Appendix G:
Congestion Management Process

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Introduction

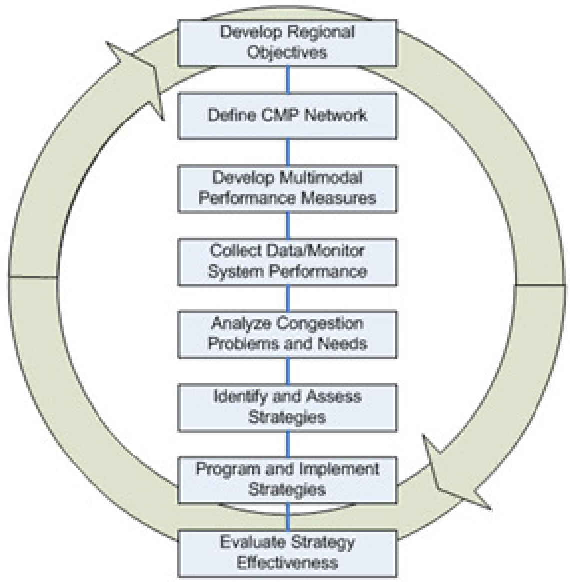
A Congestion Management Process (CMP) is a systematic and regionally-accepted approach for managing congestion that provides accurate, up-to-date information on transportation system performance and assesses alternative strategies for congestion management that meet State and local needs. It identifies strategies and recommendations throughout the region to minimize congestion and enhance the ability of people and goods to reach their destinations.

A CMP is required in metropolitan areas with a population exceeding 200,000, known as Transportation Management Areas (TMAs). In TMAs designated as ozone or carbon monoxide non-attainment areas, the CMP takes on a greater significance because Federal law prohibits projects that result in a significant increase in carrying capacity for single occupant vehicles (SOVs) from being programmed in these areas unless the project is addressed in the region's CMP.

The Michiana Area Council of Government's 2019 Congestion Management Process (CMP) was created to replace the previous CMP. The CMP was developed as an integral part of 2045 Transportation Plan. The CMP is tailored to the unique characteristics of the MACOG region. It provides a structured framework for evaluating travel demand reduction and operational management strategies, lends itself to identifying, prioritizing, and programming transportation improvement projects, and has been integrated into the Transportation Improvement Plan (TIP) and the Transportation Plan (TP) by providing reliable tools for project evaluation, selection and prioritization.

MACOG's CMP includes the eight elements of the CMP as discussed in the Federal Highway Administration (FHWA) Congestion Management Process guidebook. The figure below shows the elements of the MACOG CMP.

Figure G-1: MACOG CMP Elements



Source: https://www.fhwa.dot.gov/planning/congestion_management_process/cmp_guidebook/fig2.cfm

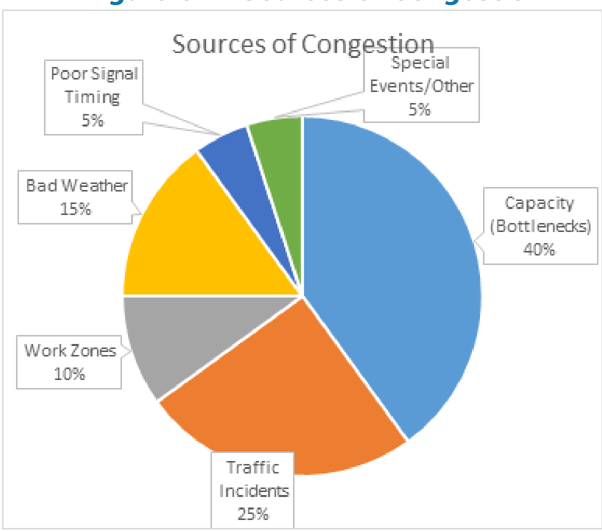
Defining Congestion

Traffic congestion is the level at which transportation system performance is no longer acceptable due to traffic interference. The level of acceptable system performance will vary by type of transportation facility, location within the region and time of day. The level of acceptable system performance depends upon transportation and development goals for the region and reflects public perception of traffic congestion. Essentially, congestion is a condition on road networks that occurs as use increases, and is characterized by slower speeds, longer trip times, and increased vehicular queuing.

Traffic congestion is generally categorized into recurring or non-recurring congestion. Recurring congestion is caused by inadequate road capacity. In other words, there are more vehicles trying to utilize a roadway than can be physically accommodated at a single time. Sometimes, poor signal timings, poor access management, and roadway geometric deficiencies contribute to reduced capacity. This type of congestion begins at regular times of the day and often occurs at the same locations. Recurring congestion is often defined as routine disruption in traffic flow.

Non-recurring congestion is an unexpected disruption in traffic flow often caused by random events such as crashes, spillages, vehicle breakdowns, inclement weather, special events, road construction, etc. According to the Federal Highway Administration (FHWA), sixty percent (60%) of congestion is caused by non-recurring factors.

Figure G-2: Sources of Congestion



Congestion Management Process

The Congestion Management Process was initially spelled out in the Safe Accountable Flexible Efficient Transportation Equity Act – A Legacy for Users (SAFETEA-LU). The CMP is a regional approach to manage and monitor the transportation system. The CMP is intended to serve as an organized and transparent way for our planning area to identify and manage congestion, connect performance measures to support funding for projects, and evaluate recommended strategies to ensure we are effectively addressing congestion.

MACOG created the CMP by following the U.S. Department of Transportation Federal Highway Administration's "Congestion Management Process: A Guidebook". The following describes the contents of a CMP:

> *"A congestion management process is a systematic and regionally-accepted approach for managing congestion that provides accurate, up-to-date information on transportation system performance and assesses alternative strategies for congestion management that meet state and local needs. The CMP is intended to move these congestion management strategies into the funding and implementation stages."*

The CMP, as defined in federal regulation, is intended to serve as a systematic process that provides for safe and effective integrated management and operation of the multimodal transportation system. The process includes:

- Development of congestion management objectives
- Establishment of measures of multimodal transportation system performance
- Collection of data and system performance monitoring to define the extent and duration of congestion and determine the causes of congestion
- Identification of congestion management strategies
- Implementation activities, including identification of an implementation schedule and possible funding sources for

each strategy

- Evaluation of the effectiveness of implemented strategies

The elements of a successful CMP defined in the process model that follows serve as a guide for the actions to be taken in developing a CMP. These eight actions include:

1. Develop Regional Objectives for Congestion Management
2. Define CMP Network
3. Develop Multimodal Performance Measures
4. Collect Data / Monitor System Performance
5. Analyze Congestion Problems and Needs
6. Identify and Assess Strategies
7. Program and Implement Strategies
8. Evaluate Strategy Effectiveness

Action 1 - Develop Regional Objectives

The Regional CMP reflect the goals and objectives developed as part of the Michiana on the Move: 2045 Transportation Plan. While MACOG will be developing more extensive regional objectives throughout the next fiscal year, the overall focus of the CMP is to reduce congestion through the use of better management and operations of the existing transportation system. Therefore the primary objectives are to:

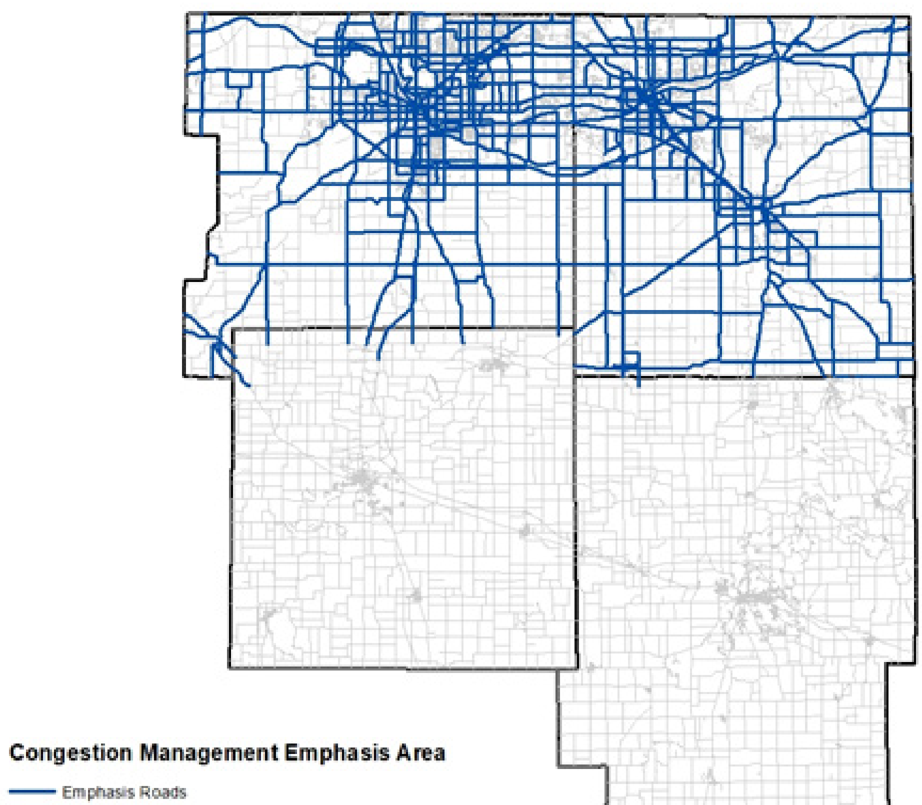
- Maximize effectiveness and efficiency of the existing transportation system
- Reduce Intersection Delay
- Reduce Corridor Delay
- Reduce Traffic Crashes
- Develop multimodal alternatives for people and goods

Action 2 - Define CMP Network

The MACOG planning area consists of the federally designated urbanized areas of Elkhart and St. Joseph Counties. MACOG also serves as a rural planning organization to Kosciusko and Marshall Counties. The 4-county region contains an estimated 601,923 people (2018 Census Population Estimates), covers 1,921 square miles, and includes 35 cities and towns. The MACOG region is comprised of over 6,548 miles of roadway, providing connectivity and access, both locally and regionally.

MACOG is unique in the sense that it is an MPO that represents rural areas as well as two urbanized areas (the South Bend Urbanized Area and the Elkhart/Goshen Urbanized Area). While MACOG monitors and studies congestion throughout the entire region, the CMP is intended to be focused on metropolitan areas with a population exceeding 200,000.

Figure G-3: Congestion Management Emphasis Area



For MACOG's Congestion Management Process network an emphasis is placed on all federally functionally classified roads (major collector and above) in St. Joseph and Elkhart Counties which consists of 1,147 centerline miles of roadway.

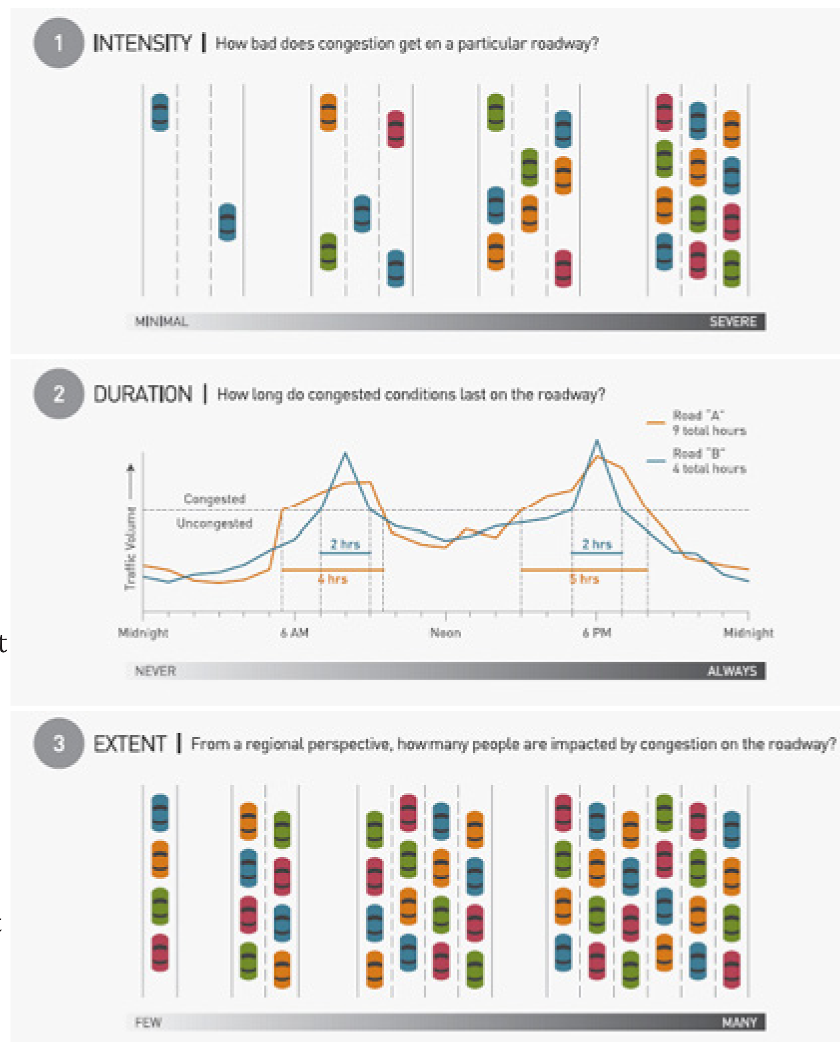
Action 3 - Develop Multi-Modal Performance Measures

Performance measures are defined as specific indicators used to evaluate how well a person, organization, or a system is operating. Performance measures for the CMP specifically characterize current and future conditions on the transportation system in the region, track progress toward meeting regional objectives, identify specific locations with issues to address, assess the effectiveness of strategies, and communicate system performance.

Since congestion is a complex topic there are multiple facets of congestion that can be measured. Congestion deals with both spatial (the where such as an intersection, roadway segment, or transit route) and temporal dimensions (the when such as time of day or year). Additionally, the transportation network is a system that does not operate in isolation. This means that actions that take place in one part of the transportation system can affect (positively or negatively) congestion on other nearby facilities. There is also a relative aspect to congestion where transportation users may qualitatively perceive congestion as being more or less severe based on observations at the same location at a different time, or at a different location. This is why it is important understand the following four major dimensions of congestion:

- Intensity – The relative severity of congestion that affects travel. Intensity has traditionally been measured through indicators such as V/C ratios or LOS measures that consistently relate the different levels of congestion experienced on roadways.
- Duration – The amount of time the congested conditions persist before returning to an uncongested state.
- Extent – The number of system users or components (e.g. vehicles, pedestrians, transit routes, and lane miles) affected by congestion, for example the proportion of system network components (roads, bus lines, etc.) that exceed a defined performance measure target.
- Variability – The changes in congestion that occur on different days or at different times of day. When congestion is highly variable due to non-recurring conditions, such as a roadway with a high number of traffic crashes causing delays, this has an impact on the reliability of the system.

Figure G-4: Dimensions of Congestions



These four dimensions of congestion discussed are not, however, all inclusive of the range of issues that could be considered in selecting performance measures for the CMP. Therefore, the following performance measures can be utilized when assessing the transportation system:

Level of Service and Volume to Capacity Ratio

The most common measure currently used to define congestion involves Level-of-Service (LOS) values as defined in the Highway Capacity Manual (HCM). LOS is a qualitative measure describing operational conditions of a segment or traffic stream. Six different levels are defined (LOS A, B, C, D, E, and F).

LOS A = Free flow

LOS B = Reasonable free flow

LOS C = Stable flow

LOS D = Approaching unstable flow

LOS E = Unstable flow

LOS F = Forced or breakdown flow

Level of Service (LOS) and Volume-to-Capacity Ratios (V/C) gauge the intensity of roadway congestion at a particular location. They are primarily used as general indicators of roadway sufficiency or for detailed corridor studies. LOS is expressed as values A through F, representing the volume over capacity, while V/C represents it as a ratio.

Travel Time Measures

Average Travel Time

The average travel time is defined as the total time to traverse a length of a roadway under prevailing traffic conditions. All stopped delays are included in the average travel time. This measure can be used to compare the quality of service of various alternate routes from a point of origin to a point of the destination.

Average Travel Speed

The average travel speed is calculated by dividing the distance traveled by the average total time to travel along a given length of roadway. The total time includes stopped delays in addition to the actual time the vehicle is in motion. The number of travel time runs depends on the variance in travel time, the acceptable degree of precision, and the level of confidence desired.

Delay

Total delay or stopped delay is the time that a vehicle is stopped in traffic or at an intersection. Expressed in seconds per vehicle, stopped delay can be measured as the actual “locked wheel” time, or in terms of time less than a very slow speed, such as 5 mph. The Highway Capacity Manual’s (HCM) delay equation uses turning movement volumes to capacity ratios to determine stopped delays at intersections.

Travel Time Index

Travel Time Index (TTI) is the ratio of travel time in the peak period to the travel time at free-flow conditions. TTI measures the travel time for a given roadway segment. Travel time can include waiting time at signals, as well as delay caused by traffic.

Traffic Counts and Turn Movements

When monitored correctly, the amount of traffic on the road network can be useful in identifying potential congested areas. Roads and intersections are designed to handle certain volumes at any given time. The volumes and type of vehicles are often good indicators of existing or future problems. MACOG has an extensive traffic count program with nearly 5,000 locations counted every three years. These counts are on State and local roads throughout the region and extending into surrounding counties. This helps MACOG to establish at baseline roadway network that is used in the Travel Demand Model (TDM), which allows us to model congestion issues on a comprehensive roadway network including all National Highway Network roads and other roads that are functionally classified as major collector and above.

MACOG has an extensive traffic count database that, in some locations, extends to the early 1980s. Most of the locations counted use traditional road tube collection methods, however, MACOG is expanding with the use of video capture systems (i.e. MioVision). This new method uses artificial intelligence (AI) machine learning techniques to analyze turning movements at intersections. This significantly reduces the required staff time to gather and process turning movements in the region.

This is an ongoing process designed to provide decision-makers with valuable information about the transportation system performance and to evaluate the effectiveness of strategies to address congestion. By monitoring the effectiveness of congestion mitigation strategies, MACOG can improve our ability to select the most cost-effective strategies at each location specific to its condition and needs.

Crash Rates

Traffic crashes can cause non-recurring congestion by temporarily blocking one or more lanes of traffic. Time is needed for emergency response professionals (i.e. police, firefighters, emergency medical services, emergency management agencies, etc.) to perform their jobs. This also includes "clear time" to remove the vehicles and debris from the roadway and crash site. Crashes at an intersection can affect the entire function of the intersection. During a fatal crash, the roadway is often completely closed for hours.

MACOG reviews and improves the accuracy of reported crash locations from the Automated Reporting Information Exchange System (ARIES), the database portal that all police departments report traffic crashes into for Indiana, since 2006. This information is used to identify locations where safety may be an issue, which could be an indicator of non-recurring traffic incidents causing delays. When MACOG studies crash data we use the three most recent years of crash data to identify high crash intersections and corridors. High crash corridors are based on the total number of crashes occurring along each corridor in a community and their severity.

Action 4 - Collect Data/Monitor System Performance

Performance measures rely on the collection of data. MACOG collects and obtains a wide variety of data related to system performance. Much of this data is also used in conjunction with the Congestion Management Process. MACOG understands the limitations such as availability and cost for gathering data. The following data is useful in determining existing and future congestion, as well as, determining the cause of congestion.

Traffic Count and Turn Movement Data

The MACOG traffic counting program allows us to monitor any increases or decreases in traffic over time. MACOG collects count data at over 5,000 locations on state and local facilities every three years that in some locations, go back to the early 1980s. The counters used by MACOG are capable of collecting information such as volume, speed, time of day, and vehicle classification.

In addition to an extensive traffic count database, MACOG has expanded with the use of video capture systems to gather turning movement data at intersections.

Crash Data

MACOG reviews and improves the accuracy of reported crash locations from ARIES, the database portal that all police departments report traffic crashes into for Indiana, since 2006. This information is used to identify locations where safety may be an issue, which could be an indicator of non-recurring traffic incidents causing delays.

Land Use Data

Congestion is often the result of developments in land use. MACOG tracks changes to land use developments with the aid of aerial photography. Information on land use changes, trends and future development are used in MACOG's Travel Demand Modeling. Additionally, the HELPViz Land Use Model was developed by RSG for MACOG. Using the Land-Based Classification System's activity-based codes, 2002 aerial photography and 2013 oblique photography was used to describe land use changes in the urbanized areas of the region over a 10-year period which was then used to adapt HELPViz to the area.

This land use model offers sensitivity to land use zoning, building codes and infrastructure facilities such as the transportation network, water and sewer utilities. HELPviz allocates the future population and employment regional totals to the TAZs based on build out capacities, the transportation network and infrastructure facilities. HELPviz uses a Nested Logit model framework and uses information at both TAZ and parcel levels.

Transit Data

MACOG oversees the operation of the Interurban Trolley, the public transit system in Elkhart and Goshen. This means that MACOG has a robust dataset of transit data including boarding and alighting statistics, total ridership, on-time performance, and archived Automatic Vehicle Location. Additionally, MACOG has strong partnership with Transpo and are typically provided similar datasets because MACOG frequently assists them with various planning projects.

Bicycle / Pedestrian Data

Although MACOG has an extensive traffic data collection program it has largely been focused on vehicular traffic. MACOG has begun expanding the traffic data collection to be more inclusive of all modes by launching an active transportation (i.e. walking and cycling) data collection program. In 2019, automated counters were procured and will be installed to continuously collect data on bicycles and pedestrians on key active transportation facilities. The data will allow MACOG to understand pedestrian and cyclist behavior such as factors that affect usage including seasonal variations, weather effects, and time of day. The data will also help plan facilities to meet the needs of the users.

Other Data Sources

Additionally, MACOG is continuing to evaluate the effectiveness and benefits of other data sources, including the National Performance Management Research Data Set (NPMRDS), mobile data sets (i.e. StreetLight), and other transportation data sources and analysis programs. New and innovated data collection techniques and sources are constantly being promoted, which requires MACOG to reevaluate the effectiveness of each dataset.

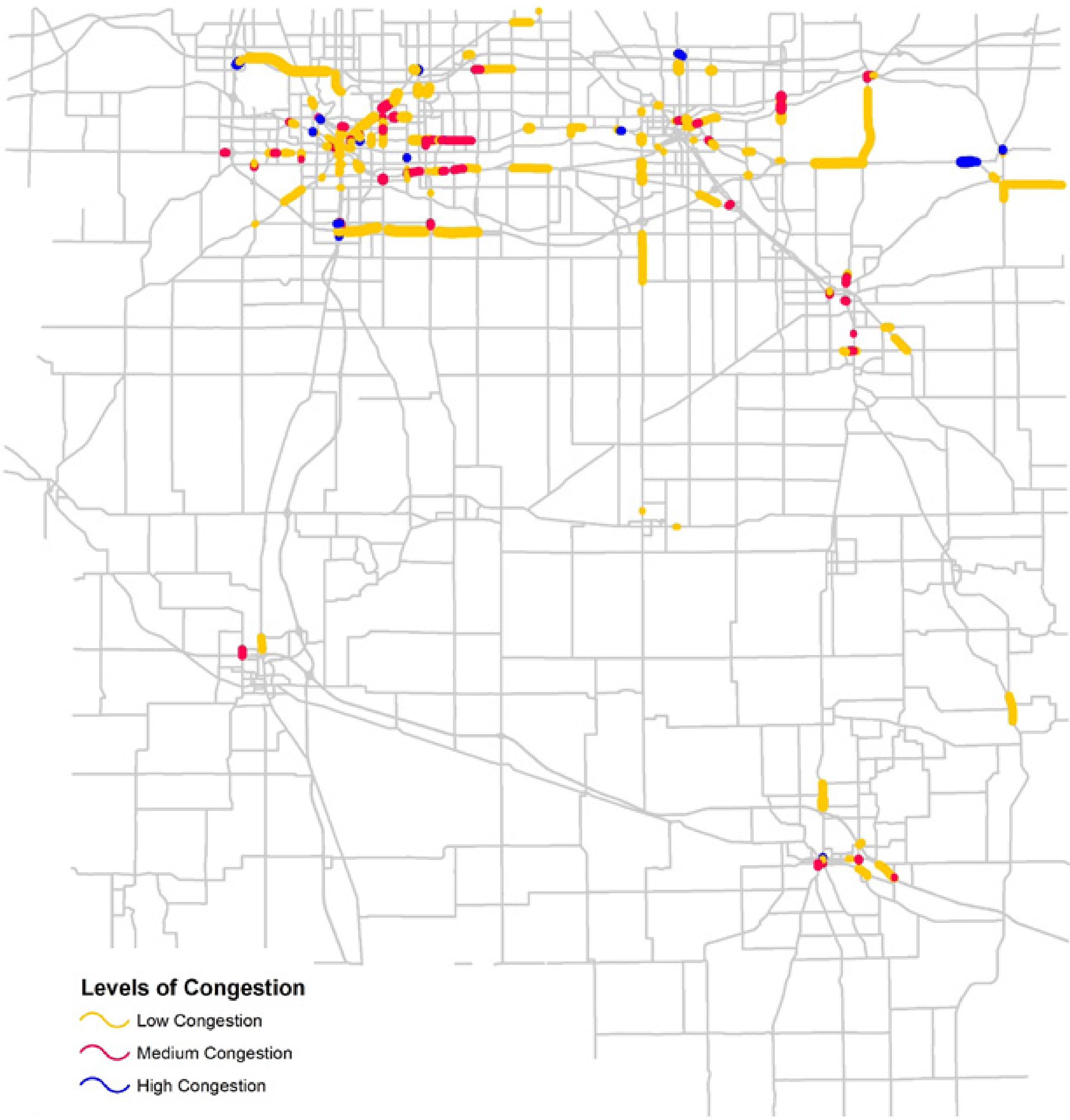
Action 5 - Analyze Congestion Problems and Needs

In order to identify congestion, MACOG utilizes performance measures, data collected for performance monitoring, and analytical tools. Input from local communities was also included as to the location of congested areas.

The traffic count data collected by MACOG is analyzed to measure the V/C ratios for the AM and PM peak hours. This V/C ratio can be used to calculate the LOS during the most congested times of the day. With improvements to the traffic count database, the peak hour average speed data can be used to identify existing and future areas of potential congestion issues through comparison to the daily 85th percentile speed values throughout the transportation network, rather than just at a few selected locations.

Travel time survey data is traditionally collected using the floating car method to gather data for the AM and PM peak hours. Utilizing this travel time data with available free flow times, the TTI for the collected corridors can be calculated. The TTI can then be used to designate the congestion level as low, moderate, high, or severe. However, the floating car method is subject to drawbacks with peak hour data collection often occurring outside normal business hours and different driving habits among drivers resulting in different congested speeds. Instead, MACOG is looking to the data provided through FHWA's National Performance Management Research Data Set (NPMRDS) to provide consistent results for future

Figure G-5: Level of Congestion



analysis.

Lastly, a transportation model is utilized to simulate the traffic flow for the region in order to discover where there are areas of congestion, and also to determine the effects of vehicular traffic on regional air quality. The transportation model is a network of links and nodes designed to represent the overall system of roads in a given area. This model is then combined with data previously described to create a simulation of the traffic flows of the region. The travel forecasting models offer a means by which decision makers can look at different transportation options and see the potential effects they might have at the regional or corridor level.

MACOG continues to improve the collection, interpretation, and dissemination of data required to enhance the Congestion Management

Process.

Congested Segments

The map shows the existing congestion on roadways throughout the region as identified by the travel demand model. The model generated a worst-case Level of Service based on multiple durations (peak hour, peak period, intersection, etc). A Level-of-Service D, E, and F were then identified as congested with Level of Service D representing low congestion and Level of Service F representing high congestion. Due to the regional nature of the model, MACOG continues to make refinements and as such will produce updated congestion maps as needed.

Action 6 - Identify And Assess Strategies

The identification and assessment of appropriate congestion mitigation strategies is a key component of the CMP. The strategies for managing congestion can be divided into four categories:

1. Travel Demand Management (TDM)
2. Traffic System Management (TSM)
3. Active & Public Transportation Improvements
4. Road Capacity Strategies

Travel Demand Management

The primary purpose of TDM strategies is to create a more efficient transportation system by reducing the number of vehicles during peak periods while providing mobility options to those who want to travel. To accomplish this type of change, TDM will incentivize changes in behaviors and are effective in dense, mixed-use environments. These strategies include:

- Parking management: Providing traveler information on parking spaces availability can reduce the amount of time vehicles spend searching for a parking space. Reduced parking fees for high-occupant vehicles or by the time of day will incentivize individuals to either carpool or change the travel time to non-peak hours.
- Carpools and vanpools: Ridesharing reduces single-occupant vehicle (SOV) trips and vehicle miles traveled (VMT). Carpools are generally two to five people sharing a ride in their personal vehicles. Vanpools are typically leased through a vanpool provider (public or private) and can accommodate up to twelve people.
- Employer programs: These include allowing employees to work from home (telecommute) which helps reduce SOV trips, especially during peak travel times. Additionally, employers may allow workers to arrive and leave work outside the traditional commute period, either a Compressed Week (four 10-hour workdays) or Flexible Schedules (start and end times vary).

Transportation System Management

While TDM address the supply (number of vehicles) of congestion, TSM seeks to identify operational strategies to enhance the capacity of the transportation system. Through better management and operation of existing transportation facilities, improved capacity and traffic flow will also benefit air quality, movement of goods, and system accessibility and safety. These strategies include:

- Access Management: Controlling the design and operation of driveway and street connections will allow more free-flowing traffic conditions with fewer access points for delays.
- Intersection Improvements: Congestion and travel-time can be improved with enhanced traffic control devices, additional turning lanes, pedestrian safety medians, and other appropriate geometric designs to help reduce congestion and improve safety.
- Signal Interconnect & Optimization: Delays may be caused by excessive wait-times at signalized intersections. Traffic flow could be improved through updated equipment upgrades, timing plan improvements, interconnected signals, or traffic signal removal.
- Traffic Calming: Changing the physical

design of the roadway can result in traffic to slow down or even a reduction of the amount of traffic. This could include narrowing roads, speed humps, road diets, traffic circles, etc. This can also have the benefit of increasing biking and walking by creating a safer space for pedestrians and cyclists.

- Traffic Incident Management: Coordinating multi-disciplinary process to detect, respond to, and clear traffic incidents so that traffic flow may be restored as safely and quickly as possible. Effective traffic incident management reduces the duration and impacts of traffic incidents and improves the safety of motorist, crash victims, and emergency responders.
- Remove At-Grade Rail Crossings: In a few key locations of the region, at-grade rail crossings reduce traffic flow on major corridors. Congestion segments could be improved by separating the roadway from the railway.

Active & Public Transportation Improvements

Shifting the view of congestion from a motorized traffic focus to a people centric focus can result in a multi-modal implementation. Improving other modes of transportation can encourage more individuals to switch their preference from SOV to walking, biking, or public transit. These strategies include:

- Land Use or Livable Community Policies: Development policies that support increased accessibility to bicycle, pedestrian and transit can reduce demand for travel by automobile. Examples would include policies that encourage new transit-oriented designs or reinvestment in existing urban centers.
- Complete Street Design: Optimize the use of existing streets by incorporating bicycle facilities in the form of bike lanes, buffered bike lanes, shared-use paths, or side paths to facilitate road sharing and encourage bicycle use.
- Improved Transit Service: Congestion on a particular corridor or destination may be alleviated with the addition of new fixed-route service, more frequent service, or extended service. More reliable & frequent service has been shown to increase ridership and decrease vehicular traffic.

Road Capacity Strategies

This category of strategies addresses adding more base capacity to the road network. Given the expense and possible adverse environmental impacts of new single-occupant vehicle capacity, management and operations strategies should be given due consideration before additional capacity is considered. Additionally, these improvement may only be a short-term solution, because increasing the capacity might induce more demand. These strategies include:

- Additional Travel Lanes: Deficient roadway capacity is a major contributor to congestion. Additional roadway capacity is needed in many areas to keep-up with increased travel demand.
- Geometric Design Improvements: Bottlenecks can occur where short sections of the roadway are of an insufficient width or number of lanes to accommodate the travel demand. Intersections may need additional turn lanes, channelized turn lanes, or grade-separated interchanges.
- Center Turn Lanes: Providing an area where vehicles can move out of the thru lanes and pause while making a left turn can improve the flow of traffic. This can also reduce the risk of rear-end crashes and make turning vehicles more visible to on-coming traffic.

Action 7 - Program And Implement Strategies

The CMP has been integrated into the transportation planning process. In the Transportation Plan, MACOG used LOS and V/C to assist in evaluating and prioritizing the final recommended projects. Similarly, when considering projects for in the Transportation

Improvement Program (TIP), congestion is an important criterion in the project scoring.

A scoring system was developed as part of the FY 2020-2024 TIP, which identifies ten categories to evaluate projects. Two categories that relate to the CMP. One of those specifically focuses on congestion, where 10 points (out of 100) are awarded to projects that aim to reduce vehicle miles traveled (VMT) or vehicle hours traveled (VHT). The other is on connectivity, where another 10 points are given for projects that improve mobility options or provide intermodal connections.

Action 8 - Evaluate Strategies

Understanding and evaluating the effectiveness of the CMP is dependent upon the proper monitoring of the implemented strategies. The monitoring will help decision makers determine whether strategies were successful in alleviating congestion and if so, to what degree they were successful. The evaluation of implemented strategies will be accomplished through the feedback of data collection efforts and performance measures. The following measures and data can be collected after a project has been completed to monitor effectiveness:

- Level of Service
- Delay Studies
- Crash Rates
- Traffic volumes

Reduction in congestion leads to less stress, safer roads, shorter travel times, and improved air quality. MACOG's Congestion Management Process is meant to identify areas where congestion may be a problem and recommend a range of potentially useful strategies to alleviate congestion. Identification of congested areas can lead to more detailed studies and may ultimately lead to projects in the Transportation Plan and Transportation Improvement Program. Through continuous monitoring and updated process, the CMP will evolve and change with the transportation system, in the hopes of making a better and safer transportation network.