 2005-2007 three year average ACS journey to work figures with the modeled home-workplace trips.

In Table 21, work at home workers are removed from the ACS data to make the two sets of home-workplace trip more comparable. On the side of the table listing trip generation model estimates, home-workplace trips from persons in households and group quarters are totaled to be consistent with ACS workers. Counties that lie partially outside the modeled study area are again not included in the table.

Table 20. PRODS_GQ.TXT Temporary File

SUBZONE	Integer (I6)	Trip generation subzone (6 characters)
GQ WORKER TRIP PURPOSE 1	Real Number (F12.4)	Home-workplace trips by group quarters workers with low earnings. (12 characters, 4 decimal places)
ZERO	Real Number (F12.4)	Zero (12 characters, 4 decimal places)
GQ WORKER TRIP PURPOSE 3	Real Number (F12.4)	Home-work related trips by workers (12 characters, 4 decimal places)
. . . .	. . . .	. . . .
GQ WORKER TRIP PURPOSE 19	Real Number (F12.4)	Shop-shop trips made by workers (12 characters, 4 decimal places)
GQ NONWORKER TRIP PURPOSE 20	Real Number (F12.4)	Home-nonhome trips at residences by nonworking adults. (12 characters, 4 decimal places)
GQ NONWORKER TRIP PURPOSE 21	Real Number (F12.4)	Home-nonhome trips not at residences by nonworking adults (12 characters, 4 decimal places)
. . . .	. . . .	. . . .
GQ NONWORKER TRIP PURPOSE 33	Real Number (F12.4)	Shop-shop trips by nonworking adults (12 characters, 4 decimal places)

Table 21. ACS Journey to Work Trips and Modeled Home-Workplace Trips

	2005-2007 ACS Journey to Work			Modeled Home-Workplace Trips			
	Workers	Work at Home	ACS Commuters	Households	Group Quarters	Total	ACS/ Trip Generation
Chicago	1,203,063	40,638	1,162,425	1,416,714	5,857	1,422,571	0.82
Sub Cook	1,176,899	36,980	1,139,919	1,351,024	3,771	1,354,795	0.84
DuPage	466,098	20,651	445,447	533,874	2,866	536,740	0.83
Kane	235,466	9,599	225,867	272,079	277	272,356	0.83
Kendall	44,626	1,474	43,152	61,827	11	61,838	0.70
Lake	342,154	17,219	324,935	376,026	10,561	386,587	0.84
McHenry	154,228	7,836	146,392	180,208	24	180,232	0.81
Will	314,656	11,216	303,440	364,380	588	364,968	0.83
Grundy	22,122	778	21,344	25,357	0	25,357	0.84
Boone	23,669	1,058	22,611	58,954	0	58,954	0.38
DeKalb	50,768	1,510	49,258	55,606	1,056	56,662	0.87
Kankakee	47,330	1,439	45,891	56,893	362	57,255	0.80
Winnebago	134,092	4,083	130,009	157,248	168	157,416	0.83
Lake	211,988	4,385	207,603	245,495	792	246,287	0.84
Porter	75,220	2,767	72,453	90,255	834	91,089	0.80
LaPorte	49,002	1,633	47,369	57,544	3	57,547	0.82
Kenosha	75,512	1,956	73,556	86,659	340	86,999	0.85
Racine	92,960	2,214	90,746	104,045	9	104,054	0.87
Walworth	51,575	1,770	49,805	54,960	1,230	56,190	0.89
Total	4,771,428	169,206	4,602,222	5,549,148	28,749	5,577,897	0.83

The ACS journey to work and the modeled home-workplace trips should be in roughly the same ratio throughout the region. There should be fewer ACS journey to work movements than the bidirectional home production-workplace attraction model estimates, yet this ratio should be somewhat more than 50 percent because the ACS includes all work travel taking

place during a week while the CMAP survey records trips during one or two days. This is the case except for Boone and Kendall counties where the model estimates are inconsistent with the remainder of the modeled study area. Both counties are near the edges of the region and rapidly growing. The different years for the two sets of figures – the 2005-2007 average ACS versus the 2010 model target year – may partly explain why these two counties are so different from other counties.

Allocation of Nonhome Trip Ends

At this point in the logic of the CMAP trip generation model, all trips generated by persons residing inside the modeled study area – both in households and group quarters - are accounted for. We also know the location of the trip end for all home production ends of trips. What remains to be determined is where the nonhome trip ends are located. These are allocated to trip generation subzones in this step of the model.

The allocation process is not complicated. An attractiveness share is calculated for each subzone, which depending on the trip's purpose is some function of employment or households in the subzone. Since the Chicago CBD is atypical in its mix of employment, subzones within the CBD are weighted differently from non-CBD subzones. After totaling the shares for all subzones, trip ends are then proportionally allocated to subzones by these shares.

Employment Input File. An input file is read before the allocation of nonhome trip ends takes place. This file is named **ATTR_IN.TXT** and it is analogous to the input files for households and group quarters. It is another comma delimited file with the format shown in Table 22.

Table 22. ATTR_IN.TXT Input File

SUBZONE	Integer (1-25000)	The trip generation subzone, which must be in sequence in the file from low to high values.
RETAIL EMP	Integer	Retail employment in the trip generation subzone.
TOTAL EMP	Integer	Total employment in the trip generation subzone.
FRAC HIGH EARN	Real Number	The fraction of workers working in the subzone with earnings above the regional median worker earnings.

The two employment quantities are prepared by CMAP as part of the regional socioeconomic forecast. The fraction of higher income workers working in the subzone is a new input variable associated with this revision of the CMAP trip generation. In the file created for model development this variable was estimated from the 2000 CTPP, Table 2-19 of the Part 2 summaries by workplace. It is anticipated that a CTPP-like product will be prepared from the five year cumulative ACS and it will allow this variable to be updated. Employment figures for Indiana and Wisconsin are factored by the control variables **WI_EMPFACT** and **IN_EMPFACT** immediately after the file is read.

Subzone Shares of Trip Ends. One problem encountered in estimating the share of nonhome trip ends that each subzone should receive was caused by the different household sample rates

in the CMAP survey in Illinois and Indiana. In calculating household trip generation rates, this was ignored and a single regional expansion factor was calculated for each household type. This is not unreasonable since one would not expect rates for the same categories of individuals in the same types of household to differ by state. However, the different sample rates do affect trips made because travelers are far more likely to complete trips, and have both trip ends, in their state of residence. If a single household type expansion factor were applied for households from Illinois and Indiana then Indiana trips would be substantially under represented and Illinois trips slightly over expanded due to the higher household sample rate in Indiana. As a result new household expansion factors were calculated for the 224 household types within each state that respected the different household sampling rates.

The newly expanded trips from the CMAP survey were tabulated into three spreadsheets for workers, nonworking adults, and children ages twelve thorough fifteen. Each spreadsheet includes tables of nonhome trip ends by purpose and by five percent PUMAs, and the Chicago CBD. Additional columns in the spreadsheets have households, retail, non-retail and total employment in the same geographic areas.

Linear regressions were repeatedly run for the estimation data in the spreadsheets. In these regressions, different combinations of employment and households were the independent variables and trip ends the dependent variable. These regression provided guidance as to which dependent variables should be linked with which trip purposes for allocation. For the majority of trip purposes, a single independent household/employment variable proved adequate and logical, workplace purposes were linked with total employment, shop purposes with retail employment, and so forth. A minority of trip purposes were linked to linear combinations of retail and non-retail employment.

When a single independent household/employment variable is used for the allocation, its weight is the average trip ends per type of employment or average trip ends per household. The weights are needed in this case only because separate averages are calculated for CBD and non-CBD subzones. When the allocation is a linear combination of retail and non-retail employment, the result is also weighted differently for CBD and non-CBD subzones. The added trip purposes carried through the calculations greatly simplify the linking of trip ends to household/employment variables.

Weights for allocation of nonhome productions or attractions are listed in Table 23. Table 24 is a similar table listing the weights for allocation of nonhome attractions or destinations. After workplace attractions are allocated, they are factored into workplace attractions for workers with above and below median earnings by the factors in the **ATTR_IN.TXT** input data set.

Table 23. Weights for Allocation of Production or Origin Nonhome Trip Ends

Production or Origin	Attraction or Destination	Households		Employment					
				Retail		Non-Retail		Total	
		CBD	Non-CBD	CBD	Non-CBD	CBD	Non-CBD	CBD	Non-CBD
Worker									
	Nonhome/Work at Residence (A)							0.018	0.018
Work (P)	Nonhome/Work Not at Residence (A)							0.399	0.217
	Shop (A)							0.087	0.070
Work (O)	Work (D)							0.093	0.140
Nonhome/Work at Residence (O)	All Destinations (D)	0.109	0.062						
Nonhome/Work Not at Residence (O)				1.591	1.356	0.017	0.064		
Shop (O)				0.684	1.070				
Nonworking Adult									
Nonhome at Residence (O)	All Destinations (D)	0.050	0.053						
Nonhome Not at Residence (O)				1.047	1.531	0.006	0.015		
Shop (O)				0.472	1.119				
Child 12-15									
School (P)	All Attractions (A)				0.786		0.022	0.011	
Nonhome at Residence (O)	All Destinations (D)	0.019	0.036						
Nonhome Not at Residence (O)					0.786		0.022	0.011	
Shop (O)				0.042	0.346				

Table 24. Weights for Allocation of Attraction or Destination Nonhome Trip Ends

		Employment Category							
		Households		Retail		Non-Retail		Total	
Production or Origin	Attraction or Destination	CBD	Non-CBD	CBD	Non-CBD	CBD	Non-CBD	CBD	Non-CBD
Worker									
Home (P)	Workplace (A)							1.307	0.975
	Work-Related (A)			0.592	0.559	0.054	0.074		
	School (A)			3.340	3.879	0.068	0.216		
	Nonhome/Work at Residence (A)	0.363	0.170						
	Nonhome/Work Not at Residence (A)			3.340	3.879	0.068	0.216		
	Shop (A)			0.891	2.127				
Work (P)	Nonhome/Work at Residence (A)	0.129	0.025						
	Nonhome/Work Not at Residence (A)			0.456	0.924	0.327	0.117		
	Shop (A)			1.224	0.454				
Work (O)	Work (D)							0.093	0.140
All Origins (O)	Nonhome/Work at Residence (D)	0.109	0.062						
	Nonhome/Work Not at Residence (D)			1.591	1.356	0.017	0.064		
	Shop (D)			0.684	1.070				
Nonworking Adult									
Home (P)	School (A)				3.550		0.266	0.190	
	Nonhome at Residence (A)	0.100	0.197						
	Nonhome Not at Residence (A)				3.550		0.266	0.190	
	Shop (A)			0.545	2.218				
All Origins (O)	Nonhome at Residence (D)	0.050	0.053						
	Nonhome Not at Residence (D)			1.047	1.531	0.006	0.015		
	Shop (D)			0.472	1.119				
Child 12-15									
Home (P)	School (A)			0.644	3.346	0.006	0.233		
	Nonhome at Residence (A)	0.152	0.134						
	Nonhome Not at Residence (A)			0.644	3.346	0.006	0.233		
	Shop (A)			0.073	0.820				
School (P)	Nonhome at Residence (A)	0.019	0.036						
	Nonhome Not at Residence (A)				0.786		0.022	0.011	
	Shop (A)			0.042	0.346				
All Origins (O)	Nonhome at Residence (D)	0.019	0.036						
	Nonhome Not at Residence (D)				0.786		0.022	0.011	
	Shop (D)			0.042	0.346				

Optional Output File FIRST_PA.TXT. If the **SAVE_FILE** control variable is true an optional file is written with the household and group quarters trip ends - productions/origins and attractions/destinations at this point in the model. This file is in a fixed format designed to be

easily read by commercial data base management software. There is one record per subzone as shown in Table 25. The group quarters variables are zero for the second (high income home-workplace) trip type and for trip types 34-49 (child trip types).

Table 25. FIRST_PA.TXT Optional File

SUBZONE	Integer (I6)	Trip generation subzone (1-25000) (6 characters)
ZONE	Integer (I6)	Modeling zone number (1-5000) (6 characters).
TRIP TYPE	Integer (I2)	Trip type (1-49) as per Tables 14-16 (2 characters).
HH PRODS	Real Number (F9.1)	Household productions/origins for trip type (9 characters, 1 decimal place)
HH ATTRS	Real Number (F9.1)	Household attractions/destinations for trip type (9 characters, 1 decimal place)
GQ PRODS	Real Number (F9.1)	Group quarters productions/origins for trip type (9 characters, 1 decimal place)
GQ ATTRS	Real Number (F9.1)	Group quarters attractions/destinations for trip type (9 characters, 1 decimal place)

External Trip Ends

After accounting for all trips made by study area residents, the next step is to factor out trip ends for trips with one trip end outside the modeled study area. In the model, only home-workplace trips for households are factored in this manner. This is largely due to data limitations. The CMAP survey sample is far too small for any reliable estimation of these factors and only the CTPP commuting data are available. Additionally, home-workplace trips are lengthier than other trip purposes and more likely to have one trip end outside the area modeled. Trips by persons residing in group quarters are not factored for external trip ends.

A summary home-workplace table was first developed from the 2000 CTPP Table 3.1. This table contains the home to workplace commutes for workers by five percent PUMAs. After removing workers who work at home, the table has three components for workers who travel to work and who: (1) live and work inside (internal-internal) the modeled study area; (2) live outside (external) the study area, but work inside (internal) inside the study area, and; (3) live inside (internal) the study area, but work outside (external) the study area.

External trip factors to adjust the home productions and workplace attractions in a five percent PUMA were developed from the table in the following manner. The home production factor is the fraction of all trips from internal households (internal-internal plus internal-external) linked to external workplaces (internal-external), and the workplace attraction factor is the fraction of all trips to internal workplaces (internal-internal plus external-internal) that are linked to external households (external-internal). Home productions in five percent PUMS are factored first followed by workplace attractions. Finally, workplace attractions are factored at the regional level to equal home productions.

External Trip Factor Input File. These external trip factors are entered in a new model input file named **EXT_IN.TXT.** This is a comma delimited with one record for every five percent PUMA with the variables listed in Table 26.

Table 26. EXT_IN.TXT Input File

FIVE PERCENT PUMA	Integer	Six digit numeric code for five percent PUMAs (two digit county FIPS code plus four digit code for five percent PUMA).
EXT PROD FACT	Real Number	Fraction of home productions in home-workplace trips linked to external workplace attractions.
EXT ATTR FACT	Real Number	Fraction of workplace attractions in home-workplace trips linked to external home productions.

Optional File EXTERNAL_PA.TXT. An optional output file with the externally linked trip ends is written when **SAVE_FILE** is true. These external trips should be helpful when creating trip tables between points of entry into the modeled study area and zones. This fixed format file has the variables in the format listed in Table 27.

Table 27. EXTERNAL_PA.TXT Optional File

SUBZONE	Integer (I6)	Trip generation subzone (1-25000) (6 characters)
ZONE	Integer (I6)	Modeling zone number (1-5000) (6 characters).
TRIP TYPE	Integer (I2)	Trip type (1-2 for home–workplace purposes) (2 characters).
EXT PRODS	Real Number (F9.1)	Household productions linked to workplaces outside the modeled study area. (9 characters, 1 decimal place)
EXT ATTRS	Real Number (F9.1)	Workplace attractions linked to households outside the modeled study area. (9 characters, 1 decimal place)

Optional Output File SECOND_PA.TXT. If the **SAVE_FILE** control variable is true, a second optional file is written by the external trips subroutine that contains the household trip productions/origins and attractions/destinations after removing external trip ends. Note that the production/origins and attractions/destinations for persons in group quarters are excluded from the external trip factoring and at this point do not change from the values in Table 25.

Table 28 lists the format for the **SECOND.PA.TXT** file. It is in the standard fixed format used previously for similar files (Table 25 and Table 27).

Table 28. SECOND_PA.TXT Optional File

SUBZONE	Integer (I6)	Trip generation subzone (1-25000) (6 characters)
ZONE	Integer (I6)	Modeling zone number (1-5000) (6 characters).
TRIP TYPE	Integer (I2)	Trip type (1-49) as per Tables 14-16 (2 characters).
HH PRODS	Real Number (F9.1)	Household trip productions/origins for trips within the modeled study area. (9 characters, 1 decimal place)
HH ATTRS	Real Number (F9.1)	Household trip attractions/destinations for trips within the modeled study area. (9 characters, 1 decimal place)

Nonmotorized Submodels

The final product of the CMAP trip generation model is person trip ends for vehicular trips wholly within the modeled area. The remaining step in the model is, therefore, to estimate and remove person trips that are made by nonmotorized modes. New nonmotorized mode choice models were developed in this model revision for this purpose.

Nonmotorized Vehicular Mode Choice. The nonmotorized submodels are all binary choice models that forecast the proportion of trip productions/origins that will be completed by nonmotorized modes. It is assumed that nonmotorized trips take place within a subzone or more generally that the nonmotorized productions/origins equals the nonmotorized attractions/destinations in the subzone.

Expanded trips from the CMAP survey were tabulated by vehicular and nonmotorized modes by trip purpose for five percent PUMAs and the Chicago CBD. Independent variables suspected of affecting nonmotorized-vehicular mode choice were next added to these tables, including: (1) households and employment variables; (2) zero vehicle households; (3) weighted average pedestrian environmental factor, and; (4) area in square miles for computing household and employment densities. The weighted average pedestrian environmental factor was calculated by weighting the subzone pedestrian environmental factors within a five percent PUMA by their area.

Fairly simple aggregate logit models were then estimated from the quantities in these spreadsheets using the ALOGIT program. The combined home-workplace and home-work related nonmotorized submodel was also re-estimated using nonmotorized commuting proportions tabulated from the ACS PUMS data. There proved to be little difference between the two work submodels estimated with CMAP survey and ACS data, but the ACS submodel was coded into the trip generation model only because the ACS has a much larger sample of households.

The nonmotorized submodels plus their nonmotorized utility coefficients and vehicular bias are listed in Table 29.

Table 29. Utility Variables in the Nonmotorized Submodels

		Nonmotorized Utility Variables						
		Employment/ Area (1000's)	Pedestrian Environment Factor	No Vehicle Households/ All Households	Households/ Area (1000's)	Vehicle Bias	ρ^2 with respect to zero	ρ^2 with respect to constants
Worker								
Home	Workplace Work-Related	0.0799	0.0129	2.598		4.237	0.797	0.081
	Nonwork	0.0023	0.0724	2.398		4.133	0.632	0.131
Work	Nonhome	0.0089	0.0850			4.236	0.577	0.343
Nonhome/Work	Non-Home/Work	0.0082	0.0380		0.1380	3.835	0.656	0.224
Nonworking Adult								
Home	Nonhome		0.0551	1.530		3.399	0.546	0.077
Nonhome	Nonhome	0.0024	0.0855		0.0831	4.396	0.638	0.204
Child 12-15								
Home	Nonhome		0.0535			2.383	0.314	0.045
Nonhome	Nonhome		0.0625			3.137	0.498	0.059

As noted, these submodels are binary choice models (nonmotorized versus motorized) applied at the geographic level of subzones. They also are applied to fewer aggregate trip types, partly to increase the nonmotorized observations used for estimating each submodel. Independent variables are as follows:

1. The two density variables in the nonmotorized utility are average total employment and households per square mile within the subzone.
2. The pedestrian environment factor was input into the model in an earlier step.
3. The no vehicle household fraction is determined internally within the model by the submodel for household vehicle availability.
4. The utility for the vehicular choice is a constant in all the models and is essentially treated as bias toward the motorized choice.

The nonmotorized submodels implemented in the trip generation code are also bounded by the highest observed percentages of nonmotorized trips, the average nonmotorized fraction of trips in the Chicago CBD.

Optional Output File NONMOTOR_PA.TXT. The subroutine for the nonmotorized calculations can also output and optional file with the nonmotorized trip ends. This file is the **NONMOTOR_PA.TXT** file. It is another fixed format file similar to earlier output files of productions/origins and attractions/destinations. Variables in the **NONMOTOR_PA.TXT** file are listed in Table 30.

For households, the nonmotorized trip productions/origins should equal nonmotorized attractions/destinations except when the latter have been adjusted due to too few attractions in the subzone. The nonmotorized productions/origins for persons in group quarters always equal the nonmotorized attractions/destinations.

Table 30. NONMOTOR_PA.TXT Optional File

SUBZONE	Integer (I6)	Trip generation subzone (1-25000) (6 characters)
ZONE	Integer (I6)	Modeling zone number (1-5000) (6 characters)
TRIP TYPE	Integer (I2)	Trip type (1-49) as per Tables 14-16 (2 characters)
HH NM PRODS	Real Number (F9.1)	Household nonmotor productions/origins for trips within the modeled study area. (9 characters, 1 decimal place)
HH NM PRODS FRAC	Real Number (F6.3)	Household nonmotor productions/origins as a fraction of all household productions/origins. (6 characters, 3 decimal places)
HH NM ATTRS	Real Number (F9.1)	Household nonmotor attractions/destinations for trips within the modeled study area. (9 characters, 1 decimal place)
HH NM ATTRS FRAC	Real Number (F6.3)	Household nonmotor attractions/destinations as a fraction of all household attractions/destinations. (6 characters, 3 decimal places)
GQ NM TRIP P/A	Real Number (F9.1)	Group quarters nonmotor trip ends (productions/origins equal attractions/destinations). (9 characters, 1 decimal place)
GQ NM PRODS FRAC	Real Number (F6.3)	Group quarters nonmotor productions/origins as a fraction of all Group quarters productions/origins. (6 characters, 3 decimal places)
GQ NM ATTRS FRAC	Real Number (F6.3)	Group quarters nonmotor attractions/destinations as a fraction of all Group quarters attractions/destinations. (6 characters, 3 decimal places)

Final Reports and Trip Output Files

The last subroutine in the model code writes the final trip reports into **TG_OUTPUT.TXT.** It also creates an output file for use in the remaining CMAP models. The trip types included in this file are either the current CMAP model's eleven trip purposes or the expanded forty-nine purposes that are carried in this revision of the trip generation model. The control variable **EXP_TTYPE** determines the number of trip purposes included in this file.

The output files with the final vehicular trip ends for internal trips for all residents in the modeled study area are named either **TRIP49_PA.TXT** or **TRIP11_PA.TXT**, depending on the number of trip purposes requested by the user. Regardless of naming, the file is in by now familiar fixed format previously used. Variables in these output files are listed in Table 31.

Table 31. TRIP11_PA.TXT or TRIP49_PA.TXT Final Trip Ends File

SUBZONE	Integer (I6)	Trip generation subzone (1-25000) (6 characters)
ZONE	Integer (I6)	Modeling zone number (1-5000) (6 characters)
TRIP TYPE	Integer (I2)	Trip type (1-11 when **EXP_TTYPE**= false, or 1-49 when **EXP_TTYPE**= true). (2 characters)
HH PRODS	Real Number (F9.1)	Household trip productions/origins for trips within the modeled study area. (9 characters, 1 decimal place)
HH ATTRS	Real Number (F9.1)	Household trip attractions/destinations for trips within the modeled study area. (9 characters, 1 decimal place)

Correspondence between the forty-nine expanded trip purposes and the eleven current CMAP trip purposes is shown in the concluding Table 32.

Table 32. Correspondence Between Expanded and Current Trip Purposes

Expanded Trip Purposes			Current CMAP Trip Purposes		
1	**Worker**	Workplace-Low Income (A)	1	Home (P)	Work (A)
2		Workplace-High Income (A)			
3		Work-Related (A)			
4	Home (P)	School (A)			
5		Nonhome/Work at Residence (A)	3		Nonhome/Work (A)
6		Nonhome/Work Not at Residence (A)			
7		Shop (A)	2		Shop (A)
8	Work (P)	Nonhome/Work at Residence (A)	5	Work (P)	Nonhome/Work (A)
9		Nonhome/Work Not at Residence (A)			
10		Shop (A)	4		Shop (A)
11	Work (O)	Work (D)	6	Work (O)	Work (D)
12	Nonhome/Work at Residence (O)	Nonhome/Work at Residence (D)	7	Nonhome/Work (O)	Nonhome/Work (D)
13		Nonhome/Work Not at Residence (D)			
14		Shop (D)			
15	Nonhome/Work Not at Residence (O)	Nonhome/Work at Residence (D)			
16		Nonhome/Work Not at Residence (D)			
17		Shop (D)			
18	Shop (O)	Nonhome/Work at Residence (D)			
19		Nonhome/Work Not at Residence (D)			
20		Shop (D)			
21	**Nonworking Adult**	School (A)	1	Home (P)	Work (A)
22	Home (P)	Nonhome at Residence (A)	99		Nonhome (A)
23		Nonhome Not at Residence (A)			
24		Shop (A)	8		Shop (A)
25	Nonhome at Residence (O)	Nonhome at Residence (D)	10	Nonhome (O)	Nonhome (D)
26		Nonhome Not at Residence (D)			
27		Shop (D)			
28	Nonhome Not at Residence (O)	Nonhome at Residence (D)			
29		Nonhome Not at Residence (D)			
30		Shop (D)			
31	Shop (O)	Nonhome at Residence (D)			
32		Nonhome Not at Residence (D)			
33		Shop (D)			
34	**Child 12-15**	School (A)	11	Home (P)	Nonhome (A)
35	Home (P)	Nonhome at Residence (A)			
36		Nonhome Not at Residence (A)			
37		Shop (A)			
38	School (P)	Nonhome at Residence (A)			
39		Nonhome Not at Residence (A)			
40		Shop (A)			
41	Nonhome at Residence (O)	Nonhome at Residence (D)			
42		Nonhome Not at Residence (D)			
43		Shop (D)			
44	Nonhome Not at Residence (O)	Nonhome at Residence (D)			
45		Nonhome Not at Residence (D)			
46		Shop (D)			
47	Shop (O)	Nonhome at Residence (D)			
48		Nonhome Not at Residence (D)			
49		Shop (D)			

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[7]. Christopher, Ed J., Alan R. Fijal, and Anne C. Ghislandi. CATS 1990 Household Travel Survey: A Methodological Overview. *Working Paper 94-05.* April 1994.

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FY14-0109

CMAP

GO TO 2040
UPDATE APPENDIX



Public Engagement Summary

October 2014

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Introduction

As part of the federally mandated update to metropolitan Chicago's GO TO 2040 comprehensive regional plan, the public must be afforded an opportunity to provide input on the process and resulting updated plan documents. Therefore, a public comment period was conducted by the Chicago Metropolitan Agency for Planning (CMAP) from June 13, 2014 through August 1, 2014. The comment period was designed to ensure adequate feedback from stakeholders and the general public on the draft GO TO 2040 plan update, as well as the proposed Federal Fiscal Year (FFY) 2014-19 Transportation Improvement Program (TIP).

This outreach appendix:

- Provides background about the public comment process.
- Describes the outreach methods employed and the resulting participation.
- Summarizes the comments received, as well as CMAP's responses to the public input.

Background

A hallmark of CMAP's work has been its emphasis on public participation, and this was a key component throughout the development of the original GO TO 2040 plan, which involved thousands of residents and stakeholders in setting a vision and priorities for the seven-county northeastern Illinois region. Leading up to the adoption of GO TO 2040 by CMAP's Board and Metropolitan Planning Organization (MPO) Policy Committee in October 2010, a public comment period (similar to this year's effort) was conducted to garner feedback on the draft plan. CMAP reached out to hundreds of stakeholders in 2010 and received over 1,000 comments about GO TO 2040's major themes and recommendations, which helped shape the plan into the strong document that guides the region today.

Federal law under Moving Ahead for Progress in the 21st Century (MAP-21) mandates CMAP's continued adherence to the previous public engagement guidelines for metropolitan transportation plans, which is consistent with CMAP's 2013 Public Participation Plan. These guidelines dictate that all interested parties must have a reasonable opportunity to provide input for a comment period of no less than 45 calendar days, with public meetings conducted at accessible and convenient times and locations, and with plan materials available for public viewing via electronic formats and using visual techniques. The outreach process described in the following sections was performed with these requirements in mind.

Select revisions were made to the plan update based on public comments received. In October 2014, the plan was updated per federal requirements.

Outreach Process

Prior to the 50-day public comment period that commenced on June 13, 2014, numerous outreach techniques were employed to alert the public about the plan update and solicit their feedback. The philosophy behind this outreach effort was to engage CMAP's existing network, rather than endeavor to forge an abundance of new partnerships (as was necessary leading up to the original GO TO 2040 plan's adoption). Through the outreach methods described as follows, both regional stakeholders and the broader public were engaged and encouraged to participate in the plan update process.

Outreach Methods

Starting in fall 2013, an outreach strategy was devised for engaging the public in the plan update process. As the plan update was being developed, the technical elements and draft summary were shared with, and vetted by, CMAP working committees, the Board, and the MPO Policy Committee. Using a variety of communication methods, CMAP staff utilized the agency's broad existing network to notify stakeholders and the general public about opportunities to participate in the forthcoming comment period.

CMAP Committees and Partners

Once the plan update and technical appendices were drafted in spring 2014, staff began to inform each CMAP working committee – including the Citizens Advisory Committee – about the upcoming public comment period at meetings and through meeting materials. CMAP staff asked working committee members, many of whom represent important partner organizations and agencies, to spread the word in turn about the public comment period through their own organizational networks. Additionally, a letter was mailed to all County Board Chairs across the region, inviting their respective boards to provide input and offering to attend meetings to discuss the plan update at each board's discretion.

Subregional Councils

With their local knowledge of community activities and issues, the Planning Liaisons (PLs) who staff the subregional councils across the seven-county region created the ideal network for notifying local leadership (and in turn, their constituents) about the draft plan update. The network of PLs also provides geographic coverage across the seven counties, and the councils presented a logical way to organize public meetings for the public comment period. Therefore, the PLs were integral to arranging and announcing the comment period's series of open house meetings, spreading the word to their respective local leadership by making meeting announcements, posting on on-line calendars, and/or sending emails and mailing flyers. PLs attended the meetings that they helped to organize and provided valuable local perspective in many instances.

General Public

Many private citizens have been engaged with CMAP's work in years past, though some members of the general public are not familiar with CMAP and GO TO 2040. Using both electronic and print communication methods, CMAP staff aimed to strike a balance between investing time wisely to target individuals within the agency's network, while also making plan update information available and easy to find.

To that end, CMAP ran legal notices in a number of printed newspaper publications across the Chicago region, including the Chicago Sun-Times local papers, the Daily Herald, and the Northwest Herald. These notices ran over 30 days prior to the formal public hearing (held July 31, 2014), and this general circulation in printed media was intended to reach those members of the public who may not be regular Internet users.

Electronic Communications

Beyond meeting announcements, formal letter invitations to regional leaders, and printed newspaper notices, the main outreach method used prior to and during this public comment period was electronic communication. The plan update has its own dedicated page on the CMAP website, which housed important details about public participation and was available to anyone with access to the Internet. The draft plan update's webpage (http://www.cmap.illinois.gov/about/2040/update) had 699 page views – 483 of them unique – during the length of the entire public comment period.

CMAP began including information in its Weekly Update e-blast – which is electronically sent to approximately 14,000 stakeholders each week – about the forthcoming public comment period starting in spring 2013. That e-blast became a vehicle for sharing details about each upcoming public meeting at least a week in advance. Additionally, CMAP staff used its database, with thousands of stakeholder contacts, to send out geographic-specific e-blasts at least a week before each public meeting, such that people in CMAP's database would receive a reminder email about the upcoming meeting most convenient to their location.

Expanding upon this outreach through CMAP's existing network, staff also reached out to specific organizations representing populations that historically have not always had a voice in planning processes. For instance, members of CMAP's working committees who serve underrepresented populations were asked specifically to share plan update information with their constituents. Additionally, CMAP has built a network of organizations that represent Latino communities around the region. Staff translated the plan update public outreach messaging into Spanish and distributed it to those organizations to encourage participation.

Public Input Formats and Participation

CMAP solicited public comments through a variety of vehicles to accommodate varied schedules and preferred modes of communication. All comments received are considered and valued equally, no matter the format of submission. This description of input formats explains the ways in which interested parties participated in the plan update process throughout the public comment period.

Public Meetings

Public meetings were geographically distributed around the Chicago region in order to provide all residents of the seven-county area with adequate and convenient opportunities to participate in the plan update process. A logical way to organize these meetings for maximum geographic coverage was to work with the PLs, who serve as a bridge between CMAP and the councils of mayors, and have strong networks to reach the mayors and managers in their areas. It was therefore determined by geography that a total of ten public open house meetings in addition to one formal public hearing would be held during this public comment period. The public meeting details are displayed in Table 1 (on page 6).

The location and time of day for each of the public meetings was selected with participants' convenience and accessibility in mind. To the extent possible, CMAP and the PLs worked to schedule the meetings at locations that were familiar and inviting, were accessible by different transportation modes (i.e. – are near transit service, or with available parking), and were convenient for typically underrepresented populations. Meetings were held during the late afternoon to early evening hours on weeknights, which is commonly the most convenient time for members of the general public to attend public meetings outside of typical work hours.

Since the purpose of the public comment period was to provide information and gather feedback on the drafted plan update, an "open house" meeting format was a suitable method of public engagement. Attendees were encouraged to arrive at any time and stay as long as they were able during the posted open house meeting hours. Visual aids and posters were displayed, summarizing the policy recommendations and implementation activities of the four themes in GO TO 2040. Several hard copies of the draft plan update summary and supporting appendices were available for participants to read in more detail and take home. CMAP staff were also available to answer questions, and comment cards were provided for attendees to write and submit formal written comments during the meeting.

Approximately 220 people attended these public meetings in total, and about 25 comment cards were submitted during the course of the public meetings. The final public meeting was a hearing – which included a formal oral comment session – and 11 people gave oral testimony that was recorded and transcribed by CMAP staff.

Table 1. Public Meeting Date and Location Details

Lake County
Tuesday, July 17, 2014
Lake County Division of Transportation
(600 W. Winchester Rd., Libertyville, IL 60048)
Attendance: 11

South Cook County
Thursday, June 19, 2014
South Suburban Mayors and Managers Assoc.
(1904 W. 174th St., East Hazel Crest, IL 60429)
Attendance: 17

Will County
Monday, June 23, 2014
New Lenox Village Hall
(1 Veterans Parkway, New Lenox, IL 60451)
Attendance: 28

Southwest Cook County
Tuesday, June 24, 2014.
Palos Hills City Hall
(10335 South Roberts Rd., Palos Hills, IL 60465)
Attendance: 8

DuPage County
Municipal Leaders Meeting, Public Open House
Wednesday, June 25, 2014
DuPage County Administration Building
(421 N. County Farm Rd., Wheaton, IL 60187)
Attendance Total: 34

West Central Cook County
Wednesday, July 9, 2014
LaGrange Village Hall
(53 S. LaGrange Rd., LaGrange, IL 60525)
Attendance: 16

Northwest / North Central Cook County
Thursday, July 10, 2014
Arlington Heights Village Hall
(33 S. Arlington Heights Rd., Arlington Heights, IL 60005)
Attendance: 18

Kendall County
Monday, July 14, 2014
Historic County Courthouse
(109 W. Ridge St., Yorkville, IL 60560)
Attendance: 7

Kane County
Tuesday, July 15, 2014
Kane County Government Center
(719 S. Batavia Ave., Geneva, IL 60134)
Attendance: 17

McHenry County
Thursday, July 17, 2014
McHenry County Administration Building
(667 Ware Rd., Woodstock, IL 60098)
Attendance: 23

Central Cook County – Public Hearing
Public Open House, Oral Comment Session
Thursday, July 31, 2014
Chicago Metropolitan Agency for Planning
(233 S. Wacker Dr., Chicago, IL 60606)
Attendance: 41

On-line Comment Form

Another primary method available for collecting input during this public comment period was electronically through an on-line form on the CMAP website. This on-line comment form included links to the draft plan update summary and appendices so that interested parties could download and review the draft update materials and then share input from the same webpage at their convenience. This input format facilitated participation from those people who were interested in the update process but were unable to attend one of the public meetings.

Nearly 60 on-line comments were received, ranging from topics across the major themes of GO TO 2040.

Other Comment Types

CMAP staff also accepted comments in the form of e-mails, hard copy letters, phone calls, and faxes. Individuals, organizations, and units of government submitted over 50 comments in these various formats. These included communications with CMAP partners that had direct feedback on specific areas of the plan update.

One distinct category of comments received was form letters – standardized, project-specific messages from individuals who were galvanized by the advocacy of a nonprofit organization about a given topic. Some individuals customized their comment to express a personal sentiment, but the vast majority of these comments were identical in content. These comments were either submitted one-by-one directly to a designated CMAP staff person over email, or were collected by the organization and submitted in bulk at the close of the comment period. Table 2 summarizes the organizations, issues, and number of form letters received.

Table 2. Form Letter Comments

Organizational Membership	Issue / Project of Concern	Number of Standardized Comments
Environmental Law and Policy Center	Opposes the Illiana Expressway	221
Midwest High Speed Rail Association	Supports the CrossRail Chicago project	660
Sierra Club – Illinois Chapter	Opposes the Illiana Expressway	401

As Table 2 shows, hundreds of form letter comments were generated to voice opinions about two specific transportation projects (discussed further on pages 10-11). The volume of form letters demonstrates the strength of these advocacy efforts, which are a welcome contribution to long-range transportation planning.

Input Summary and Results

In total, over 1,400 comments were received during the public comment period, the majority of which were form letters (see Table 2). The approximately 150 non-standardized comments spanned submission formats, as well as levels of detail and analysis. They were submitted by a

range of commenters – from private citizens to nonprofit organizations to various governmental entities – and comments were received from all across the region.

The geographic origin of all comments received during the public comment period – including form letters – is displayed in Figure 1. Nearly one third of all comments were submitted from outside of the CMAP region, most of which were form letters. Figure 2 focuses on the geographic origin of the approximately 150 non-standardized comments, which mostly came from people who live and work within the seven-county CMAP region. Of those comments, 60 percent originated in Cook County, followed by 18 percent submitted from Will County, and 12 percent submitted from the remaining collar counties.

Figure 1. Geographic Origin of All Comments

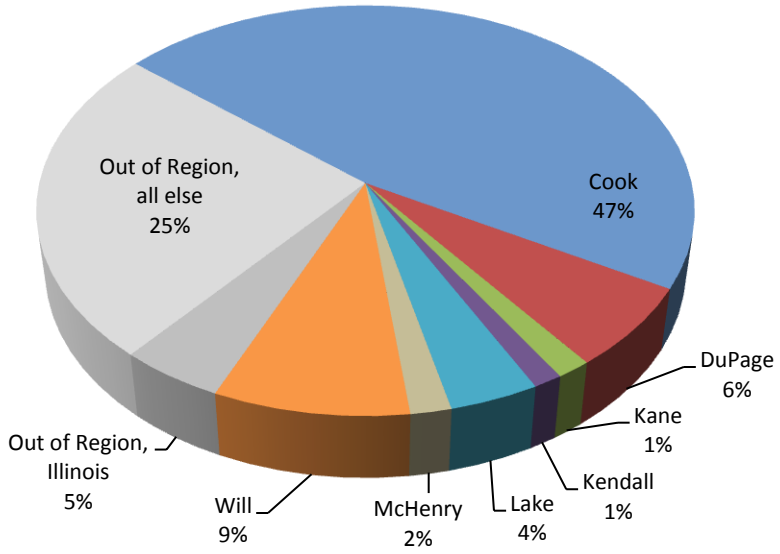
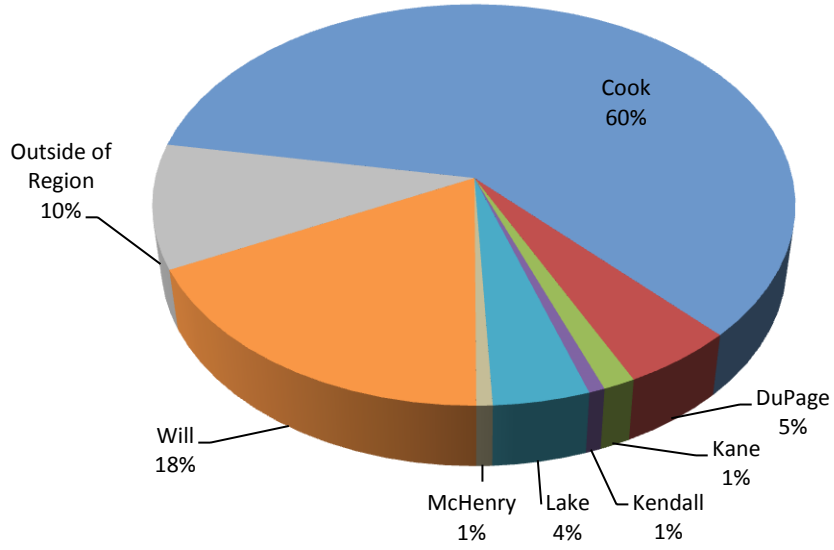


Figure 2. Geographic Origin of Comments, Excluding Form Letters



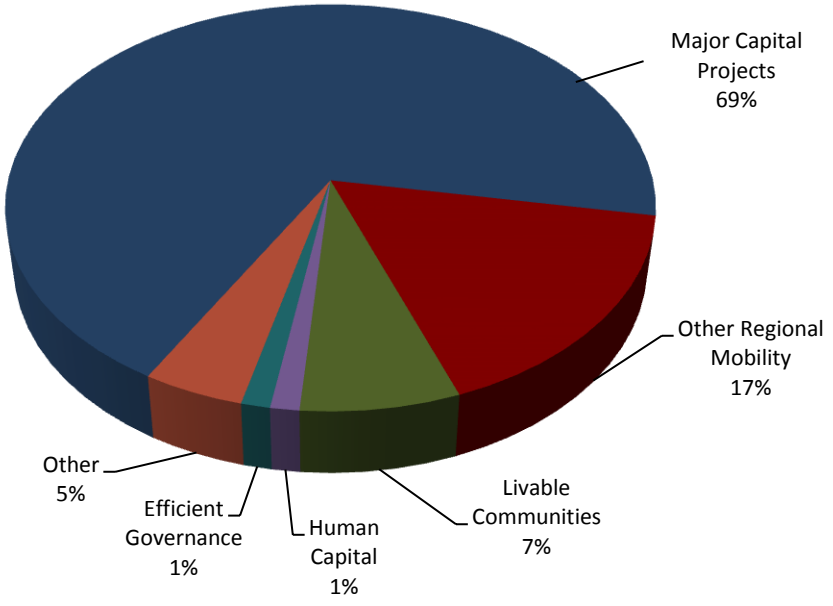
Description of Public Input

Many comments expressed an interest in principles already embedded into GO TO 2040, which reinforces the need for continued commitment to those issues. Several comments called for investing in the region's existing transportation system (with a particular support for public transit) before expanding or creating new transportation facilities. Similarly, many participants had thoughts and questions regarding the plan update's prioritization of advancing new sources of reasonably expected revenues to invest in our region's transportation system. Many comments offered suggestions for improving the implementation of recommendations already in GO TO 2040, from facilitating coordination around bicycle and pedestrian trailways planning to creating stronger stormwater management tools for local governments to use.

Other comments offered observations and made requests about specific elements of the draft plan update, which are examined further in the **Responses to Input** section. General support for CMAP's work was expressed by many commenters, from encouraging the exploration of additional funding sources to improve our region's transportation system to advocating for the continuation of the Local Technical Assistance (LTA) program.

While comments were received across all four themes of GO TO 2040, the majority pertained to transportation-related issues. Figure 3 displays the distribution of comments by plan theme, with a separate category for comments about major capital projects. This chart excludes the more the 1,200 form letters – which are addressed separately (pages 10-11) – in order to present a more balanced representation of the breadth of topics that were covered during the public comment period.

Figure 3. Comments by GO TO 2040 Plan Theme, Excluding Form Letters



A Focus on Transportation Projects

In total, the high volume of form letters focusing on two specific transportation projects shifted the overarching theme of public input toward a concern for major capital projects. Even excluding the form letters, this category of specific transportation projects – both on CMAP's list of major capital projects, as well as other roadway and transit projects – still comprised around two-thirds (or, approximately 100 comments) of the input received. Generally, people commented on the transportation projects located near where they live or work, which have the potential to directly influence their quality of life and mobility options.

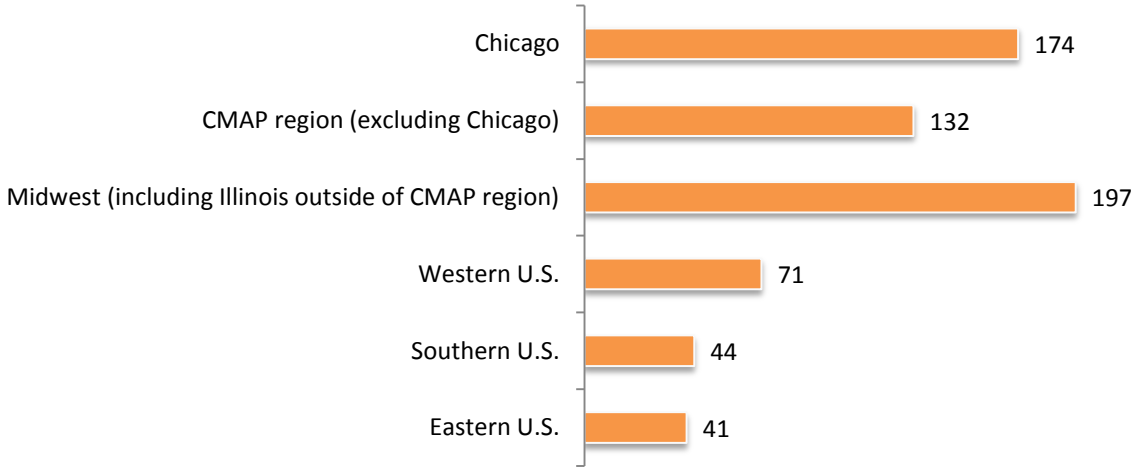
The plan update continues the same priorities of GO TO 2040. As such, the list of major capital projects includes the same set of projects under fiscal constraint as the original plan, minus three projects already completed (add lanes projects on portions of I-80, I-88, and I-94), plus two projects amended into the plan in 2013 (the Circle Interchange and the Illiana Expressway). While only about three percent of the revenue projected for transportation projects in the region through 2040 is available for major capital projects, these transportation projects still garner a great deal of attention from stakeholders and the general public.

During the public comment period for the plan update, the transportation projects and proposals that drew particular interest included:

CrossRail Chicago

The Midwest High Speed Rail Association (MHSRA) led a form-letter campaign supporting the CrossRail Chicago project and urged CMAP to adopt it as a priority in GO TO 2040. Figure 4 shows the geographic origin of comments received. Less than half of the form letters supporting CrossRail Chicago were submitted from communities within the CMAP region, while about one third were submitted from downstate Illinois, Indiana, Wisconsin, and the greater Midwest.

Figure 4. Geographic Origin of CrossRail Chicago Project Supporters



The geographic extent of interest in CrossRail Chicago is likely related to the project's scale; it proposes a phased approach to link major transportation assets and job centers throughout the region (notably O'Hare International Airport, Union Station, and McCormick Place) by integrating existing plans. None of the entities that build major capital projects in the region came forward as the project implementer, so CrossRail Chicago is not included in the universe of major capital projects (constrained or unconstrained). However, the project is currently listed in CMAP's Major Capital Projects appendix to the draft plan update, which notes the current cost estimates for this project's early stage of planning.

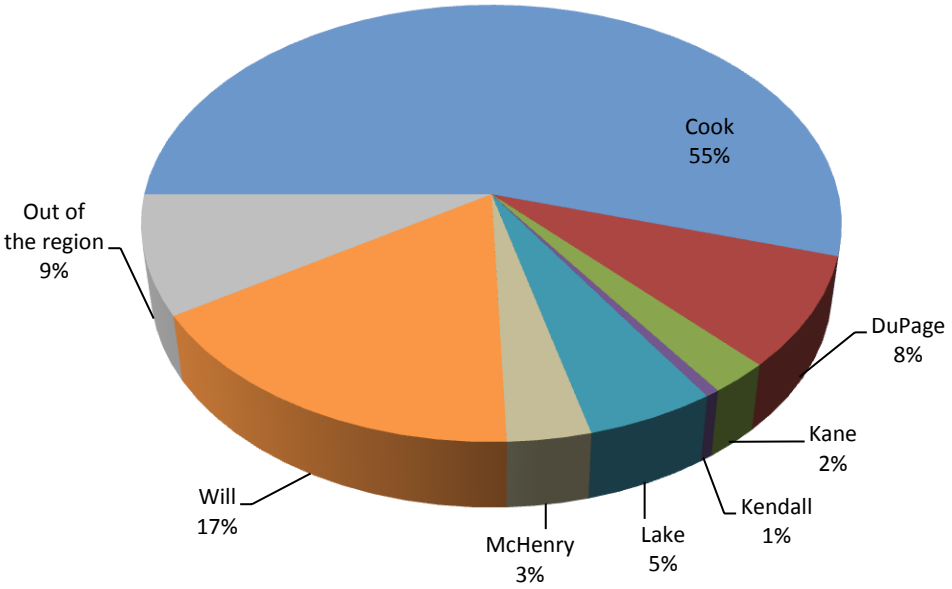
Illiana Expressway

During the public comment period, notable opposition was expressed for the Illiana Expressway (a proposed 47-mile tolled alternative for long-distance truck freight), even excluding the large volume of standardized form letters that were submitted. Both the Sierra Club – Illinois Chapter and the Environmental Law and Policy Center led form letter campaigns that collectively generated over 600 comments (see Table 2, page 7) opposing the project's inclusion on GO TO 2040's list of fiscally constrained major capital projects.

A variety of private citizens, nonprofit organizations, and county government representatives expressed this opposition. Figure 5 displays the geographic origin of all the comments opposing the Illiana Expressway, depicting how these comments were dispersed across all counties in the CMAP region (as well as in other parts of Illinois and in Indiana). There were points of concentrated opposition both in the area of the proposed roadway alignment in southern Will County, as well as on the north side of the City of Chicago.

It should be noted that there was also support expressed for the Illiana during the public comment period, but the volume was small compared to the opposition.

Figure 5. Geographic Origin of Comments Opposing the Illiana Expressway



Other transportation projects

Beyond CrossRail Chicago and the Illiana Expressway, many other comments were submitted about transportation projects both on and off the major capital projects list. Some commenters asked that certain projects be prioritized by CMAP with inclusion onto the plan's major capital projects list, while other commenters cautioned about pursuing particular projects.

The other transportation projects that were commented on specifically for support included:

- Extension of Metra's BNSF line into Kendall County (currently on unconstrained list)
- Circle Line (currently on unconstrained list)
- IL 53/120 Tollway (support for both the project being built and for continued adherence to the recommendations of the Blue Ribbon Advisory Council [BRAC])
- West Lake Commuter Rail (support for including on the fiscally unconstrained project list)
- STAR Line Corridor (currently on unconstrained list)
- Adding managed lanes on I-80 (currently on unconstrained list)

Responses to Input

The changes to the plan update based on comments received are described as follows. These do not include the minor changes to correct typos and formatting, but instead focus on revisions made to the plan update that were directly due to public feedback. No major changes were made to policy recommendations in the plan update, but the following describes the areas where clarification and further detail was called for by partners and stakeholders, or where the volume of comments warranted further discussion.

- *Discussion of* Bus and Arterial Rapid Transit: Discussion occurred during the development of the plan update about the best way to treat Bus Rapid Transit (BRT) and Arterial Rapid Transit (ART) projects in the update. The Regional Transportation Authority (RTA) offered guidance on this matter during the public comment period, suggesting text revisions that have since been made in the plan update summary. These changes aim to appropriately frame BRT and ART options in the context of improving the overall transit system's operations and fiscal health, echoing the RTA's Transit Strategic Plan.

- *Support for* CrossRail Chicago: Hundreds of form letters were submitted asking CMAP to prioritize the CrossRail Chicago project. Given its very early planning phase, this project remains where it was listed in the draft Major Capital Projects appendix. Language was added to the project description in the Major Capital Projects appendix to encourage supporters to continue to study the project, identify funding sources, and identify a project implementer. As details are solidified in future years, this project can be reevaluated for consideration in the universe of major capital projects.

- *Opposition to* Illiana Expressway: The Illiana Expressway was amended into the plan in 2013 and is included on the fiscally constrained major capital projects list. It received significant debate during a public process at that time and was specifically amended into the plan by a vote of the MPO Policy Committee. During this plan update public comment period, the most common arguments enumerated against this project included concerns that the roadway would cause environmental degradation, loss of prime farmland, and a large financial burden on the taxpayers of Illinois. Additionally, many comments questioned the project's consistency with the principles of sustainable growth for the region at the core of GO TO 2040.

  No major changes were made to the GO TO 2040 plan during this update process, given the amount of consensus-building and research that informed the development of the original plan. There is a process that has been established to amend the major capital projects list between plan updates, and the outcomes of those processes were preserved for the plan update. Text was added to the Illiana Expressway project description in the Major Capital Projects appendix to reflect the volume of comments received and the need to protect the region's open and green space during project implementation. It will be important to consider the environmental and local community impacts, as well as to protect the public interest in the public-private partnership funding structure as much as possible.

- *Implementation of* Reasonably Expected Revenues: Several comments were submitted regarding the plan update's prioritization of advancing new sources of reasonably expected revenues to invest in our region's transportation system. While acknowledging the necessity of these new revenues, many asked questions about the potential time frame and political support needed to implement them, or wanted assurance that local and regional stakeholders would be involved in decision making and implementation. CMAP understands the concerns about political feasibility and agrees that implementation of these revenues will need to be driven by a strong regional coalition of CMAP and its partners.

Response Summary Tables

Summary tables of all comments received are categorized by the four themes of GO TO 2040. These tables share the CMAP staff response to each comment, as well as any changes to the plan update as a result of that input. The pertinent public meeting discussions are summarized after each table for consistency reasons. A full compilation of public comments received is available for review.

Public Comments on Regional Mobility	CMAP Staff Response

• Emphasis on continued need to increase access to the region's assets via public transportation. (*Sustainable Englewood, residents*)	No change made to plan update. Comments reinforced existing CMAP priority and commitment to increasing and improving transit.
Congestion Pricing: • The express toll revenues generated in a given corridor should be used to promote, enhance, and expand transit service in that corridor's area. Any arterial improvements that these revenues fund should incorporate bicycle and pedestrian facilities and links. (*Village of Hoffman Estates*) • Local community participation in a transparent process is critical to any decision-making about future tolling of existing, non-tolled facilities. (*Village of Hoffman Estates, residents*)	The plan update's summary and Financial Plan appendix address these comments, which are taken under continued advisement as reasonably expected revenues are explored further and implemented. Language was added to the summary (page 4) to reinforce the necessity for local and regional stakeholders to work collaboratively in pursuing new revenue sources.
State Motor Fuel Tax (MFT) Issues: • Continued discussions are merited for indexing MFT to inflation and finding a better long-term funding solution. The politics cannot be ignored, analysis about replacements should be shared with stakeholders, and discussions should be open and public. (*Village of Hoffman Estates, DuPage Mayors and Managers Conference [DMMC]*) • Support for replacing MFT with a vehicle miles travelled (VMT) fee. (*Resident*)	The plan update's summary and Financial Plan appendix address these comments, which are taken under continued advisement as reasonably expected revenues are explored further and implemented. Language was added to the summary (page 4) to reinforce the necessity for local and regional stakeholders to work collaboratively in pursuing new revenue sources.
• Communities considering variable parking pricing would benefit from guidance as to how revenues would best be used. (*Village of Hoffman Estates*)	No change made. CMAP recommends that local revenues generated by variable parking pricing be invested in local transportation improvements. The plan update summary calls for CMAP's continued work with local governments on parking issues through the LTA program and model ordinances/toolkits (like *Parking Strategies to Support Livable Communities*, April 2012).
• The ability of local communities to access funds for new transit services or road improvements are just as important at the local level as continuing investments in existing services in more densely developed areas. Performance measures used to help prioritize funding should give due consideration to needs in both developed areas and those which are still growing, and should consider different metrics. (*Village of Hoffman Estates*)	No change made. The plan update greatly emphasizes the need for additional funding sources for maintaining existing facilities and investing in existing communities.

• Mention Pace's Transit Supportive Guidelines under the appropriate action items (Regional Mobility, Conduct supportive land use planning). (*Pace Bus*)	No change made. The Implementation Action Areas appendix provides summaries of each recommended action, which are not intended to capture every example of pertinent work by partners/implementers. Pace's Transit Supportive Guidelines already play a key role in implementing this action, and will be added as an example of implementation into CMAP's next Moving Forward report.
• The City of Chicago's implementation of a Transit Oriented Development Ordinance, Pedestrian Street Designations, and a Complete Streets Policy should be recognized. (*Resident*)	No change made. The plan update is not intended to contain every example of pertinent work by partners/implementers, but Chicago's activity in this area can be highlighted in future plan implementation reports.
• CMAP's designation of Quentin Road between Lake Cook and Dundee Roads as a Strategic Regional Arterial (SRA) is underpinning Cook County plans to expand the road from two to five lanes through part of the Deer Grove Forest Preserve. (*Residents*)	No change made to the plan update. SRA Design Concepts were produced for CMAP's predecessor agency – the Chicago Area Transportation Study (CATS) – in 1994. CMAP encourages concerned citizens' continued conversations with the Cook County Highway Department about this project.
• Would like Amtrak to work with Metra and railroad so that Amtrak trains can stop at the West Lake Forest station. (*Resident*) • Better operational management and infrastructure is needed at points of intersection between passenger rail service and freight movement. (*Resident*)	No change made to plan update. CMAP generally supports the idea of coordination between passenger and freight rail services.
• Support the transfer of freight on the outskirts of the region to avoid bottlenecks and use of multimodal facilities to maximize efficiency in freight movement. (*Resident*)	No change made. The Regional Mobility sections of the plan outlines strategies for efficient freight movement, such as completing CREATE.
• Suggestions for exploring or implementing new transportation technologies like automated vehicles, "Hyperloop" fast transit, or Superconducting Maglev technology. (*Resident, technology/product representatives*)	No change made to plan update. Transportation implementers should consider as technologies advance.

Related Discussions from Public Meetings

In general, many public meeting attendees expressed their support for CMAP's emphasis on investing strategically in transportation, and prioritizing the maintenance and modernization of our existing transportation facilities rather than focusing on building new ones. Transit service was a topic of interest in different parts of the region. At a couple of meetings, attendees had concerns and questions about specific transportation projects or proposals that are outside CMAP's major capital projects list. CMAP staff were able to help provide what information was available about these specific projects.

Public Comments on Major Capital Projects	CMAP Staff Response
• The Tollway should continue to follow the environmental recommendations outlined by the Blue Ribbon Advisory Council (BRAC) for the IL 53/120 Tollway project. (*CMAP's Environment and Natural Resources [ENR] Committee membership*)	Significant emphasis on this point was previously included in the plan and has carried over into the subsequent IL 53/120 Corridor Land Use project. Language was added to the plan update summary reiterating the importance of designing the facility to protect environmental assets and local community character as much as possible.
• Clearly differentiate support for the IL 53/120 Tollway project in central Lake County from any future examination of or support for the McHenry-Lake Corridor. (*CMAP's ENR Committee membership*)	The two projects are clearly separate in the plan update. McHenry-Lake Corridor is in the universe of major capital projects; however it sits on the "Projects Reclassified or Not Evaluated" list and therefore was not modeled.
• Support for interchange access and transit improvements planned (and under construction) for the I-90 corridor. (*Village of Hoffman Estates*)	No change required. The Jane Addams Tollway is a fiscally constrained major capital project. CMAQ funds are supporting enhanced transit elements as described in the Major Capital Projects appendix.
• Add language into the IL 53/120 Tollway project narrative that is similar to the discussion of reserving space for future transit services in the Elgin O'Hare Western Access project description. (*Village of Hoffman Estates*)	Principles from the BRAC process are guiding the continued IL 53/120 Tollway work, and they call for "innovative design solutions for a safe, integrated, multi-modal corridor." To the extent that demand exists, transit service could be considered. Text has been added to this effect in the Major Capital Projects appendix.
• Include the West Lake Corridor project – a proposed extension of the South Shore Line in Indiana – on the list of fiscally unconstrained major capital projects in the **plan update**. (*The Northwestern Indiana Regional Planning Commission [NIRPC]*)	This project was added to the Major Capital Projects appendix on the list of "Projects Not Included in the Universe," which includes projects that were submitted late, lacked important details, or were too early in the planning phase to appropriately classify.
• Mention or reference the Cook DuPage Area Rapid Transit Investment Plan – which Pace is currently developing – specifically in discussions of transit service in the Elgin O'Hare Western Access project; DuPage "J" Line; and O'Hare to Schaumburg Transit Service. (*Pace*)	References to Pace developing a phased transit investment plan were added to the project descriptions of the Elgin O'Hare Western Access project and the DuPage "J" Line project, and to the project status of the O'Hare to Schaumburg Transit Service project.

• Revise the discussion of Bus Rapid Transit (BRT) and Arterial Rapid Transit (ART) in the **plan update** to more accurately reflect how it is just one of many transit opportunities that would help achieve a world-class transportation system for the Chicago region. (*Regional Transportation Authority [RTA]*)	Text in the plan update summary was revised to reduce the prominence of BRT/ART and instead put it in the context of improving the overall transit system's operations and fiscal health, citing the RTA's Transit Strategic Plan.
• Ongoing National Environmental Policy Act (NEPA) studies and public input for both the I-290 and I-55 projects will determine the preferred project alternatives, which may not include express toll lanes, but rather may employ other managed lane strategies. (*Illinois Department of Transportation [IDOT] – District 1 Division of Highways)*	Comment on language/project classification is noted by CMAP staff. No change made to the major capital projects text.
• Mention the A2 flyover project explicitly as a potential strategy in the Metra UP West Improvements project. (*Midwest High Speed Rail Association [MHSRA]*)	The A2 flyover is among the alternatives under evaluation as part of the UPWest Improvements project. The text of the project description has been revised to reflect this.
• More transit projects should be included on the fiscally constrained list to reinforce the priority of increasing commitment to public transportation. (*Resident*)	No changes made. CMAP evaluated the benefits of proposed capital projects to help prioritize them for inclusion within the plan's fiscal constraint, and several transit improvements (as well as other projects with transit components) were ultimately included. Beyond this, the plan and its update continue to prioritize a commitment to transit.
• Clarifications were requested regarding the Financial Plan appendix, particularly about the alignment of the long-range transportation forecasts with short-term budget cycles and how that alignment might impact the need for local matching funds to support some local projects. (*DuPage County Department of Transportation*)	CMAP sent an email in response. The draft plan update represents a long-term forecast for planning purposes that is not compatible for a particular annual budget in a given year or even a particular five-year program.
<u>Support for CrossRail Chicago project</u>**:** • Phased proposal seeks to link assets and job centers around the region (O'Hare, Union Station, McCormick Place) by connecting existing infrastructure • Would make jobs more accessible via transit • Would reduce travel times from those currently experienced on existing facilities (*MHSRA, residents – form letters and individual comments)*	This project remains in the Major Capital Projects appendix on the "Projects Not Included in the Universe" list, since it is still in an early planning phase. The project can be reevaluated for inclusion in the universe of major capital projects in the future.
• Opposition for CrossRail Chicago project because of the backlog of more urgent capital projects. (*Resident*)	This project remains in the Major Capital Projects appendix on the "Projects Not Included in the Universe" list, since it is still in an early planning phase. The project can be reevaluated for

	inclusion in the universe of major capital projects in the future.
Opposition to the Illiana Expressway**:** The opposing comments urge the CMAP Board not to adopt an update to GO TO 2040 that includes the Illiana on the fiscally constrained list of major capital projects. Most common arguments include: • Project would violate core principles of sustainable growth in the region's GO TO 2040 plan and undermines the Green Infrastructure Vision. • Project would degrade the Midewin National Tallgrass Prairie, other natural resources, and prime farmland. • The project would not produce the degree of freight and economic benefits predicted. • It is fiscally risky and could leave taxpayers on the hook to cover up to $1 billion in costs. (*Resident,s President of Cook County Board of Commissioners, Will County Board Member - District 1, over two dozen nonprofit organizations -- form letters and individual comments; see compiled comments for full list)*	Language was added to the plan update Summary emphasizing the need to protect environmental assets and local community character as much as possible. The project remains on the fiscally constrained list of major capital projects since this particular plan update is being conducted to renew the baseline data rather than recommend major policy changes. It is also a CMAP priority to protect the public interest in Public Private Partnership funding proposals, which applies to this project.
• Support for the Illiana Expressway project as a needed freight asset and economic development driver. (*State Senator Pat McGuire – District 43, resident)*	Language was added to the plan update summary emphasizing the need to protect environmental assets and local community character as much as possible. The project remains on the fiscally constrained list of major capital projects, since this particular plan update is being conducted to renew the baseline data rather than recommend major policy changes. It is also a CMAP priority to protect the public interest in public-private partnership funding proposals, which applies to this project.
• Support the Circle Line project. (*Resident*)	Currently on the fiscally unconstrained list of major capital projects.
• Support for the STAR Line Corridor project. (*Resident*)	Currently on the fiscally unconstrained list of major capital projects.
• Include the extension of Metra's BNSF passenger service into Kendall County on the fiscally constrained list of major capital projects. (*Village of Montgomery*)	No change made. The project is currently on the fiscally unconstrained list of major capital projects and will require support from Kendall County to enter into and pay taxes to be a part of the RTA service area.
• Expand I-80 from New Lenox to I-55 from two to three lanes due to increasing traffic. (*Will County Board Member Tom Weigel*)	I-80 Add/Managed Lanes project (I-80 from Ridge Road to US 30, which encompasses the portion commented upon) is on the fiscally unconstrained list of major capital projects.

Related Discussions from Public Meetings

Many questions and concerns with the Illiana Expressway were expressed, in particular at the meeting held in Will County (near the project's Tier 2 alignment), but also at several other public meetings around the region. Otherwise, each public meeting tended to garner comments about the major capital projects located in the vicinity of where the meeting occurred (e.g. meeting attendees in Lake County asked about the IL 53/120 Tollway, and attendees in Kendall County supported the BNSF extension project).

Public Comments on Livable Communities	CMAP Staff Response
• Take serious steps to increase affordable housing that is evenly distributed throughout the region, beyond technical assistance. Ideas include working with partners to provide incentives in high-cost municipalities and for intergovernmental agreements; intensify consequences for failing to comply with affordable housing regulations. (*Open Communities, resident*)	No changes to the plan update made; these priorities were already captured in the Livable Communities section of the plan. CMAP also continues work that addresses these comments, from conducting Homes for a Changing Region projects across the region, to developing a Fair Housing Toolkit.
• Include accessible, community-integrated housing for people with disabilities as a goal under Livable Communities. (*Open Communities*)	No changes to the plan update made; these priorities were already captured in the Livable Communities sections of the plan. CMAP also continues work that addresses these comments, from conducting Homes for a Changing Region projects across the region, to developing a Fair Housing Toolkit.
• Include language in the Livable Communities section of the plan update about diversity and inclusion of all (particularly by income, race, national origin, disability, age, and familiar status). (*Open Communities*)	Text added to reflect this description in the introduction of the plan update summary's Livable Communities section.
• Consider the 14 Millennium Reserve priorities in final revisions to the plan update. (*Millennium Reserve*)	No changes made, since many of the Millennium Reserve goals and principles are already represented in the plan update.
• Mention Pace's Transit Supportive Guidelines under the appropriate action items (Livable Communities, Link transit, land use, and housing). (*Pace Bus*)	No change made. The Implementation Action Areas appendix provides summaries of each recommended action, which are not intended to capture every example of pertinent work by partners/implementers. Pace's Transit Supportive Guidelines already play a key role in implementing this action, and will be added as an example of implementation into CMAP's next Moving Forward report.
• CMAP should encourage communities to re-tool their zoning codes to facilitate more compact development. (*Resident*)	No change made to the plan update. CMAP addresses this comment frequently through LTA projects and also has created a Form-Based Codes Guide.

• There should be greater acknowledgement of the preservation of the region's historic architecture and arts/cultural assets. (*Resident*)	No changes made to the plan update. GO TO 2040 supports historic preservation and maintaining community character in the Livable Communities section of the plan. In part as a response to the comments of this nature during the development of GO TO 2040, CMAP created an Arts and Culture Planning Toolkit.
• Encourage coordination amongst implementers (like forest preserve districts and local governments) in building, connecting, and maintaining bicycle and pedestrian trails and signage. Comments applied to the region in general, as well as a couple that specifically pertained to West Cook County. (*Residents*)	No change made to the plan update, which already recommends connecting parks and open spaces. Many LTA projects focus on the coordination and development of communities' nonmotorized transportation systems.
• Enable better stormwater management and flood protection across the region, primarily by equipping local governments with guidance and tools for mitigation. Suggested strategies included encouraging land acquisition in flood-prone urbanized areas, and creating climate change measures for municipalities to use in their capital planning. (*DuPage County Forest Preserve District, residents)*	No change made to the plan update. CMAP recommends many stormwater management strategies to local communities in its LTA projects, and also has a Climate Adaptation Guidebook for municipalities to use. CMAP is working to secure a sustainable funding source for non-transportation related projects like these.

Related Discussions from Public Meetings

Some public meeting attendees shared anecdotes about flooding problems in their communities, and many were interested in CMAP's efforts around energy efficiency and building retrofitting.

Public Comments on Human Capital	CMAP Staff Response
• Correct two details in the plan update summary's description of the Chicago Cook Workforce Partnership (CCWP): 1) New York City has the largest nonprofit workforce board in the nation, while Chicago's is second-largest; 2) CCWP focuses on many business sectors, not just freight and manufacturing. (*CCWP*)	Factual errors were corrected in the Human Capital section of the plan update summary.
• Suggest including information about the Integrated Workforce Information System (IWIS) under the "Improve Data and Information Systems" section of the plan update Summary. (*CCWP*)	No change made to the plan update. Since data is ever-changing, CMAP does not generally name specific data resources – which evolve all the time – in its published materials. The summary provides broad details on each plan recommendation, but it is not intended to capture every example of pertinent work by partners/implementers.

Related Discussions from Public Meetings

Many public meeting attendees were interested in CMAP's cluster analyses and curious to learn more, though they left no formal comments on those topics.

Public Comments on Efficient Governance	CMAP Staff Response
• In light of the plan update, wish to reiterate concerns with a number of Regional Tax Policy Principles as currently drafted. Further discussion about tax policy should be inclusive and occur with the full benefit of CMAP's information and resources. (*DuPage Mayors and Managers Conference [DMMC], Village of Carol Stream*)	No changes made to the plan update. Comments pertain to the draft Regional Tax Policy Principles, which the CMAP Board tabled. CMAP welcomes this input as it considers next steps for addressing tax policy issues.
• Concerned with the potential impacts of proposed tax policy reforms, especially a sales tax reform initiative, on communities that do not levy a local municipal property tax. (*Village of Carol Stream*)	No changes made to the plan update. See above response. CMAP welcomes this input as it considers next steps for addressing tax policy issues.
• Implementation Action #2 under the "Reform State and Local Tax Policy" should be qualified to include caveat about avoiding redistribution of existing revenues and acknowledging that local governments have planned for their future based on the current revenue sharing practices. (*Village of Orland Park*)	No changes made to the Implementation Action Areas appendix. The text in question is just one example of tax policy reform to consider in a summary of possible actions. CMAP welcomes this input as it considers next steps for addressing tax policy issues.

Related Discussions from Public Meetings

Though not submitted through the formal comment channels, many public meeting attendees were eager to discuss and learn more about the political implications and potential cost savings resulting from local government coordination and service-sharing arrangements.

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