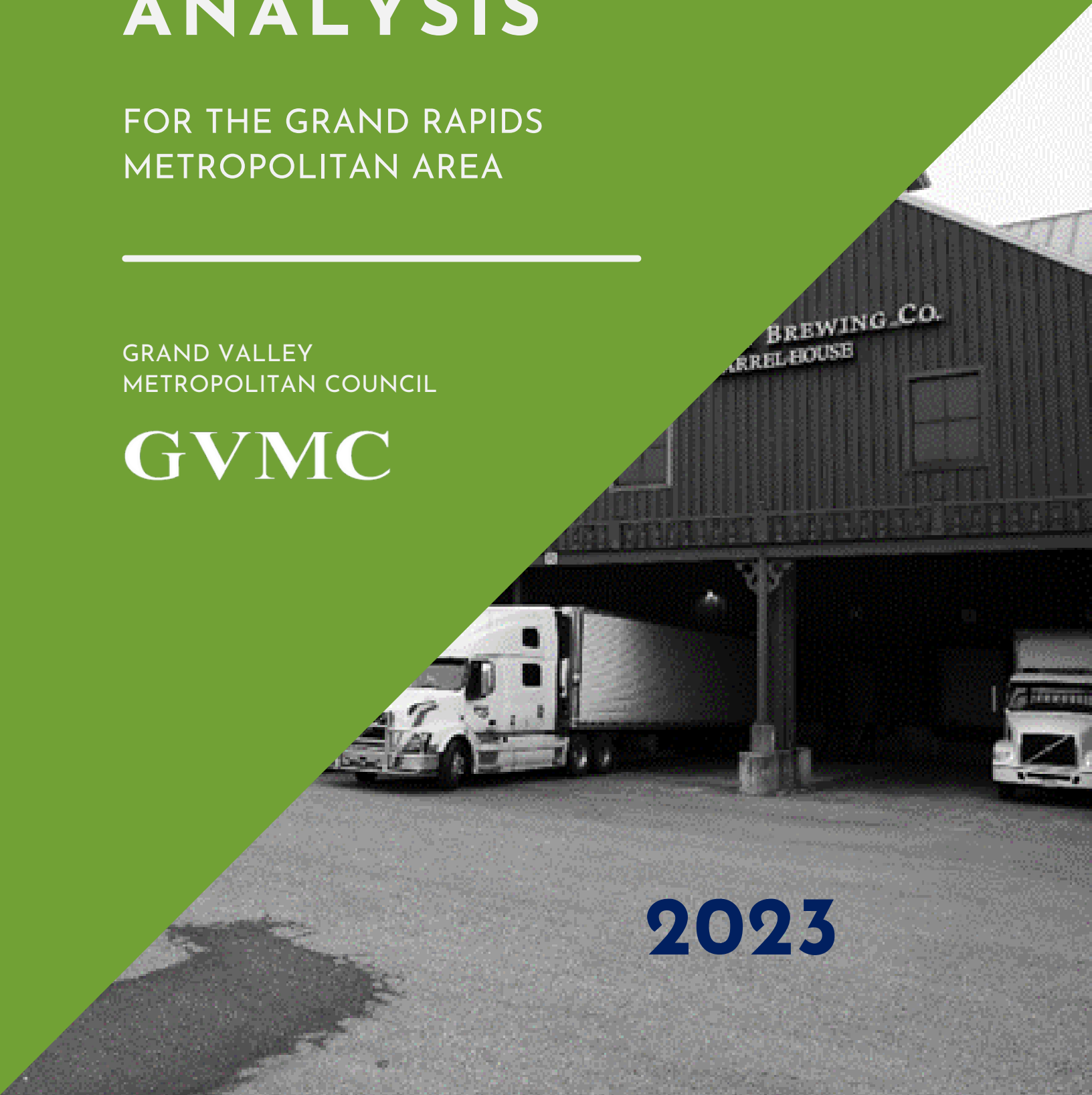
REGIONAL FREIGHT ANALYSIS

FOR THE GRAND RAPIDS METROPOLITAN AREA

GRAND VALLEY
METROPOLITAN COUNCIL

GVMC

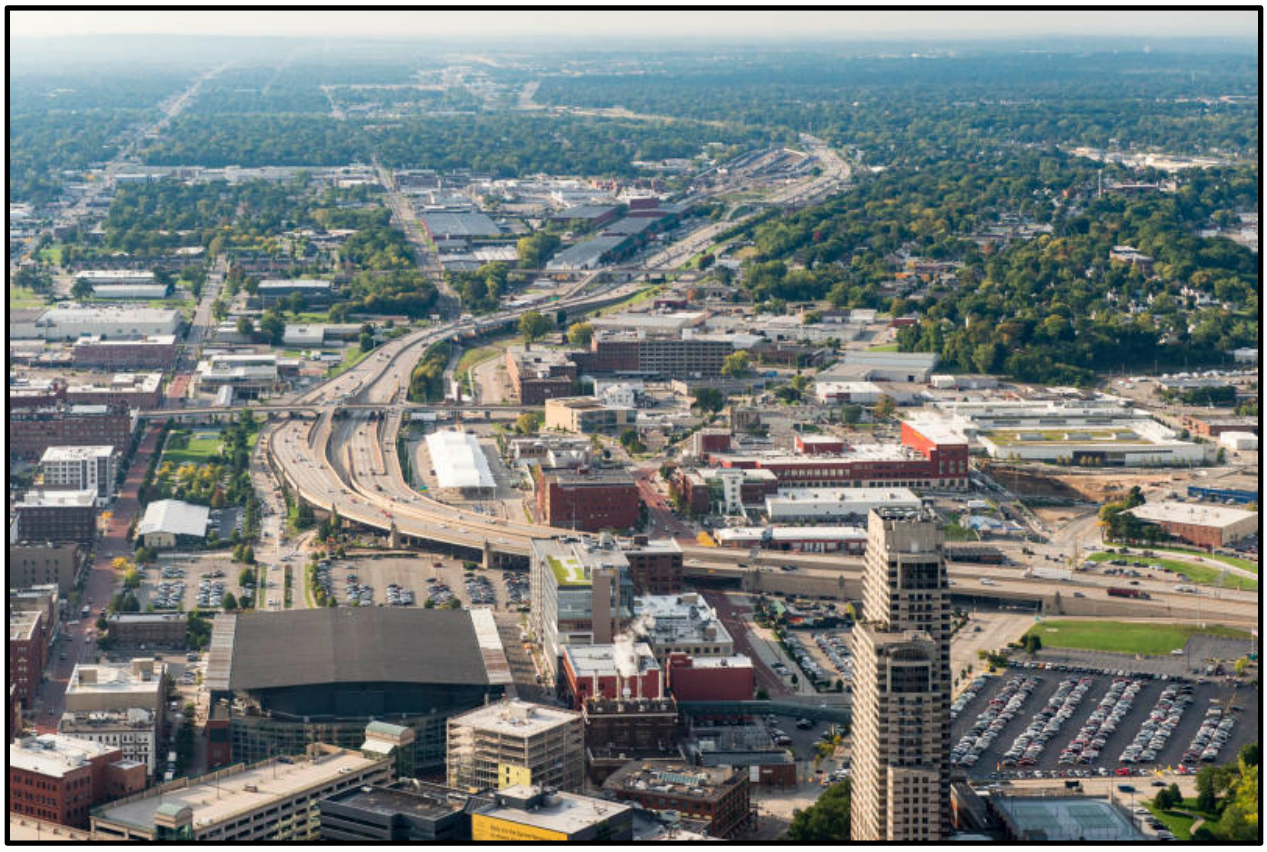


2023

Table of Contents

Part B: Regional Response to Freight

Introduction

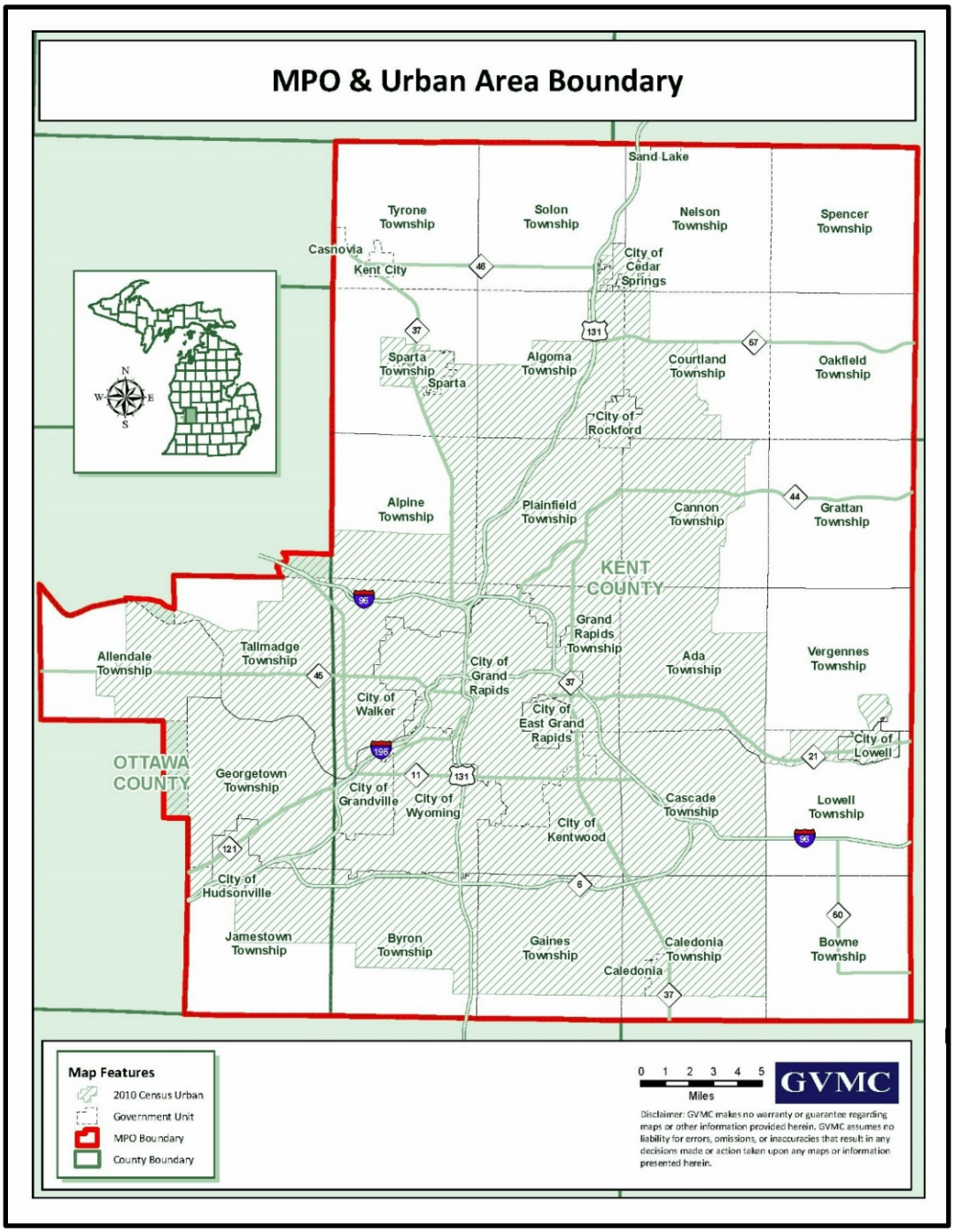


An aerial view of US-131 between M-11 (28th Street) in Wyoming and the S-curve in Grand Rapids. US-131 serves as a vital connection for people and freight to and from Grand Rapids and supports overall regional economy and mobility. Photo courtesy of MDOT.

1.1 Grand Valley Metropolitan Council

Grand Valley Metropolitan Council (GVMC) is an alliance of governmental units in the Grand Rapids, Michigan metropolitan area appointed to plan for growth and development, improve the quality of life in communities, and coordinate governmental services. GVMC is the federally designated Metropolitan Planning Organization (MPO) for Kent and eastern Ottawa Counties. A map of GVMC's MPO area is on page 3.

GVMC is responsible for carrying out all transportation-related planning activities for the Grand Rapids Metropolitan Area. These duties include further developing and maintaining our transportation system and planning for all modes of transportation, including freight, transit, nonmotorized, passenger rail, and air. A safe, reliable, and efficient transportation system supports the cost-effective movement of freight, economic development, and improved quality of life. Our freight transportation system is an important element of economic competitiveness. The more efficient and reliable our system is, the faster goods can get to their destination without the delays that result in the loss of time, increased shipping costs, and additional congestion.



Map 1: MPO Urban Area Boundary

1.2 Purpose and Outcomes

The purpose of this document is to outline the current state of the transportation system and freight operations throughout the Grand Region. This assessment highlights both quantitative data providing tonnage, volumes, and values flowing throughout the region, as well as qualitative data providing insight to how users experience freight throughout our transportation network. All the data collected in this analysis is intended to be digested as Phase 1 in creating a regional Freight Plan. Stakeholders and members of the Freight Advisory Committee will work with GVMC staff to develop a Freight Plan with goals and objectives that align with the MTP (Metropolitan Transportation Plan) and Michigan Mobility 2045 (Michigan's State Long-Range Transportation Plan). This document is organized into two parts: Part A - Freight Facts and Figures which quantifies freight volumes and values as well as provides data related to Environmental Justice areas, safety and congestion, and information on the freight system itself; Part B: GVMC's Regional Feedback – contains qualitative data collected from public and stakeholder survey responses from 2020 and input from GVMC's freight committee during the development of the 2045 MTP.

Key outcomes of this analysis include:

- A data rich foundation from which a regional freight plan can be developed,
- A description of the modes of shipping in our area and the goods they carry,
- Current impacts of freight on the transportation network in relation to safety, congestion, and environmental justice communities
- Funding/ CUFC CRFC – edit this to talk about funding options etc.
- Qualitative feedback from users of the regional transportation network and their experience with freight.

PART A: FREIGHT FACTS AND FIGURES

1. Freight Overview

Grand Rapids skyline facing south to north; photo courtesy of Experience Grand Rapids

1.1 About the Region

Located between Chicago and Detroit, GVMC's MPO area includes a growing region of more than 700,000 and counting. At its core is the second largest city in the state, Grand Rapids, which continues to grow and thrive. With a strong business climate and exceptionally high quality of life, businesses and talent are flocking to the region. More than 130 international companies are located here, as well as four of Forbes' Largest Private Companies. The region is home to the global headquarters of industry leaders like Amway, Steelcase, Herman Miller, Haworth, BISSELL, Wolverine Worldwide, and more. West Michigan business and community leaders have set in motion an unprecedented level of growth and investment, cementing our place as a world-class center for advanced manufacturing, life science and medical devices, food processing, and technology.[1]

To assist with global trading, Foreign Trade Zone #189 was established on January 15, 1993 by the Kent-Ottawa-Muskegon Foreign-Trade Zone Authority (KOM-FTZ) to offer FTZ benefits to West Michigan businesses. Foreign Trade Zones are treated as territory outside of the United States, and under Foreign Trade Zone procedures, foreign and domestic merchandise may be admitted into the zone without being subject to formal customs entry procedures, the payment of customs duties, or the payment of federal taxes. Columbian Logistics Network is the general-purpose operator of the Kent – Ottawa – Muskegon Foreign Trade Zone (#189), with two locations in the Grand Rapids area.

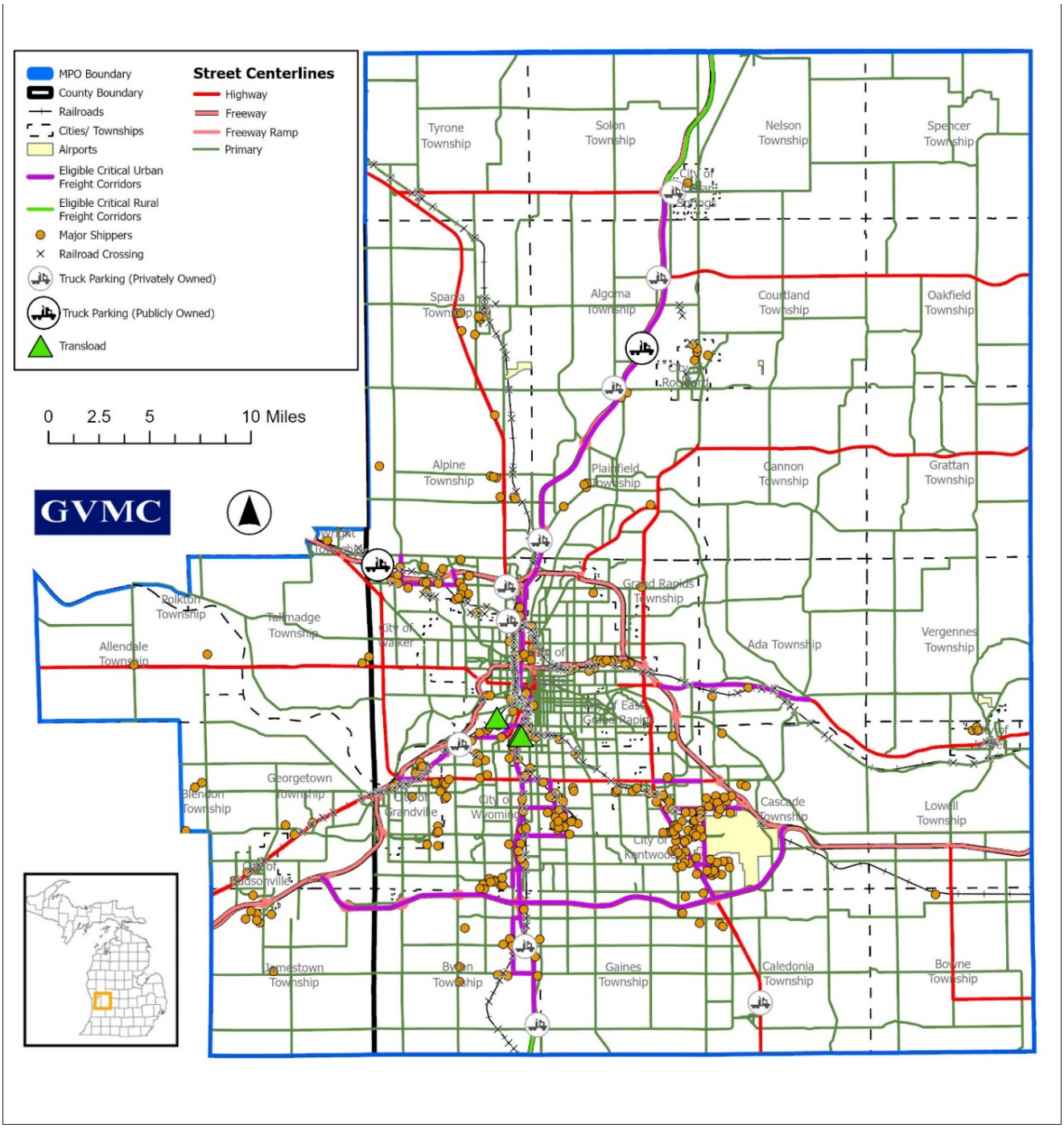
[1] The Right Place's Manufacturing in West Michigan report

1.2 Freight Defined

The Michigan Department of Transportation (MDOT) Freight Plan defines freight as "any good, product, or raw material, carried by a commercial means of transportation—including air, highway, rail, water, and pipeline."[2] The efficient movement of freight is a nationwide issue, with freight often transferring between modes at various hubs, for instance, rail to truck, before it reaches its destination. When freight is transported by more than one mode of transportation during a single journey, it is referred to as intermodal shipping.

The following map provides context to freight infrastructure and facilities within the GVMC MPO boundary. The region is equipped with rail lines, highways, transload facilities, and an international airport. Supporting the freight movements that use this infrastructure are several, both publicly and privately owned, truck parking locations, transload facilities, and identified potential segments of roadway to be classified as Critical Urban or Rural Freight Corridors.

[2] Michigan Freight Plan



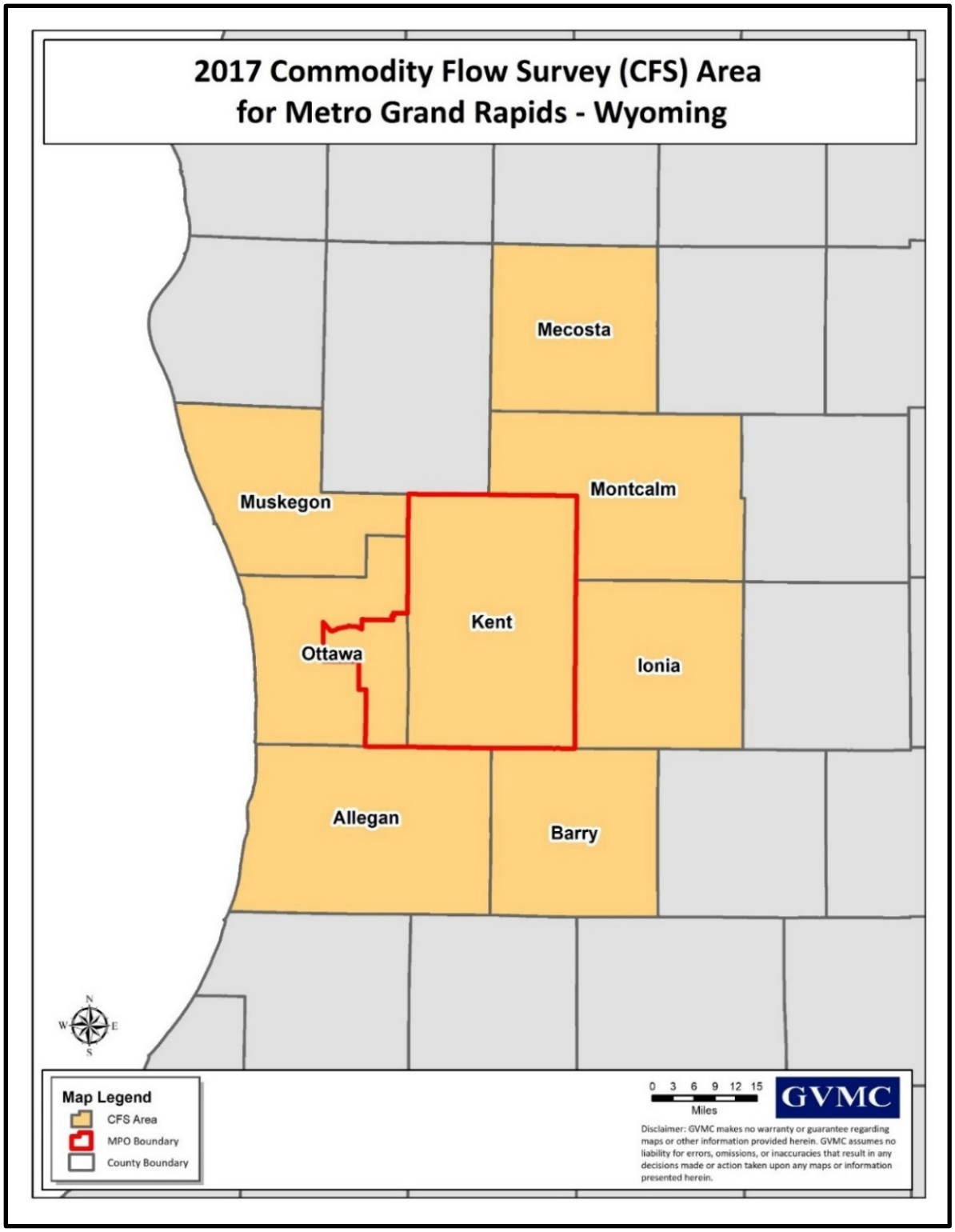
Map 2: MPO Freight Facilities

2. Freight Modes

2.1 Introduction

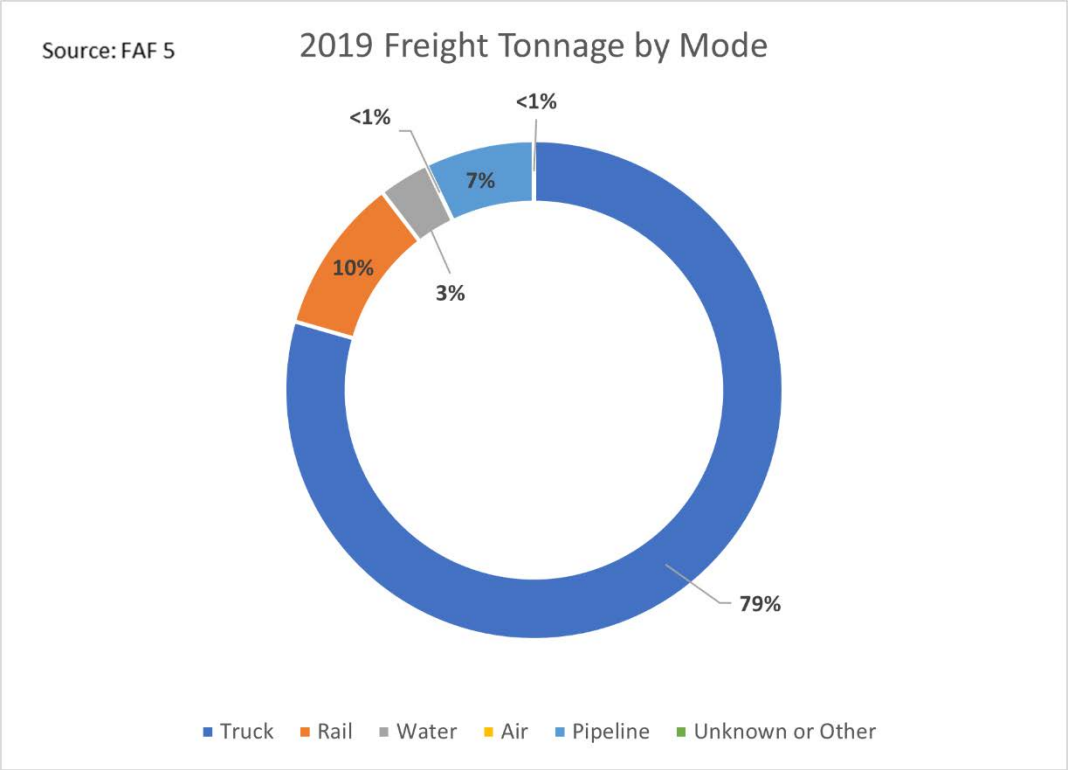
Freight is transported by five different modes within West Michigan, including air, rail, highway, pipeline, and marine. However, freight is only moved within GVMC's MPO area by air, rail, and highway/regional roads. Although there are no ports or terminal locations for pipelines in GVMC's MPO planning area, understanding freight mobility within GVMC's specific planning boundary as well as freight movement in the immediate surrounding area is important for the freight network and economy in the GVMC planning area.

This section will highlight freight data at the GVMC planning area level as well as the Grand Rapids – Wyoming – Muskegon CFS (Commodity Flow Survey area) level. This regional freight data was obtained from the Freight Analysis Framework Data Tabulation Tool (FAF5), which was developed by the FHWA (Federal Highway Administration) in conjunction with BTS (Bureau of Transportation Statistics). The Grand Rapids Region in the FAF5 is comprised of the Grand Rapids Metropolitan area as well as the Holland and Muskegon area in West Michigan.

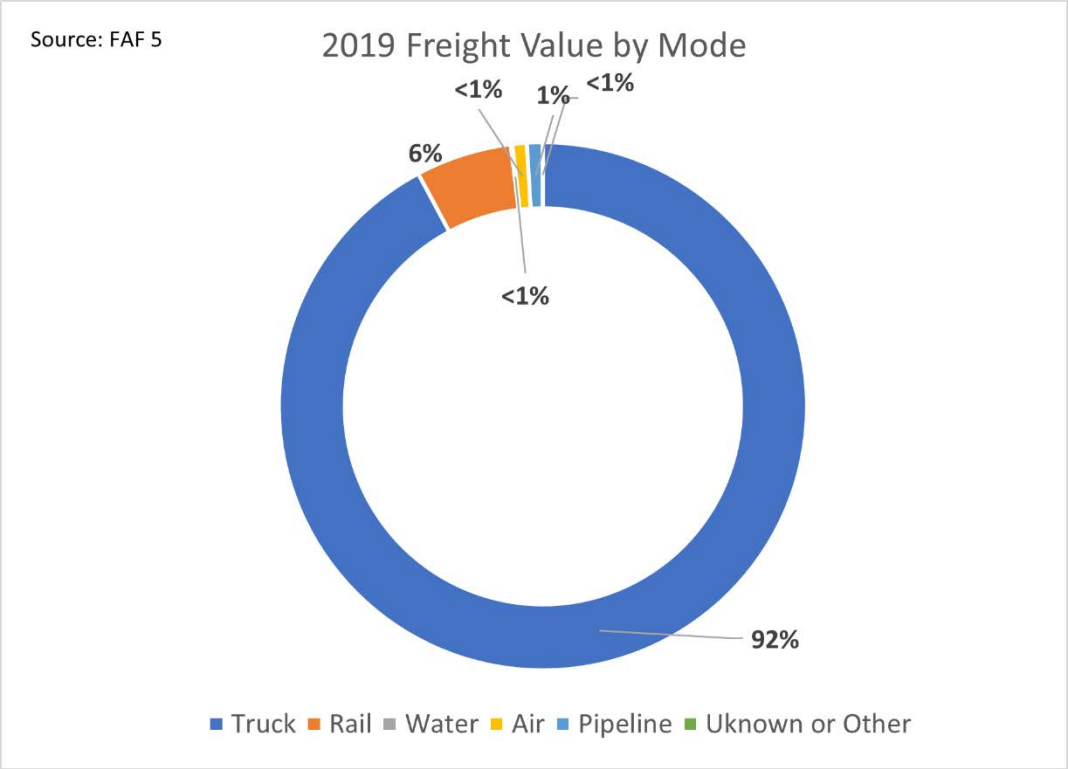


Map 3: Grand Rapids – Wyoming – Muskegon CFS Area

The following chart includes total flows where Grand Rapids CFS area is both the origin and destination by freight tonnage. Trucks are by far the number one mode of freight movement within the region followed by rail, while air being the smallest amount of tonnage moved. All modes of freight movement experienced a drop in tonnage during 2020 with the COVID 19 pandemic. Looking at the trend with estimated projected tonnage, all modes trend upward after some level of recovery from 2020, and the leader in mode by capacity remains the same across the board. *Each mode as defined by the FAF 5 can be found in Appendix I.*



The FAF data also provides insight into transportation modes in terms of freight value. The following chart includes total flows where Grand Rapids CFS area is both the origin and destination. Regions should consider both value and tonnage when analyzing freight mode in coordination with impact on the infrastructure. Trucks dominate in terms of transporting freight by value within the region being trailed by rail which is the next highest mode via value at just 6%.



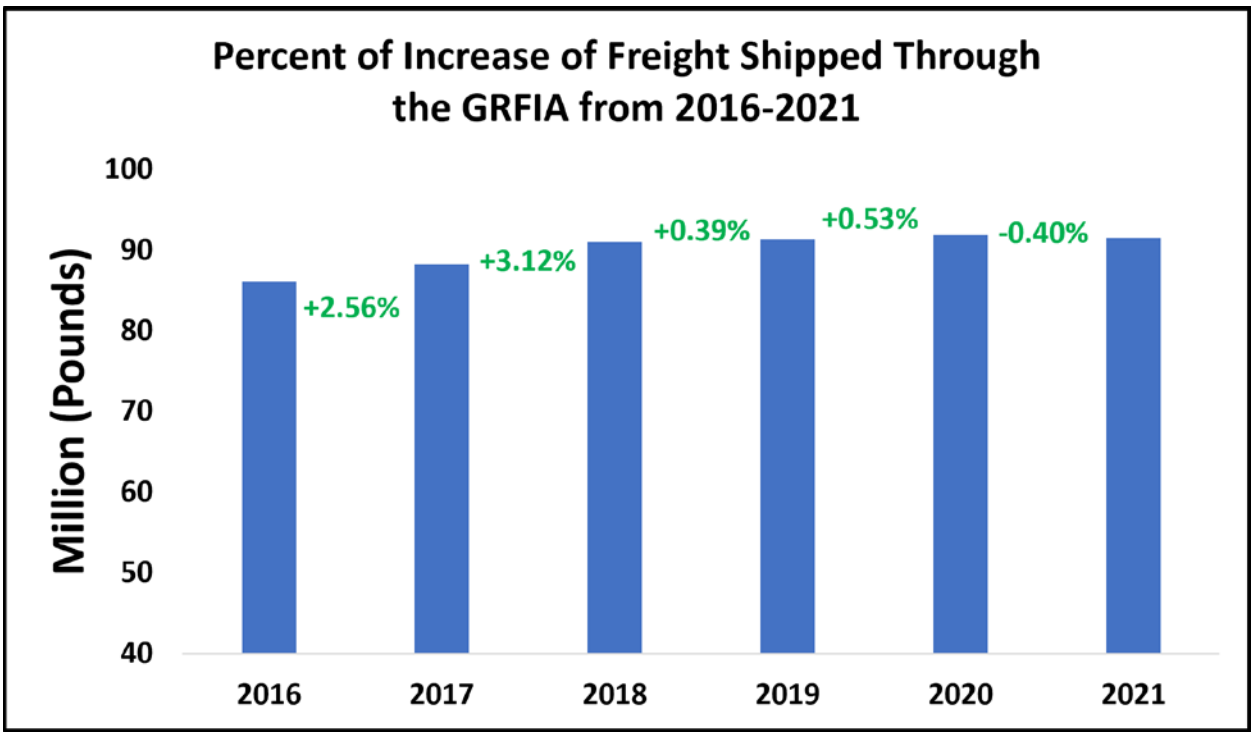
2.2 Air

GVMC Area Data

FedEx Cargo Plane at the GRFIA

Grand Rapids has a long history of moving freight by air. In 1928, a plane named *Miss Grand Rapids* transported the first shipment of furniture by air from the Kent County airport, located four miles from downtown Grand Rapids. All-cargo air freight service came to Grand Rapids in 1946. The Airport has grown substantially throughout the years and moved to its current location southeast of downtown Grand Rapids in 1963. In 1999, the airport was renamed the Gerald R. Ford International Airport (GRFIA) in honor of the 38th President of the United States. Two cargo airlines currently serve GRFIA, and more than 250,000 pounds of air cargo pass through the airport each day, on average. In 2020, the airport moved 91,883,489 pounds of freight with a steady increase over five years. In 2021, GRFIA experienced a slight drop in pounds moved. This trend aligns with a drop in air freight volumes across North America with supply chain constraints and other

global phenomena. The Airport also generates $3.1 billion in economic output for the West Michigan region.

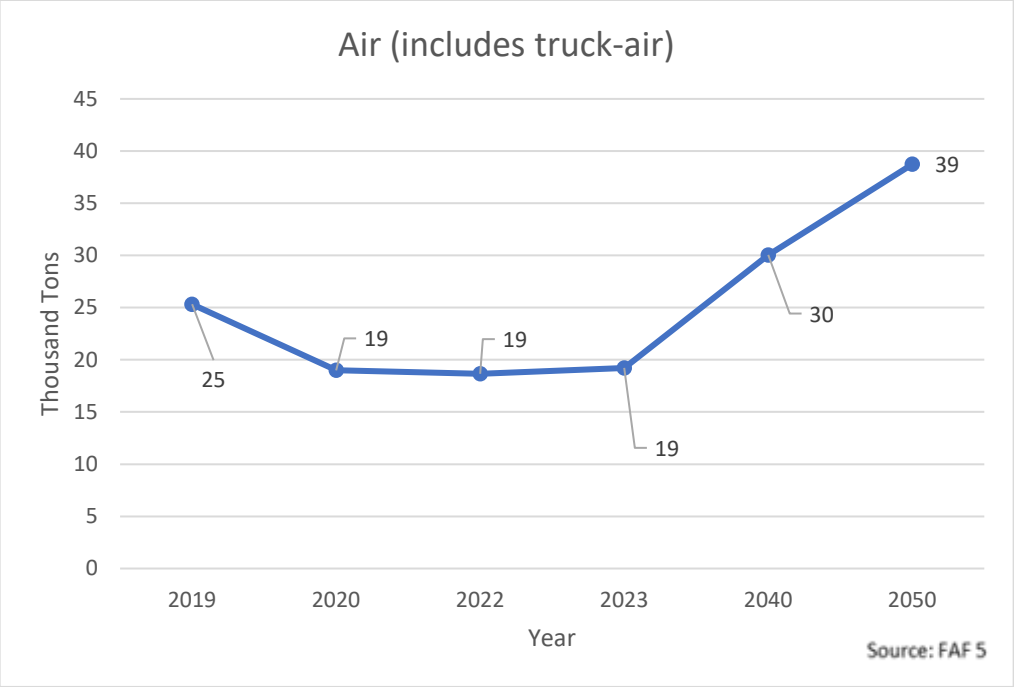


Statewide, 17 airports offer scheduled services that handle air cargo. Local airports continue to serve as strong economic engines for local communities by providing service to airport-dependent businesses to connect to the global marketplace in the quickest way possible. Highway access to the airport is a critical issue to ensure freight is moved efficiently between modes and local shippers/receivers in the MPO area.

FAF Data

Air freight movements using the Grand Rapids CFS area as the origin is projected to increase from 8.45-million-ton miles in 2022 to 16.19 million ton miles in the year 2050. Air freight movements where the Grand Rapids CFS area is the destination are projected to increase from 6.28 million ton-miles in 2022 to 13.67 million ton-miles in 2050. The industries projected to see the largest percentage growth in commodity are alcoholic beverages, tobacco products, furniture, and textiles/leather, and plastics/rubbers.

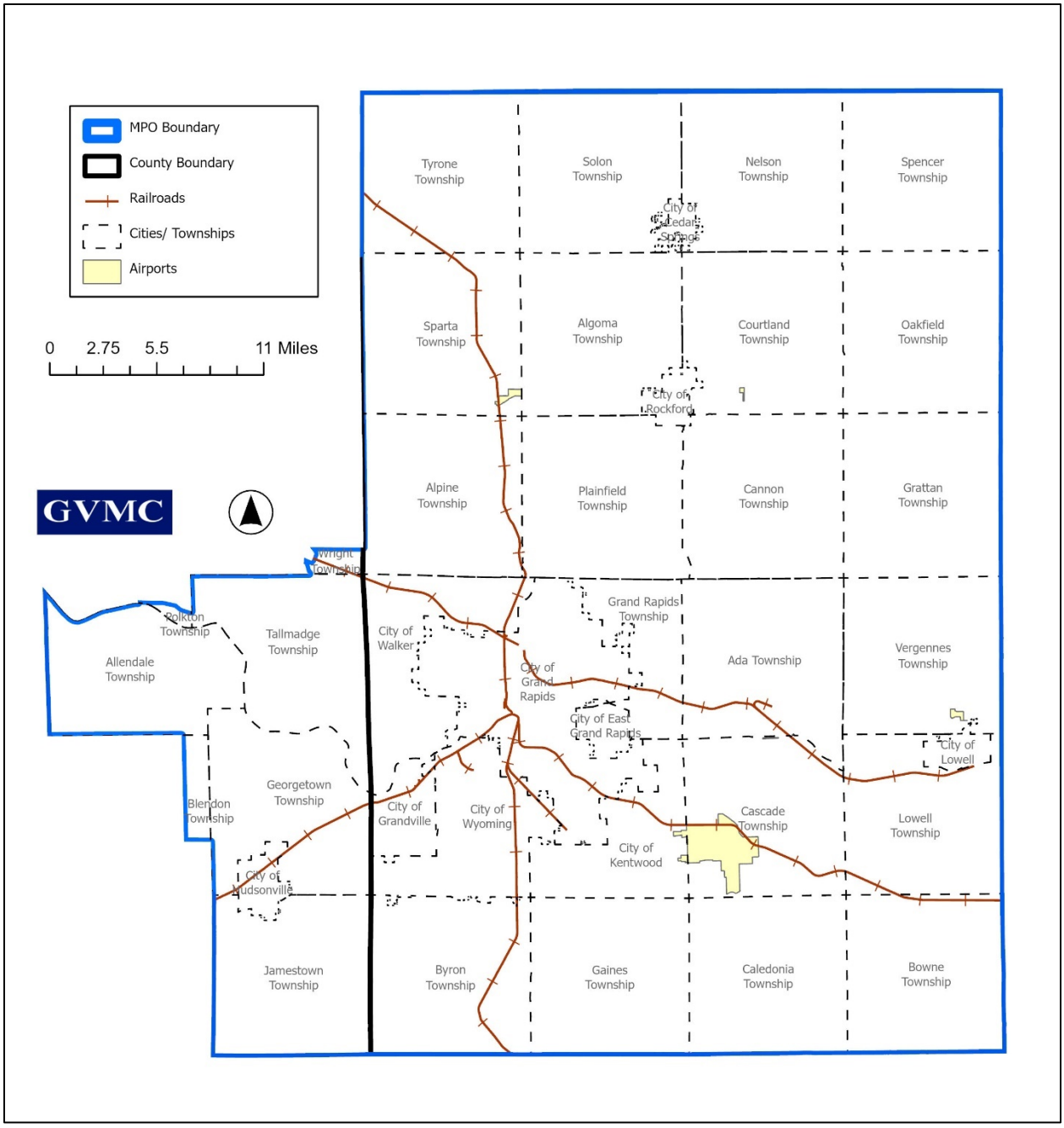
The following chart shows the change in tonnage of commodities traveling from and into the Grand Rapids FAF zone by plane. (*FAF Air mode includes shipments move by air or a combination of truck and air in commercial or private aircraft. Includes air freight and air express. In the case of imports and exports by air, domestic moves by ground to and from the port of entry or exit are categorized as a Truck.*)



2.3 Rail

GVMC Area Data

The Grand Rapids Metropolitan area is fortunate to have five freight rail companies—Grand Rapids Eastern Railroad (GRE), Marquette Rail (MQT), CSX Transportation, Grand Elk Railroad (GDLK), and the Coopersville and Marne Railroad—and one passenger rail option, the Amtrak *Pere Marquette* service to Chicago on the CSX line through Holland. There are approximately 120 miles of operational track in the metropolitan area and 270 at grade crossings. However, several major corridors have been abandoned within the past decade and have been converted for use by nonmotorized travel (rail-trails). Two short line railroads are now owned by the G&W Railroad, which is a national short line operator. Within the GVMC area all the rail lines flow through Grand Rapids. In 2018, the largest volume movement was between Grand Rapids and Holland with greater than 4 million tons. The rail line from Grand Rapids headed to Lansing was the next highest volume flow with greater than 2 million tons. The other three branches connected to Grand Rapids carried less than 2 million tons. Lumber, logs, and wood products; chemicals; and transportation equipment comprise the largest volumes of commodities traveling through the GVMC region – see Map 4.

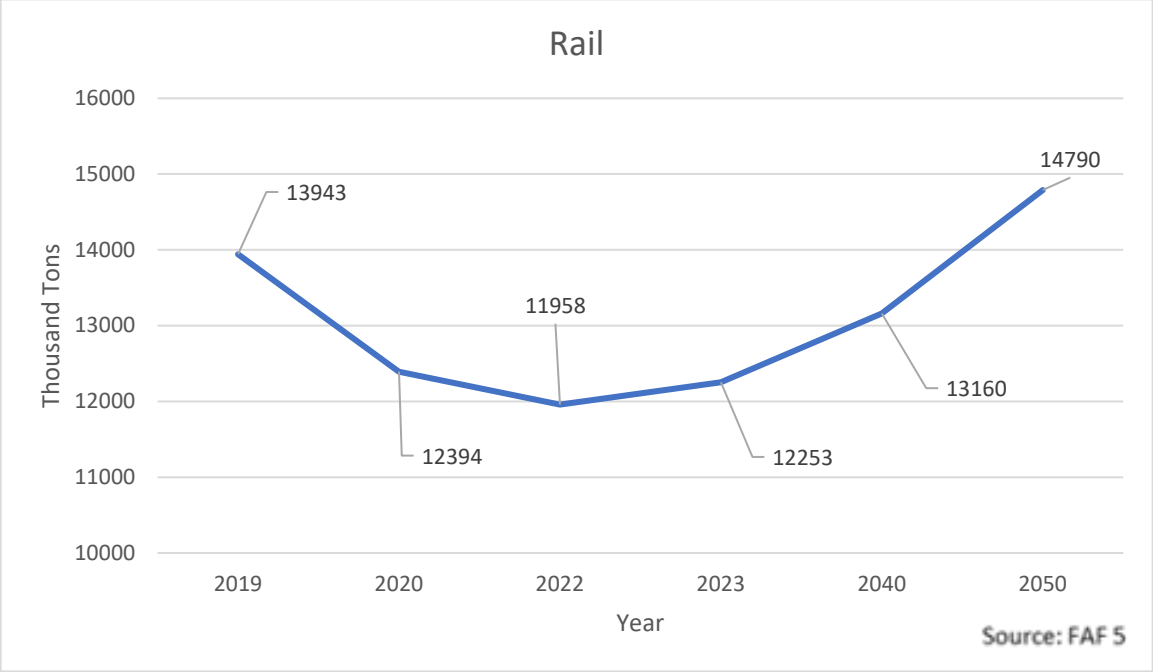


Map 4: GVMC Rail Facilities

FAF Data

Rail freight movements out of the Grand Rapids CFS area are projected to grow from 1,112.21 million ton-miles in the year 2022 to 1,957.447 million ton-miles in the year 2050. Rail freight movements into the Grand Rapids CFS area are projected to decrease from 8,601.23 million ton-miles in the year 2022 to 7,238.33 million ton-miles in the year 2050. The commodities with the largest growth in ton-miles include animal feed, alcoholic beverages, meat/seafood, base metals, and metallic ores.

The following table shows the change in tonnage of commodities traveling from and into the Grand Rapids FAF zone by rail.



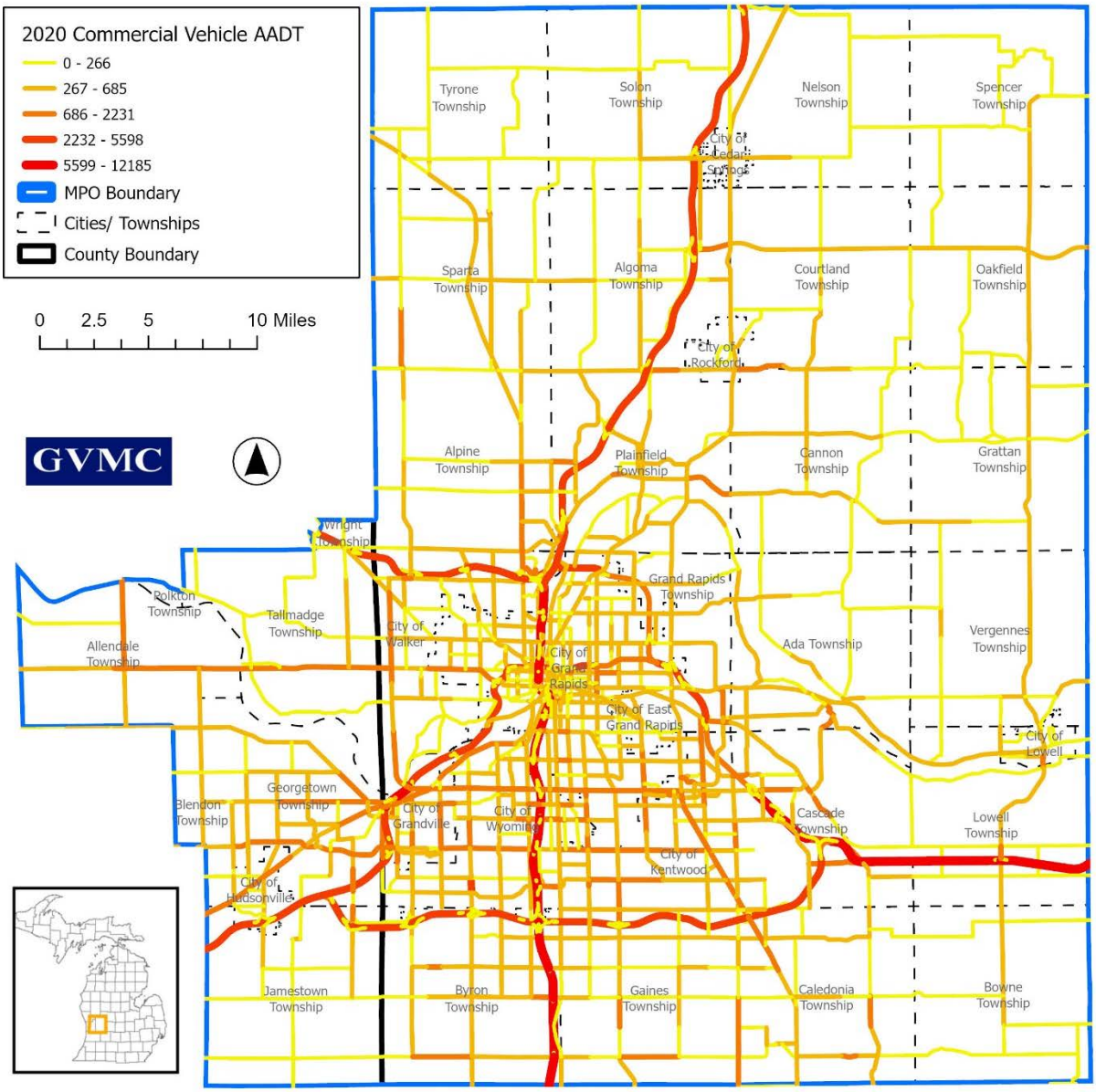
2.4 Highway

GVMC Area Data

Semi-trailers from Founder's

An extensive transportation system connects Greater Grand Rapids to major cities and transportation hubs throughout the Midwest, which makes transporting freight by highway an attractive option. Currently, more freight is carried by truck than any other form in our area. In 2018, Kent County experienced 30-70 million, and Ottawa County experienced 8-30 million total truck tons. This truck tonnage was valued between 15 -50 billion dollars and 50-100 billion dollars, respectively. MDOT has determined 62.8 miles of roadway to be eligible candidates for Critical Urban Freight Corridors and 6.7 miles of roadway to be eligible candidates for Critical Rural Freight Corridors in the GVMC area. A map of GVMC's regional freight network is included on page 13. As expected, the larger volumes of commercial vehicles are traveling on US-131, I-196, I-96,

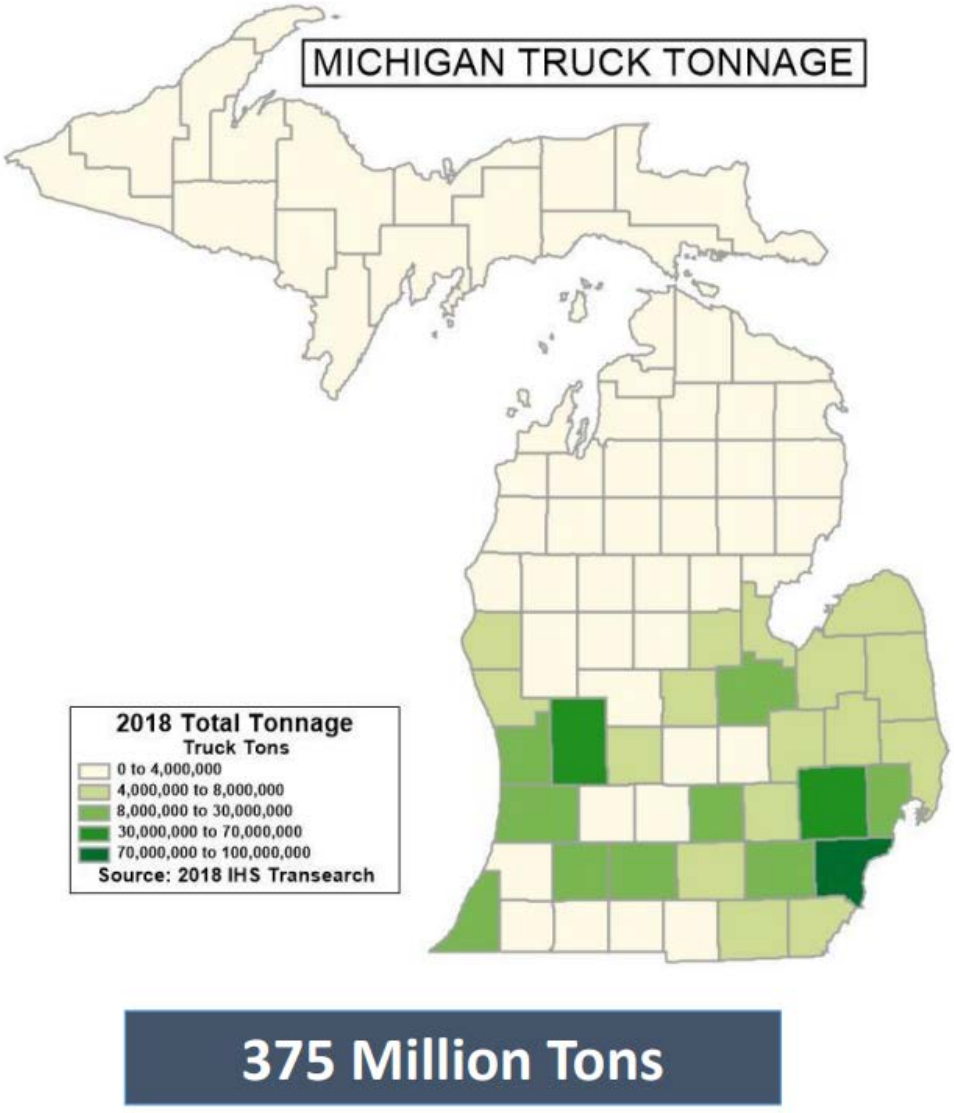
and M-6. Additionally, there are several other road segments within the area experiencing upwards of 2,230 commercial vehicles a day, identified in the map below, that help freight movement within the communities of GVMC.



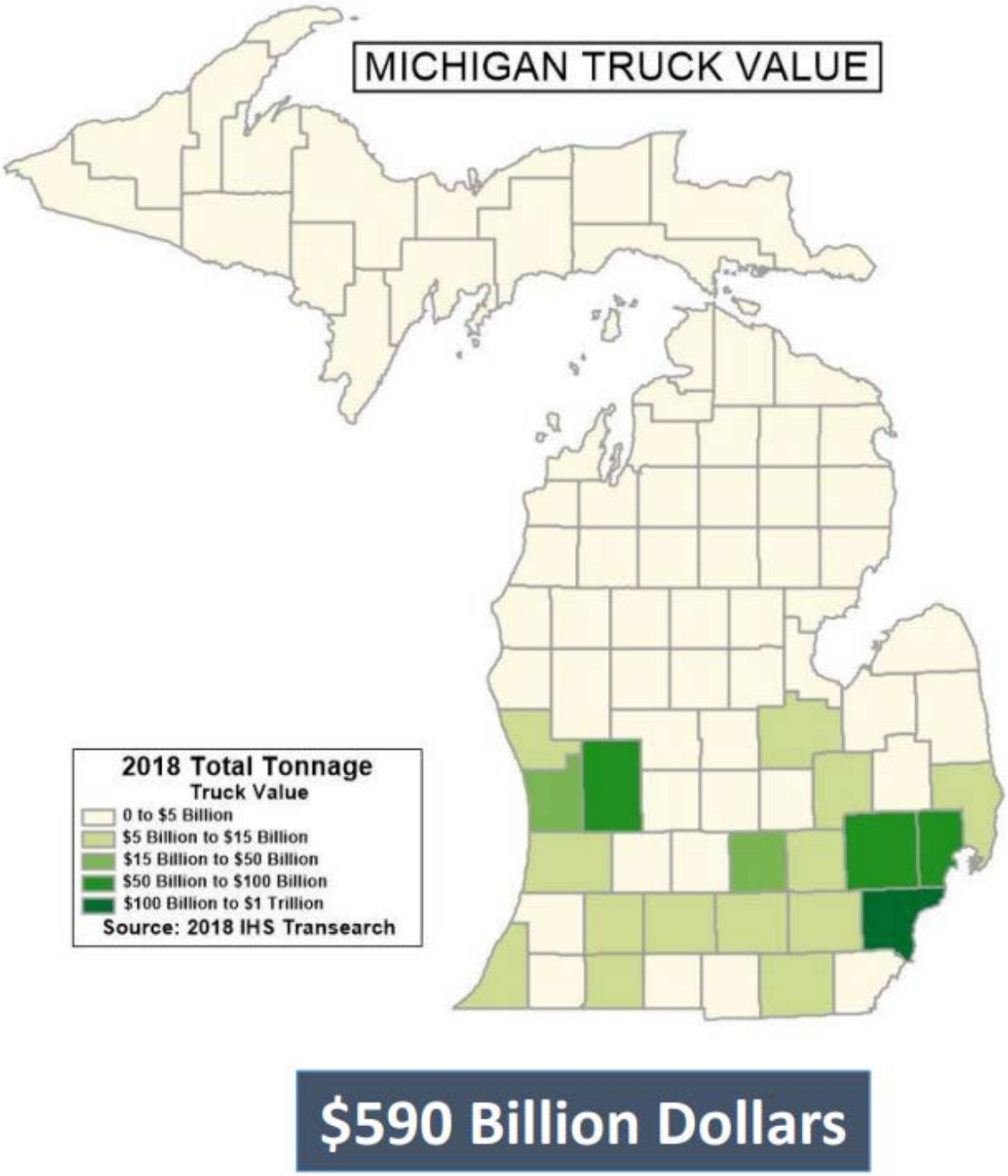
Map 5: GVMC 2020 Commercial AADT Volumes

Michigan is especially attractive to industries such as manufacturing, mining, forestry, agricultural, and construction sectors because of state specific truck weight laws. Michigan law regulates trucks on weight per axel rather than gross vehicle weight.

MDOT has conducted research to show that pavement damage is related to axel loadings rather than gross vehicle weight. This law allows larger heavier trucks on the road which in turn reduces the number of trucks on the road, lower rates for shippers, and less fuel usage. Statewide, the trucking industry accounts for more than 65% of the total freight tonnage moved and more than 73% of the tonnage transported by value.



Map 6: Michigan's Truck Tonnage by Volume. Map

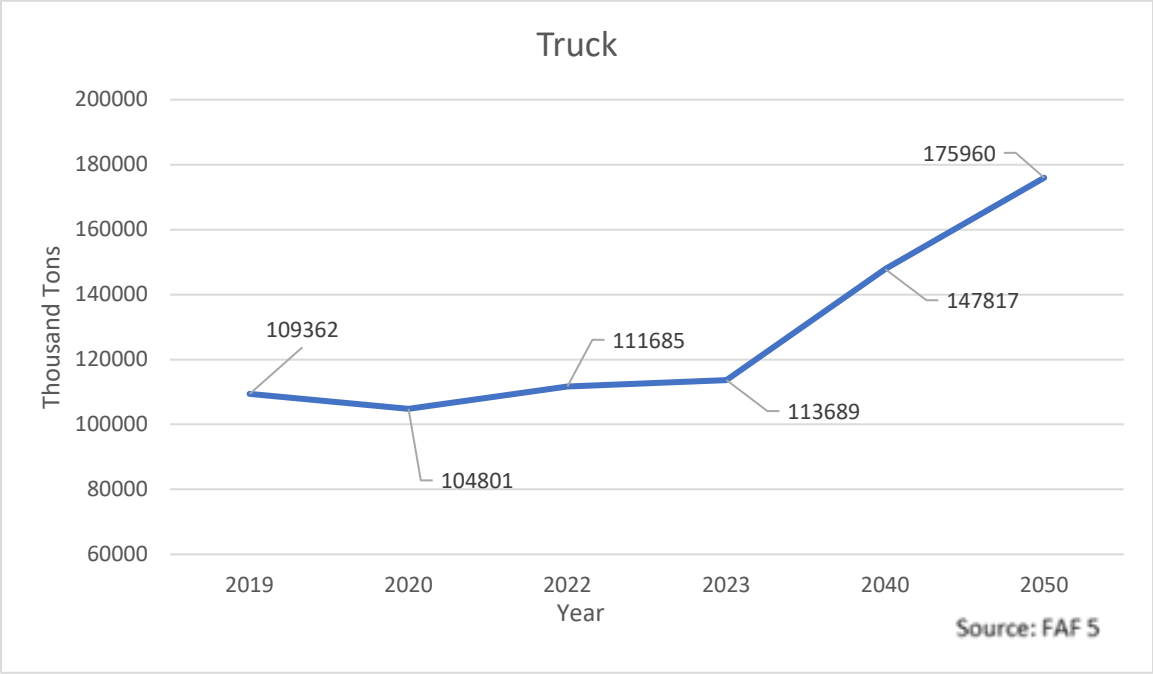


Map 7: Michigan's Truck Tonnage by Value. Map Courtesy of MDOT.

FAF Data

Truck freight movements out of the Grand Rapids CFS area are projected to grow from 10,542.82 million ton-miles in the year 2022 to 17,194.53 million ton-miles in the year 2050. Truck freight movements into the Grand Rapids CFS area are projected to grow from 9,279.74 million ton-miles in the year 2022 to 16,026.12 million ton-miles in the year 2050. The commodities with the largest growth in ton-miles include live animals/fish, pharmaceuticals, miscellaneous manufactured products, basic chemicals, and textiles/leather.

The following table shows the change in tonnage of commodities traveling from and into the Grand Rapids FAF zone by truck.

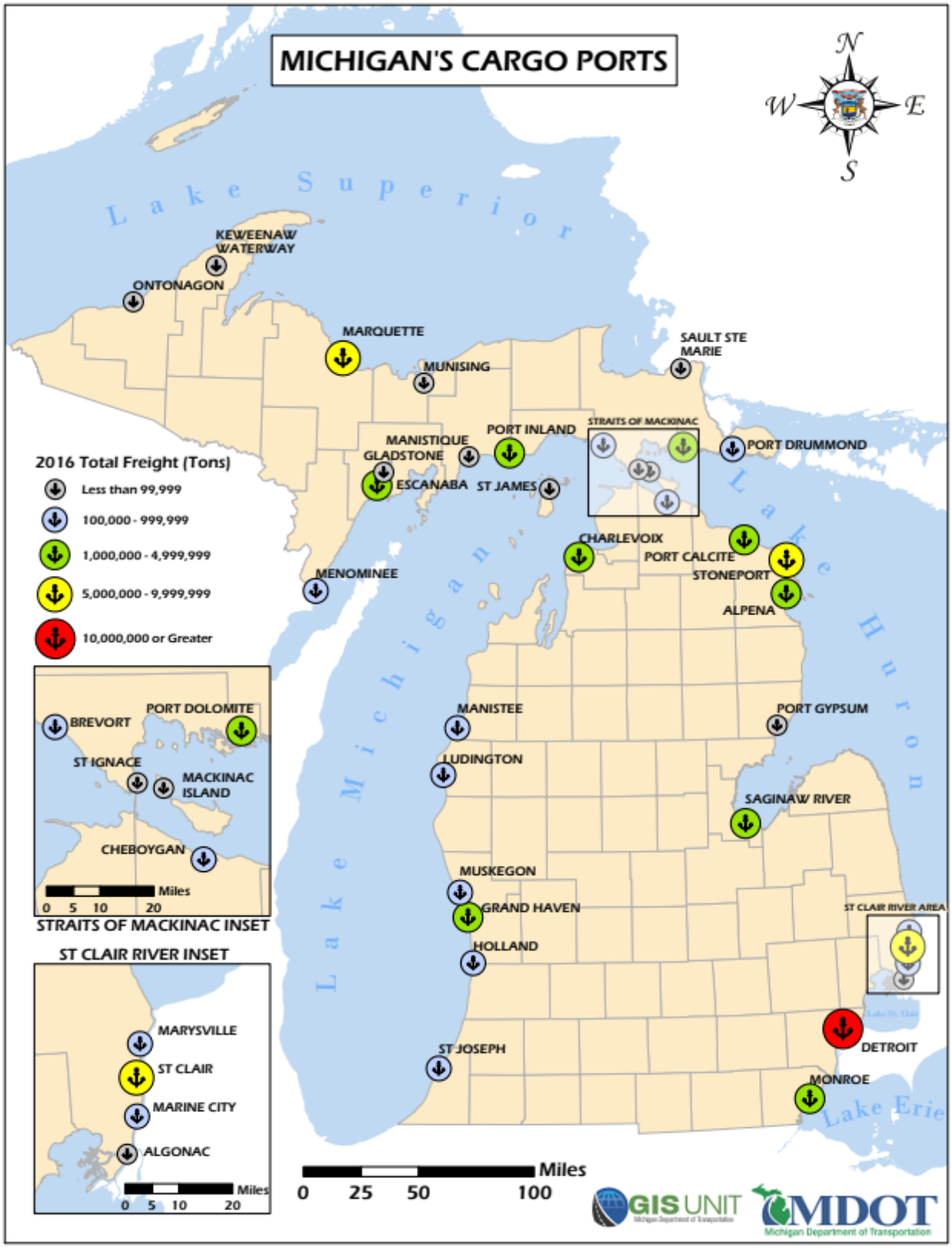


2.5 Marine and Pipeline

GVMC Area Data

The GVMC area does not have any terminal pipelines or ports within the boundary; however, the immediate surrounding areas do have these facilities. There are ports located in Grand Haven, Holland, and Muskegon as well as pipeline terminals in Ottawa and Muskegon Counties all of which are within 50 miles from the heart of the GVMC planning area. GVMC should remain cognizant of opportunities with these facilities as well as the other primary modes of freight transportation in the region that may interact with them.

Map 8: Michigan Pipelines. Courtesy of MDOT.

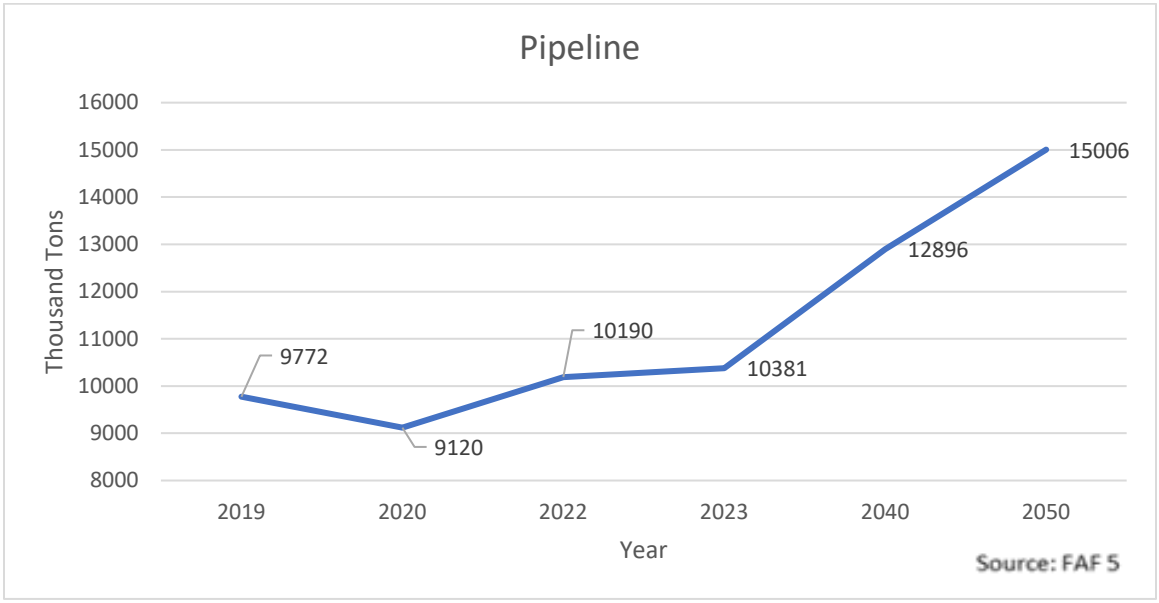


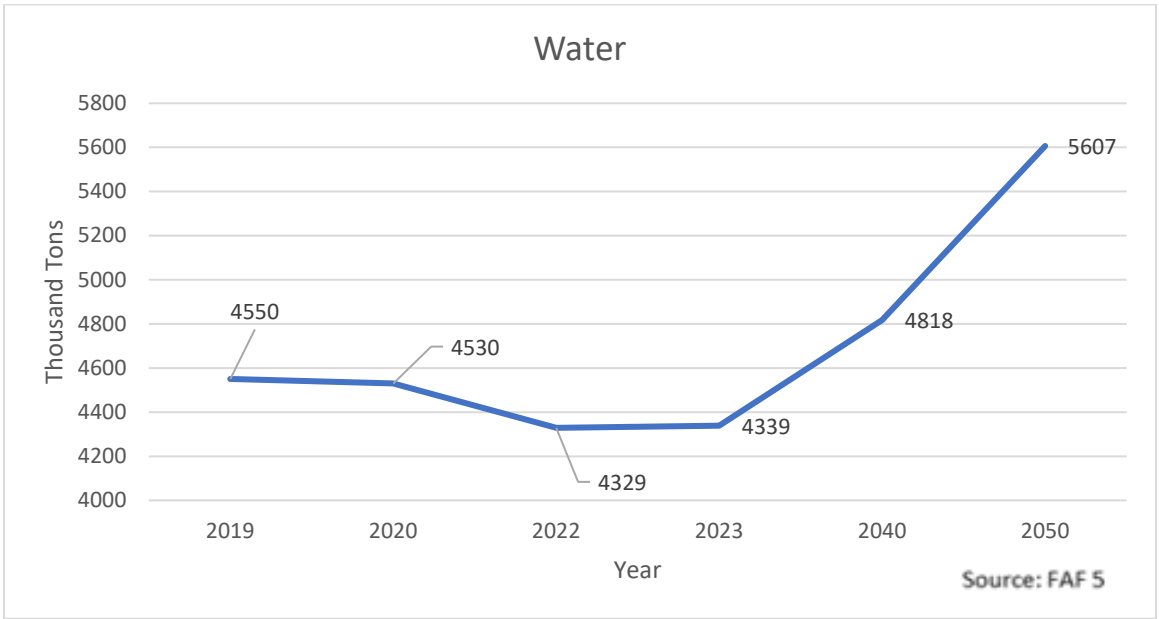
Map 9: Michigan Ports. Courtesy of MDOT.

FAF Data

Pipeline movements by commodity ton are expected to grow 29.5% and water movements by commodity ton are expected to grow by 47.2% over the next thirty years. The commodities with the largest growth in ton-miles via water are nonmetallic minerals, coal, nonmetallic mineral products, and waste/scrap. The commodities with the largest growth in ton-miles via pipeline are gasoline, coal, and basic chemicals. The following tables show the change in tonnage of commodities traveling from and into the Grand Rapids FAF zone by pipeline and water.

The following tables shows the change in tonnage of commodities traveling from and into the Grand Rapids FAF zone by rail.





3. Freight and the Economy

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3.1 Introduction

With affordable and easy access to most major markets and a robust transportation infrastructure, West Michigan is an attractive location for companies of all sizes. According to The Right Place's Manufacturing in West Michigan report, West Michigan is home to one of the nation's largest and most diverse material manufacturing supply chains in the U.S. Manufacturing is the heart of West Michigan's economy and currently accounts for 20% of all jobs in the region, which contain some of the nation's largest industry concentrations in metals, plastics, biopharmaceuticals, medical devices, production technology, automotive, office furniture and food processing.

Here are some highlights:

- FOOD CHAIN: West Michigan's agribusiness sector produces one-third of Michigan's total agricultural sales, contributing $1.5 billion to the regional economy. The sector is among the most productive and diverse regions in a state that is second only to California in its agricultural diversity.

- FOOD PROCESSING: West Michigan's access to water makes it an ideal location for food processing. In Grand Rapids alone, businesses have access to over 61.1 million gallons per day (MGD) with over 10 MGD excess capacity.

- FURNITURE HERITAGE: Since the early 1800s, Grand Rapids and West Michigan have been the epicenter for furniture craftsmanship, design, and innovation. That heritage of craftsmanship is still alive and well in the 150+ furniture companies and 225 suppliers in the region today.

- INDUSTRIAL DESIGN: West Michigan is a premier design center with many of the world's leading office furniture designers graduating from Grand Rapids-based Kendall College of Art and Design and other local universities.

- MEDICAL DEVICES: West Michigan hosts the highest concentration of medical device manufacturers in the state. As one of the fastest growing medical clusters in the Midwest, the region now employs over 20% of Michigan's medical device professionals.

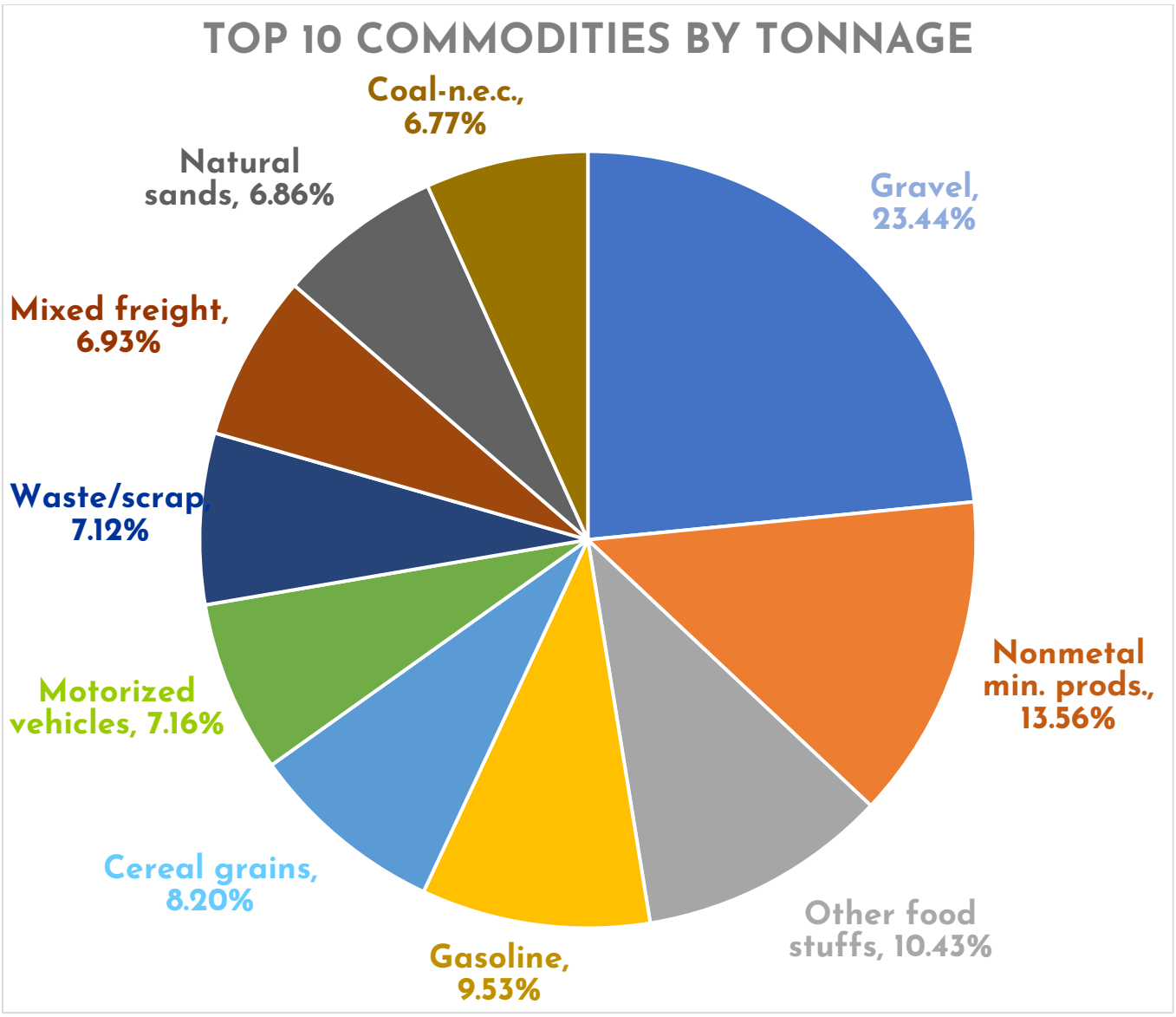
It is critical for West Michigan's transportation system to be efficient and reliable to reduce or avoid costly delays for West Michigan businesses.

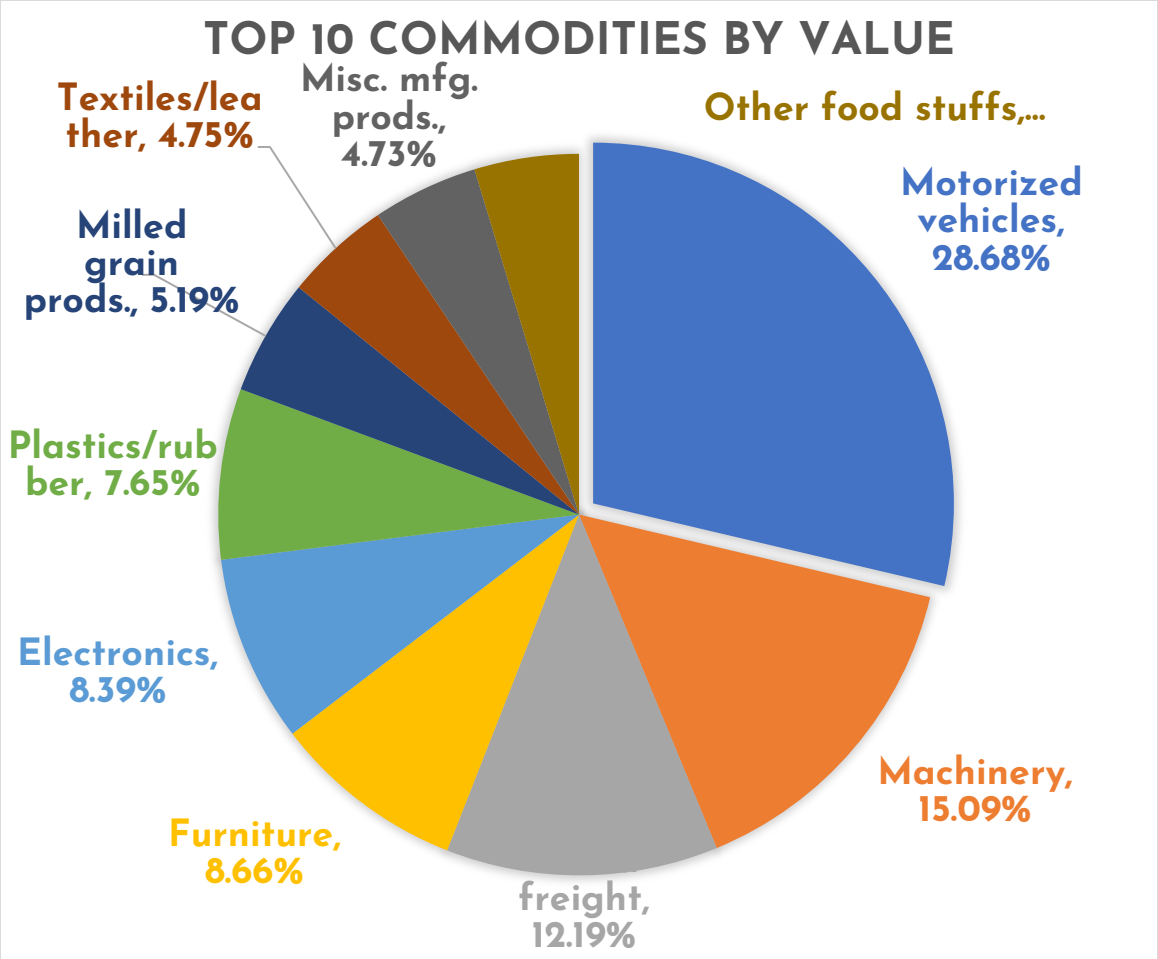
3.2 Top Commodities

Commodity Quantity and Value

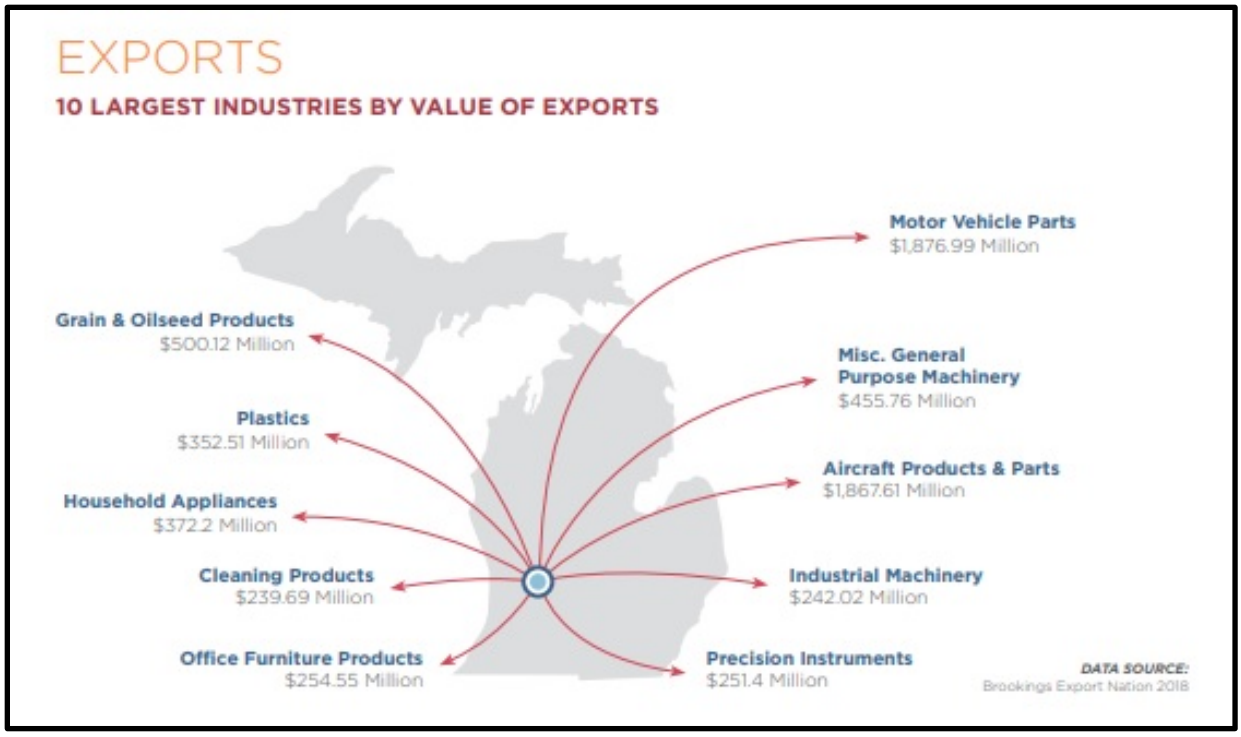
The Grand Rapids region's freight infrastructure, including road, rail, water, air, pipeline, and other (multiple-mode movements), supports the movement of a wide range of goods across the region. The best data available for understanding the commodity flow is through FAF5 at the CFS area level.

The graphics that follow show the top 10 commodities in the FAF area by tonnage and by value:

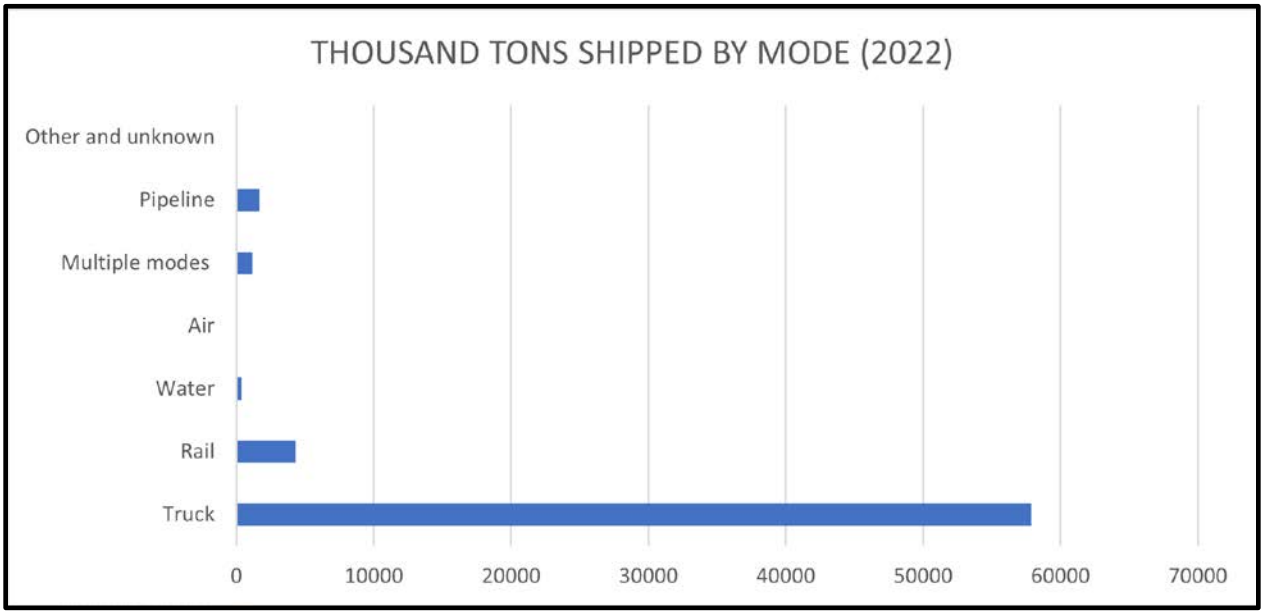

TOP 10 COMMODITIES BY TONNAGE
Coal-n.e.c., 6.77%
Natural sands, 6.86%
Gravel, 23.44%
Mixed freight, 6.93%
Waste/scrap, 7.12%
Nonmetal min. prods., 13.56%
Motorized vehicles, 7.16%
Cereal grains, 8.20%
Other food stuffs, 10.43%
Gasoline, 9.53%

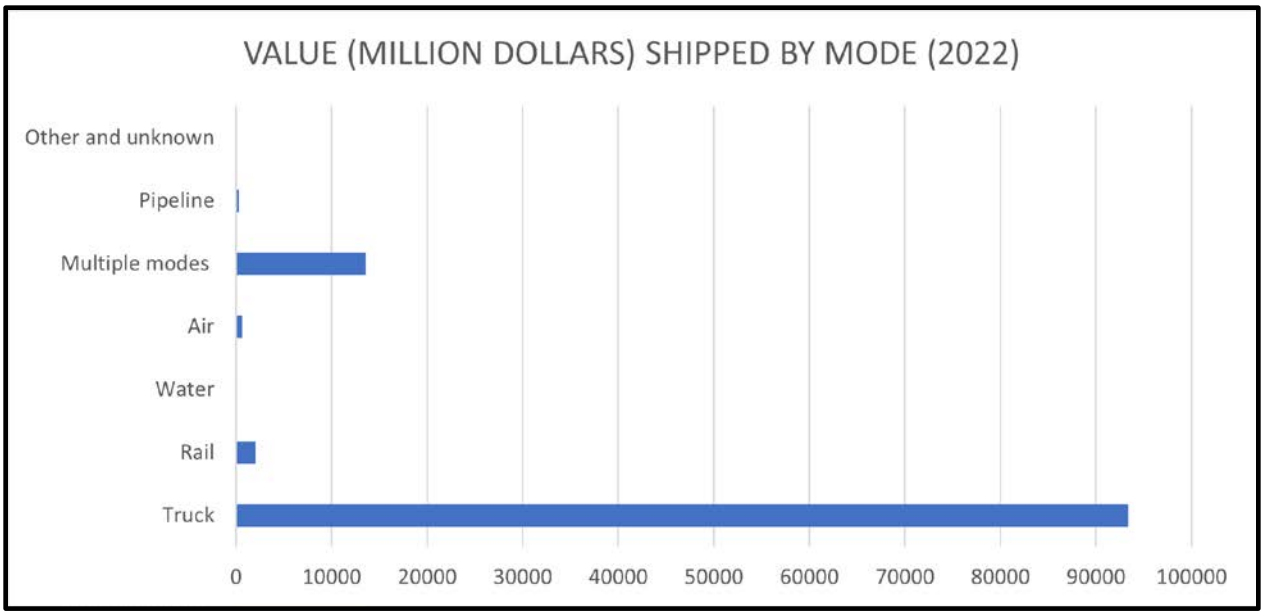


The graphic below from The Right Place's Manufacturing in West Michigan report also details the 10 largest industries by value of exports in the Grand Rapids area.



As evidenced in the charts below, freight is primarily moved by truck in our area, whether by weight or value. However, rail, water, air, pipeline, and multiple modes and mail are also used.





Commodity Movement

According to FAF data, the top three FAF zone destinations of outbound freight by both weight and value in our FAF region are Grand Rapids, Detroit, and Chicago. This means that a significant amount of outbound freight stays within our FAF region (see map on page 13) and within our state. Th

e complete list of the top 10 FAF zone destinations of outbound freight by weight and value are listed below.

Destinations of Outbound Freight by Weight and Value (FAF Zone)

By Weight	By Value
1. Grand Rapids	1. Grand Rapids
2. Detroit	2. Detroit
3. Chicago	3. Chicago
4. Pittsburgh	4. New York
5. Fort Wayne	5. Laredo
6. Laredo, TX	6. Los Angeles/Dallas
7. New York	7. Atlanta
8. Dallas	8. Cincinnati
9. Los Angeles	9. Cleveland
10. Columbus	10. Indianapolis

For more detailed information on the outbound freight movements by FAF zone, including volume and value shipped by mode, and to view similar data by state instead of FAF zone, please see Appendix B.

Similar information is also available for the top 10 origins of inbound freight by weight and value by FAF zone and is included in the table that follows. Just like

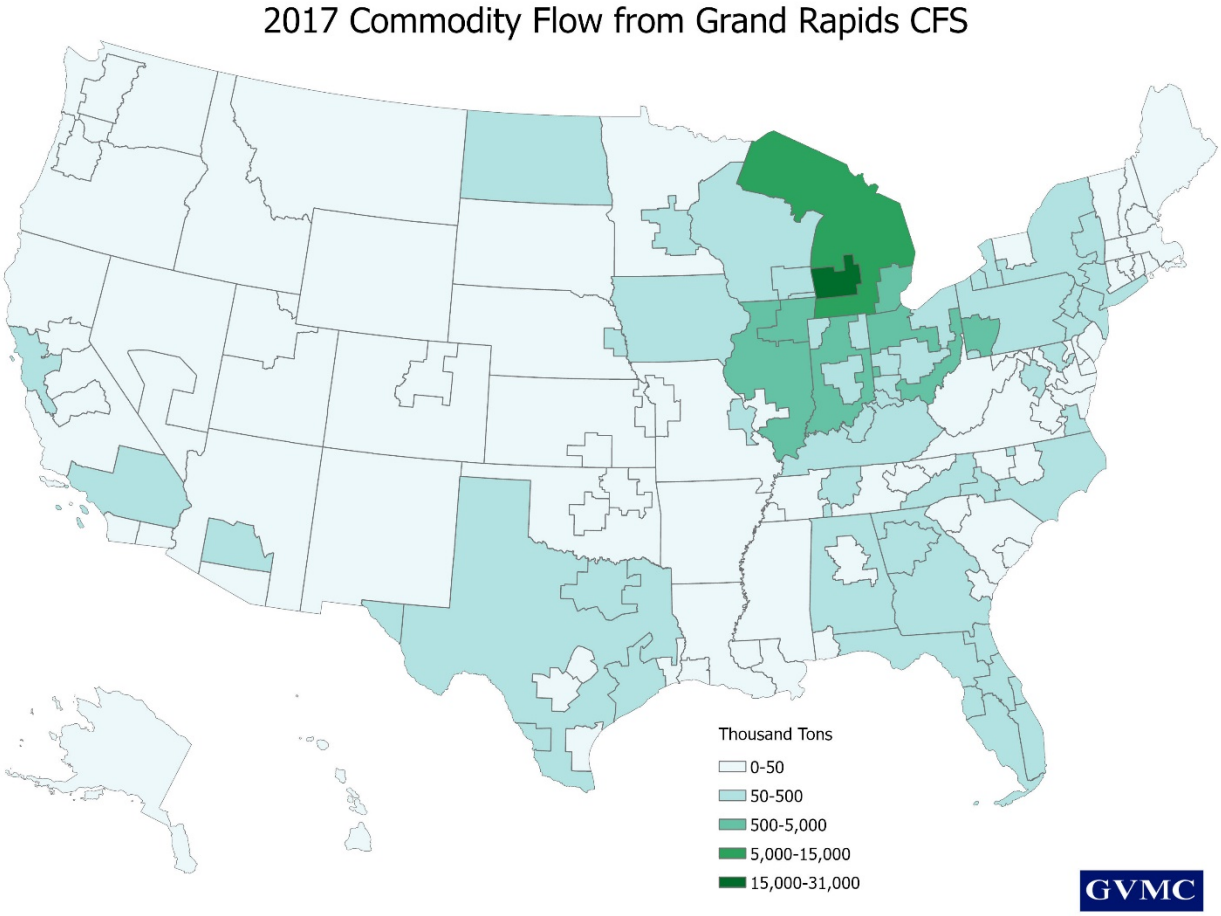
outbound freight, the data shows that the most inbound freight by both weight and value comes from other locations within our FAF zone (see map on page 13), followed by Detroit and Chicago. Statewide data, as well as details on volume and value shipped by mode, is included in Appendix B.

Origins of Inbound Freight by Weight and Value (FAF Zone)

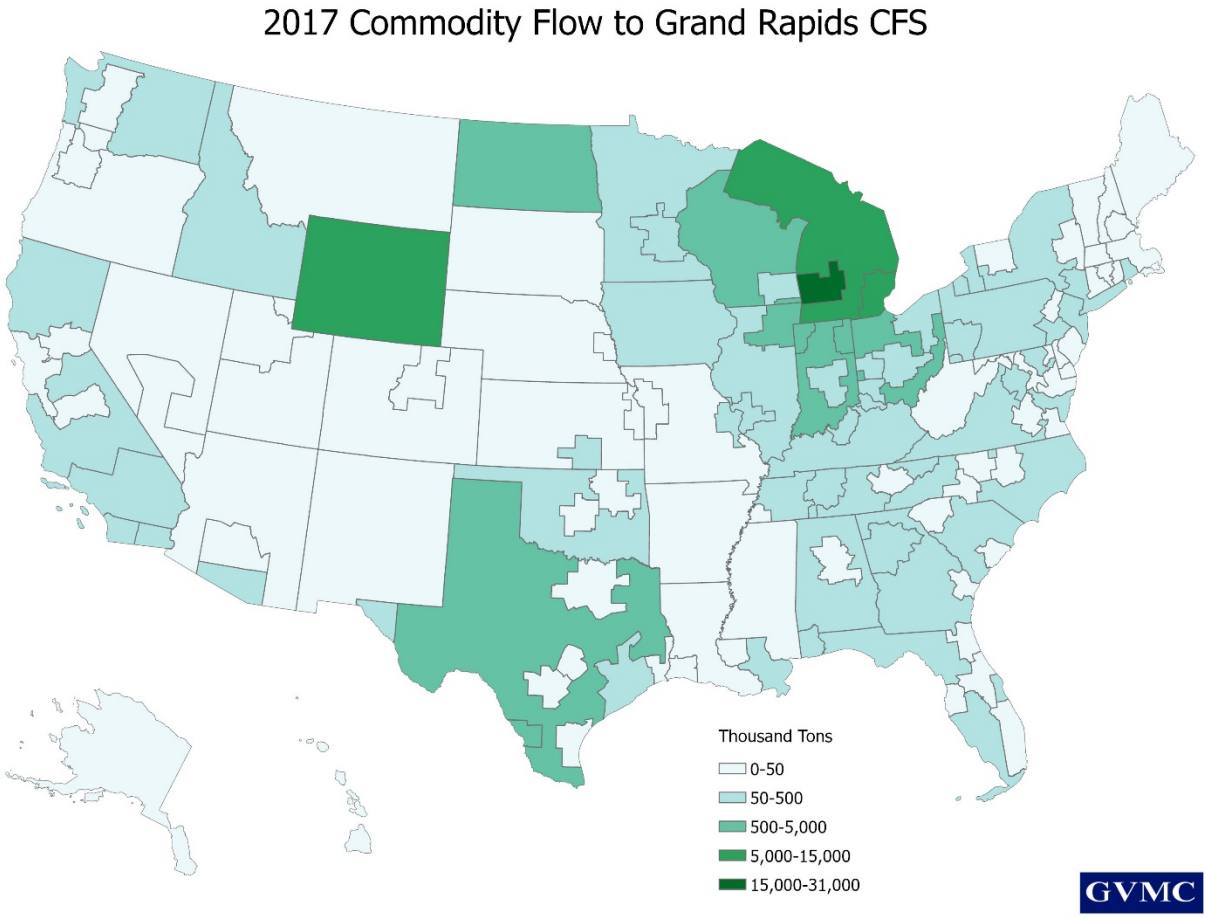
By Weight	By Value
1. Grand Rapids	1. Grand Rapids
2. Detroit	2. Detroit
3. Chicago	3. Chicago
4. Fort Wayne	4. Laredo
5. Laredo	5. New York
6. Cleveland	6. Cleveland
7. Columbus	7. Los Angeles
8. Cincinnati	8. Columbus
9. Indianapolis	9. Fort Wayne
10. New York	10. Buffalo

As seen in the charts, Grand Rapids, Detroit, and Chicago remain the top three destinations and origins of freight shipped through our area, whether by tonnage or by value, which means that we get the largest amount of goods from within our FAF region, and most goods produced within our FAF region stay within the region. Therefore, it is critically important to maintain and enhance transportation system access and connections to and from these locations.

On a national scale, the following maps show thousand tons of commodities flowing both from the Grand Rapids FAF zone to the other the other FAF zones across the United States.



Map 10: Commodity Flow from Grand Rapids – Wyoming – Muskegon CFS



Map 11: Commodity Flow to Grand Rapids – Wyoming – Muskegon CFS

4. Freight Safety

Photo courtesy of Pixabay

4.1 Introduction

The safe movement of people and goods is also of primary importance for GVMC. GVMC's 2045 Metropolitan Transportation Plan (MTP) includes the following goals and objectives that address freight and safety:

Goal 1: Further Develop an Efficient Multimodal System

Objective 1c: Implement strategies to promote efficient and reliable system management and operation that result in the reliable and safe movement of people and freight.

Goal 3: Enhance Safety and Reduce Congestion

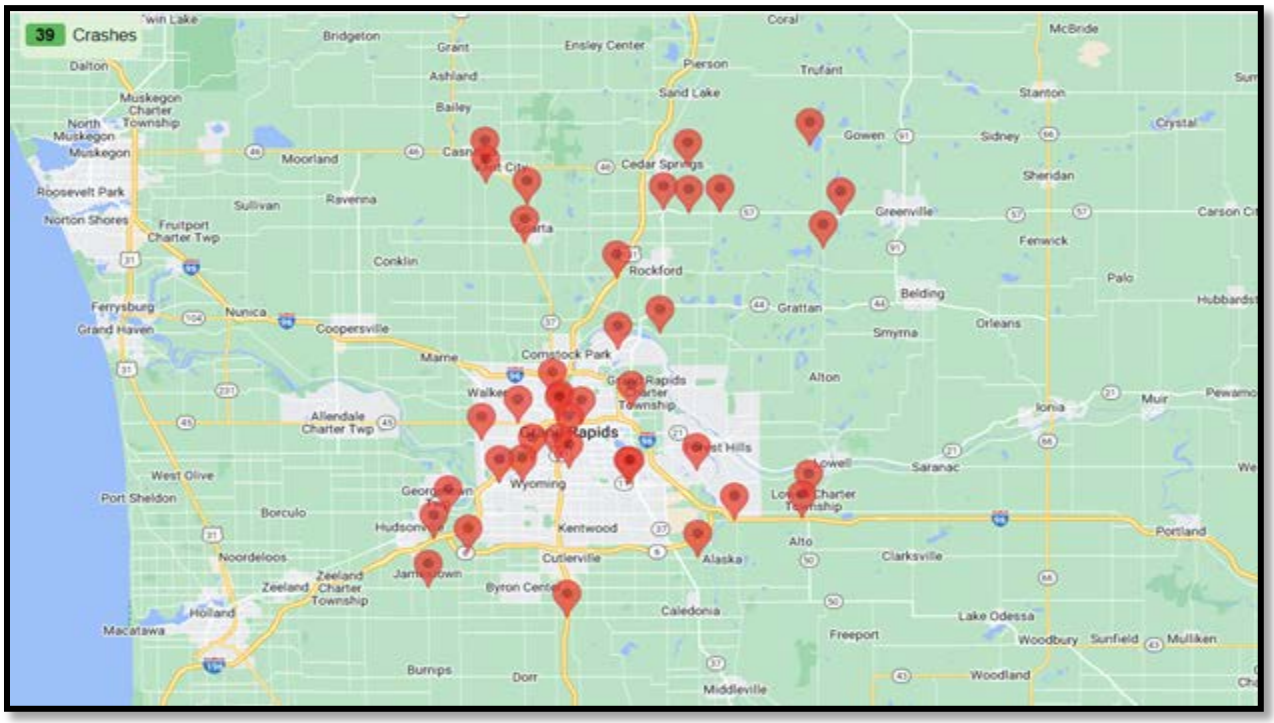
Objective 3g: Improve safety of the transportation system for motorized and nonmotorized users in support of federal performance measures by identifying and prioritizing projects that will reduce the likelihood or severity of crashes and incorporating safety improvements with all transportation projects where feasible and practical.

The MTP also includes four recommendations, one of which is to: "Work to improve safety for all users of the transportation system."

By working to achieve these goals, objectives, and recommendations, positive change can be made in the efficient and safe movement of goods throughout our transportation system.

4.2 Safety Analysis

Most freight in GVMC's area is transported by truck, which necessitates an evaluation of our roadway system to determine common conflict points and safety issues. GVMC staff conducted an analysis of all truck/bus-involved fatal and serious injury crashes in the GVMC region from 2017-2021 using data from Michigan Travel Crash Facts (https://www.michigantrafficcrashfacts.org/). The figure that follows show the locations of all truck/bus-involved fatal and serious injury crashes in the GVMC region from 2017-2021. The map shows that truck/bus-involved fatal and serious injury crashes were clustered along freeways (especially US 131) and other high truck volume corridors.



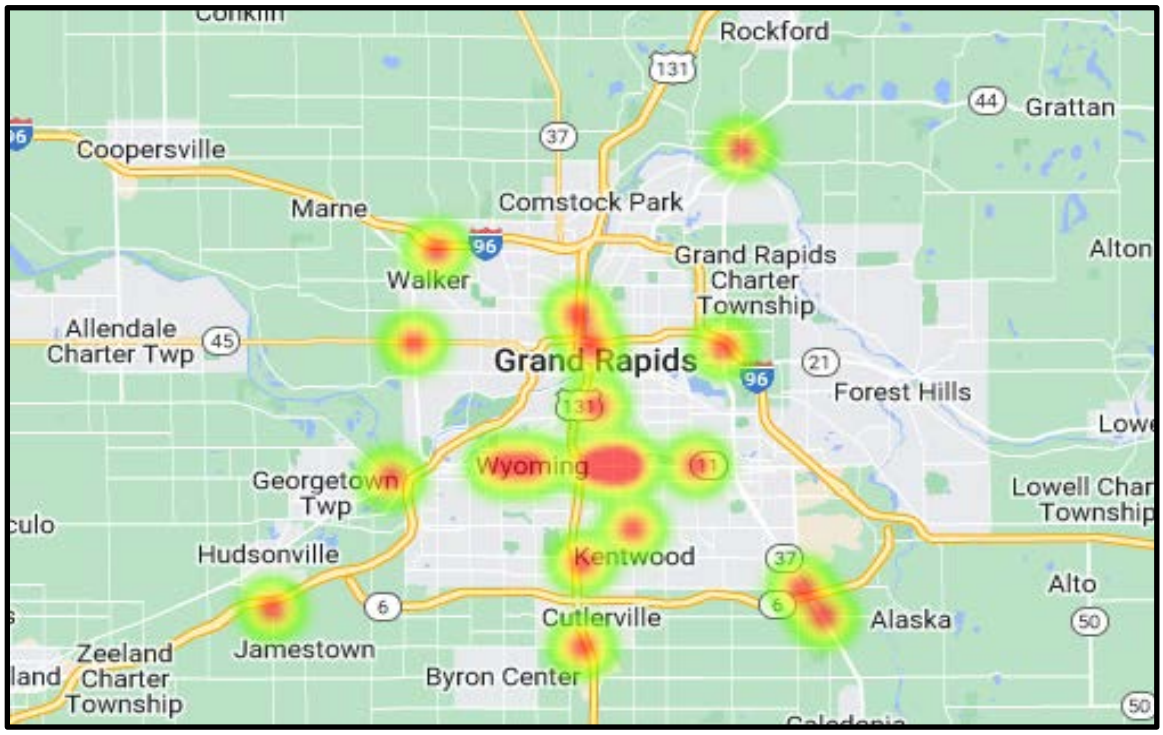
Map 12: 2017-2021 Truck-Involved Fatal and Serious Injury Crashes

Truck/bus-involved crashes accounted for 5% of all vehicle crashes from 2017-2021 in the GVMC region. Truck/bus involved crashes accounted for 12% of all crashes resulting in fatalities.

GVMC's analysis showed that primary contributing factors for these fatal and serious injury crashes were traveling too fast for conditions, errors in vehicle maneuvering, and driver inattention. Additional details on these crashes are available in Appendix E.

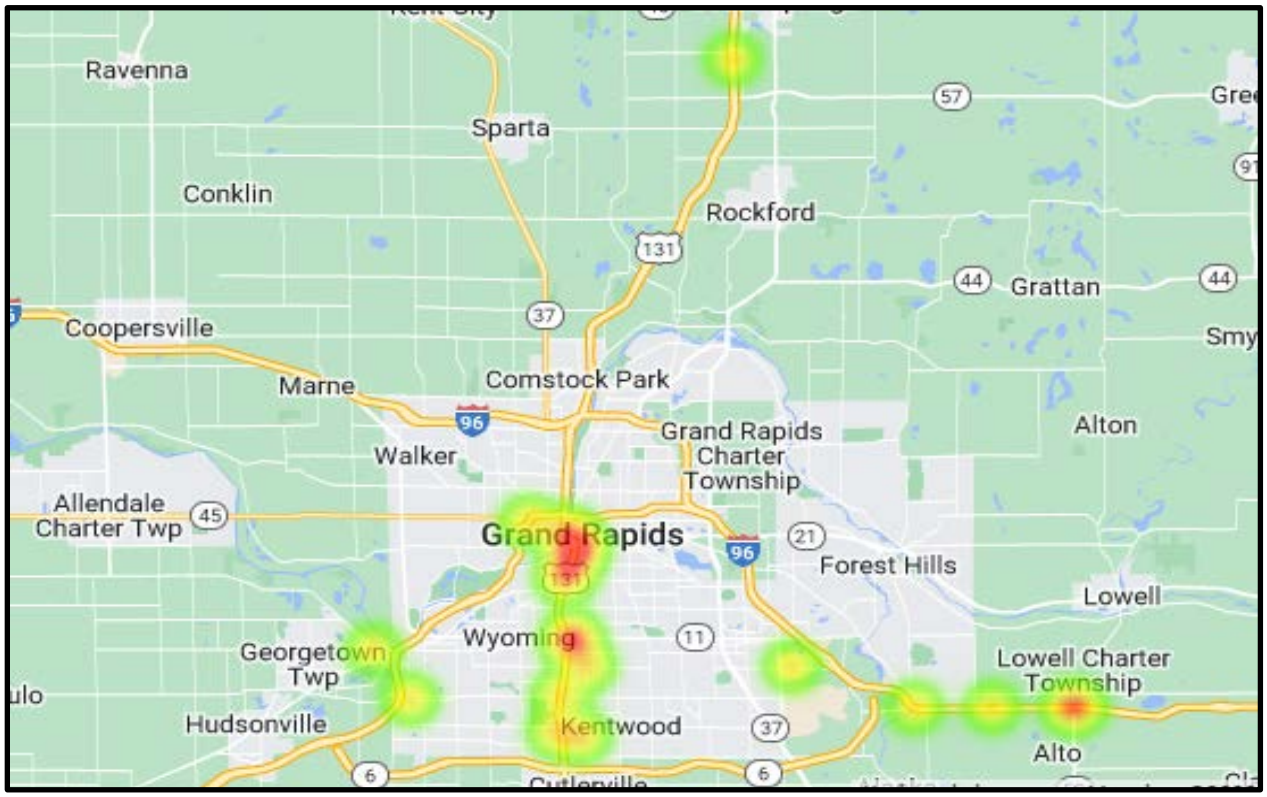
The map below illustrates the top 20 intersections and segments for truck-involved crashes from 2015-2019 in the GVMC region. These intersections are considered top

freight safety needs. The map also shows that truck-involved crashes were clustered along freeways and major truck corridors. To view the intersections as a table as well as site specific crash maps for the highest three truck related crash intersections, please see Appendix E.



Map 13: 2017-2021 Top 20 Truck-Involved Crashes Intersections Heat Map

The heat map that follows shows the top 20 truck involved crashes by road segment between 2015-2019. To view a table of these segments, please refer to Appendix E.



Map 14: 2021 Top 20 Truck-Involved Crashes Road Segments Heat Map

When assessing contributing factors to these crashes, all involved driver error.

Primary contributing factors to truck involved fatal and serious injury crashes included:

- Speed excessive to conditions, especially on freeway ramp
- Failure to stop within an assured clear distance
- Driver inattention

Primary contributing factors to other truck involved crashes also included failure to stop within an assured clear distance and speed excessive to conditions, as well as:

- Improper turn
- Improper lane change

Further details on these crashes is included in Appendix E.

Safety is also an important factor to the other modes of transportation, especially with the intermodal methods of transporting commodities. At grade crossings are junctions where to both rail and road intersect creating a facility that supports both motor vehicles and rail. From 2017-2021, there were five train involved crashes where the at-grade crossings did not have a crossing gate. Two of the crashes occurred within at-grade crossings that had no crossing gate or lighted signals; the two

locations were on Leland Ave NE in Comstock Park and Beverly Ave SW in Wyoming. See Appendix F for a list of train-involved crashes from 2017-2021.

5. Freight and Congestion

5.1 Introduction

Delays due to congestion can negatively impact regional businesses when trucks burn extra fuel when idling through congested areas and when employees lose productivity because they are caught in traffic. Therefore, it is important for GVMC to continually investigate bottleneck areas and potential solutions to ensure traffic is moving properly and that the system is reliable.

To achieve this goal, GVMC employs a Congestion Management Process (CMP) and encourages the use of Travel Demand Management (TDM) practices to manage current congestion. GVMC's 2045 Metropolitan Transportation Plan (MTP) also includes goals and objectives regarding area congestion. These include:

Goal 3: Enhance Safety and Reduce Congestion

Objective 3a: Promote services, such as Rideshare, that increase vehicle occupancy rates.

Objective 3b: Reduce the reliance on Single Occupancy Vehicles (SOVs) by developing policies that encourage the use or development of active modes of transportation.

Objective 3c: Employ the Congestion Management Process to systematically monitor, measure, diagnose, and recommend travel management alternatives for current and future congestion on our region's multi-modal system.

Objective 3d: Promote Travel Demand Management (TDM) practices to manage future traffic growth, improve system efficiency, mitigate congestion, and spread travel demand evenly to other times of the day, where feasible.

Objective 3e: Support the use of Intelligent Transportation Systems (ITS) and incident management to reduce the potential for secondary traffic incidents and non-recurring congestion.

Objective 3f: Promote sharing ITS data between agencies to streamline and improve incident management response.

Objective 3h: Improve the travel time reliability of the system in support of federal performance measures and improve quality of life.

5.2 Freight and Congestion Analysis

For the purposes of this analysis, GVMC staff obtained travel delay data from a visual analytics and information visualization tool called the Regional Integrated Transportation Information System (RITIS), which is developed and maintained by the University of Maryland Center for Advanced Transportation Technology Lab. This tool enables GVMC to monitor various performance measures in the MPO area, including travel speed, congestion, incidents, weather, events, etc. Using this tool, GVMC staff was able to identify bottlenecks on major freight corridors based on travel delay data during 2018- 2021. Bottlenecks are concentrated on major truck corridors such as US-131, I-196, M-37, M-11 and I-96. Tables that list the top 20 bottleneck locations for 2018-2021 are included in Appendix C.

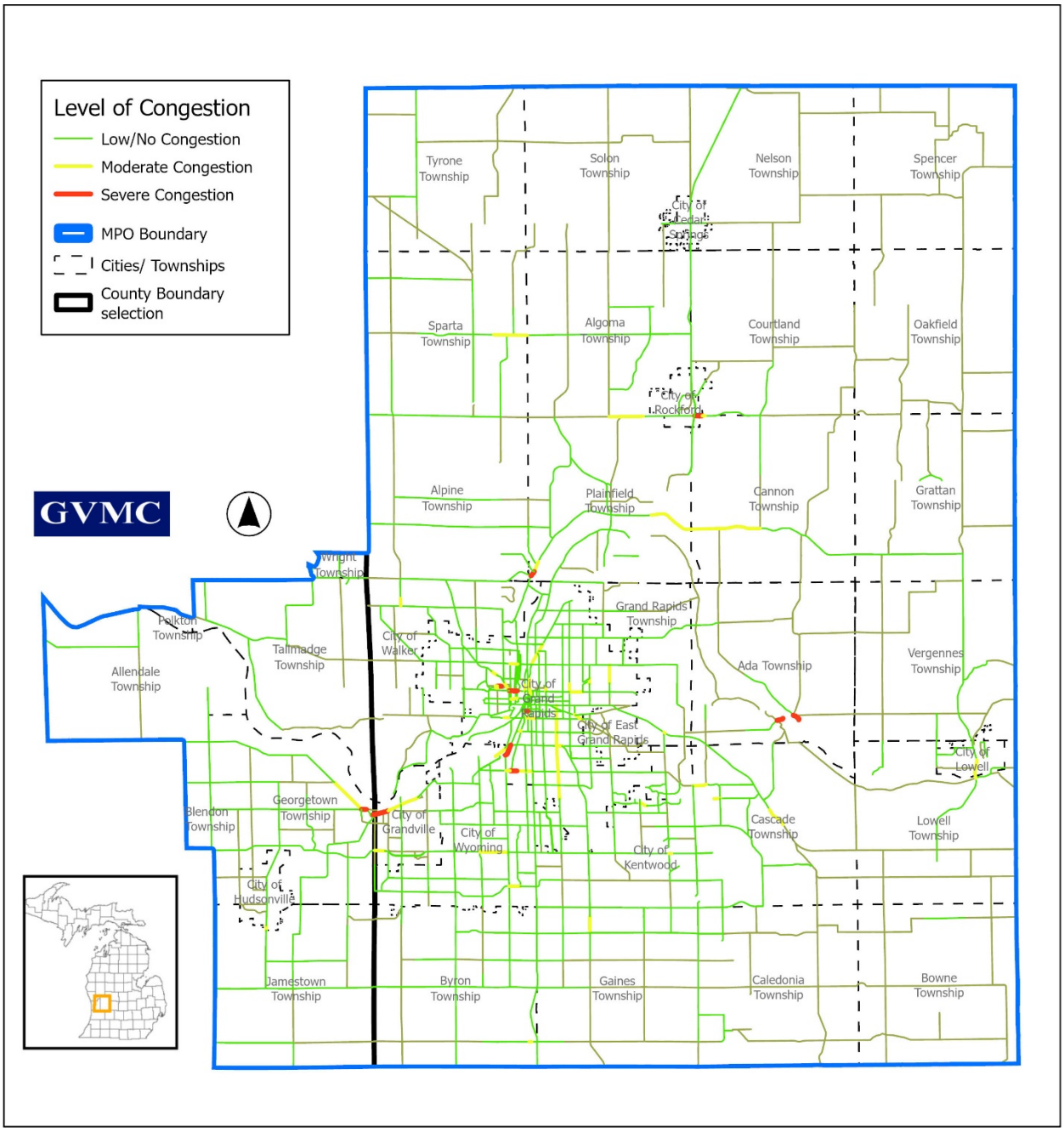
Other performance measures, including volume/capacity ratio, travel time index (TTI), Planning Time Index, and Truck Travel Time Reliability (TTTR) Index were also used to gauge the level of congestion throughout the GVMC region.

Volume-Capacity Ratio

The GVMC travel demand model provides estimated volume, speed, and travel time for each road. GVMC staff use the peak hour volume-capacity (V/C) ratio from the e model to identify congested corridors on the existing and future highway network. Corridors are identified as "Low/No Congestion," "Moderate Congestion," or "Severe Congestion," as summarized below.

V/C Ratio	Congestion Level
V/C<0.8	Low/No Congestion
0.8=<V/C<1.0	Moderate Congestion
V/C>=1.0	Severe Congestion

The following map shows the congestion level on freight routes within the GVMC region. The segments experiencing "severe" levels of congestion are primarily along interchanges or exits off I-96 and US-131. "Moderate" levels of congestion also occur along exits off I-96 and US-131 with additional segments that serve as major North/South and East/West corridors to navigate the GVMC region.



Map 15: GVMC Congestion Levels 2018

Travel Time Index

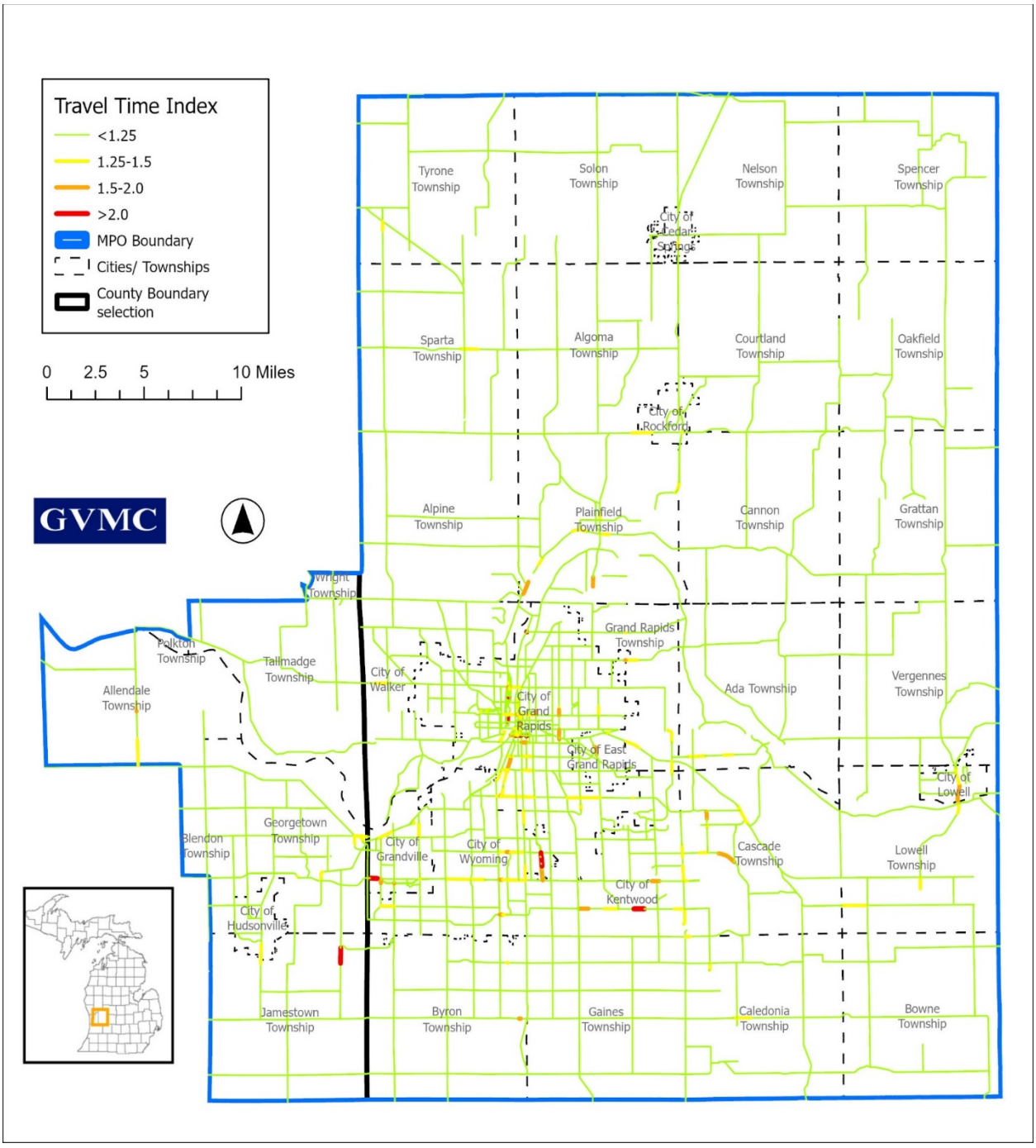
Travel Time Index (TTI) is defined as the ratio of peak periods of travel time to free-flow travel time. The higher the index, the more congested traffic conditions it represents. A TTI value of 1.00 indicates free flow conditions and a TTI value of 1.30 means the actual travel time is 30% longer than the free-flow travel time.

The travel time index provides an easy way to understand the scale of congestion. GVMC staff uses AM (7:00-9:00 AM) and PM (3:00-6:00 PM) travel time indexes on weekdays to identify congested corridors on the highway network. The thresholds for different congestion levels based on the travel time index are shown below.

Travel Time Index for Different Congestion Levels for Freeways		
Low/No Congestion	**Moderate Congestion**	**Severe Congestion**
<1.25	1.25-1.5	>1.5

Travel Time Index for Different Congestion Levels for Arterials		
Low/No Congestion	**Moderate Congestion**	**Severe Congestion**
<1.5	1.5-2.0	>2.0

The maps that follow indicate that the most congested segments and spots based on the peak period travel time index were located among freeways and M-routes, such as the US-131 S curve, I-96 and I-196 junction, M-11, and M-37.



Map 16: GVMC Travel Time Index 2018

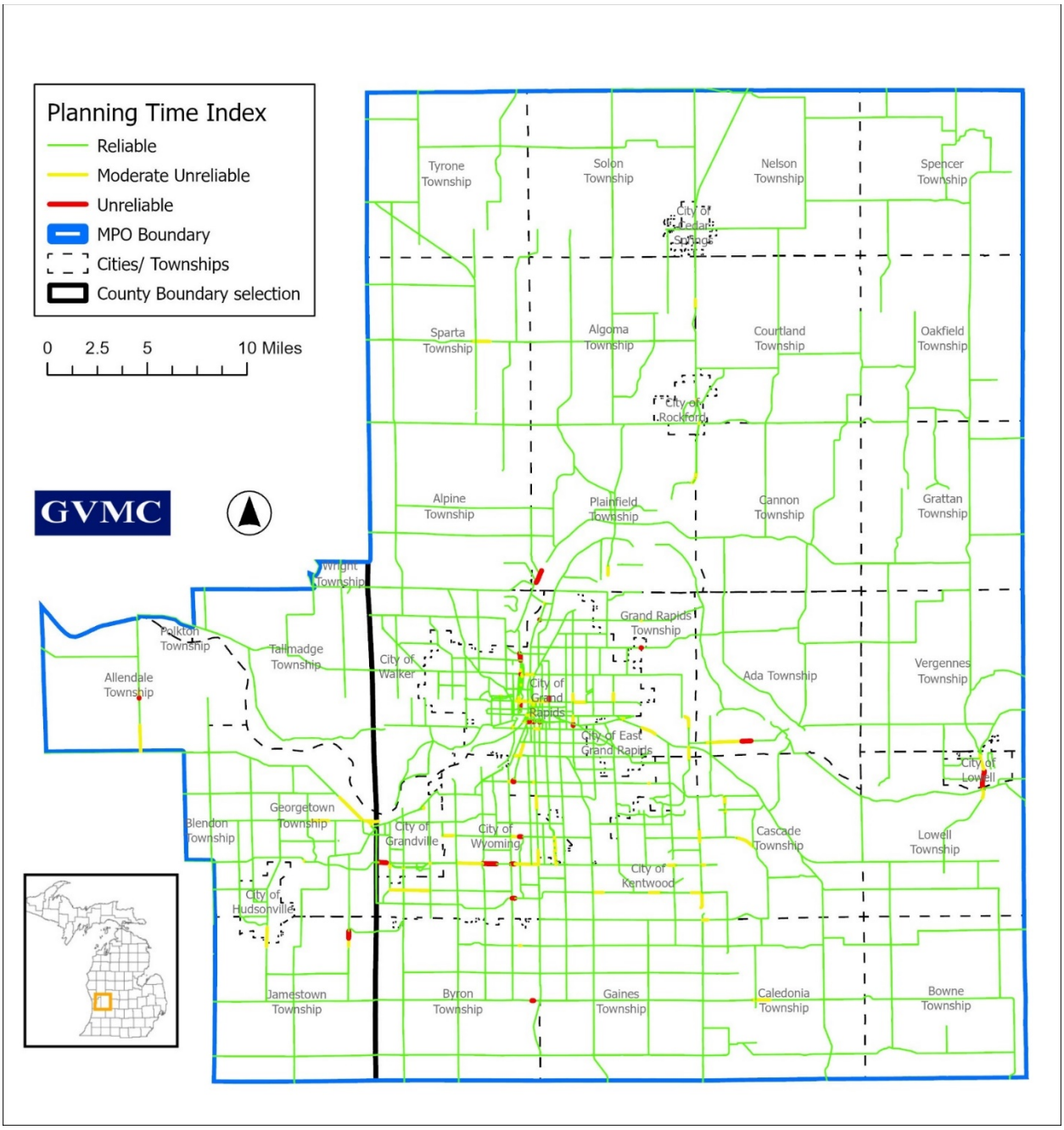
Planning Time Index

Travel time reliability is an important performance measure because it can better measure the benefits of traffic management and operation activities than simple averages. Planning time index (PTI) provides an easy way to understand the scale of travel reliability. It is calculated as the ratio of 95th travel time to free-flow travel time. GVMC also uses AM (7:00-9:00 AM) and PM (3:00-6:00 PM) planning time index on weekdays to identify unreliable corridors on the highway network. The thresholds for reliability levels based on the planning time index are shown below.

Planning Time Index for Reliability Levels		
Reliable	**Moderate Unreliable**	**Unreliable**
<2.0	2.0-3.0	>3.0

Figures below indicated that the unreliable segments based on peak period planning time index are mostly concentrated on the following routes:

- US-131 from 28th St. to Ann St.
- I-196 E from M-45 to I-96
- M-11 from Division Ave. to Patterson St.
- M-37 from 28th St. to I-96
- Fuller Ave. from I-196 to Michigan St.



Map 17: GVMC Planning Time Index 2018

Truck Travel Time Reliability Index (TTTR)

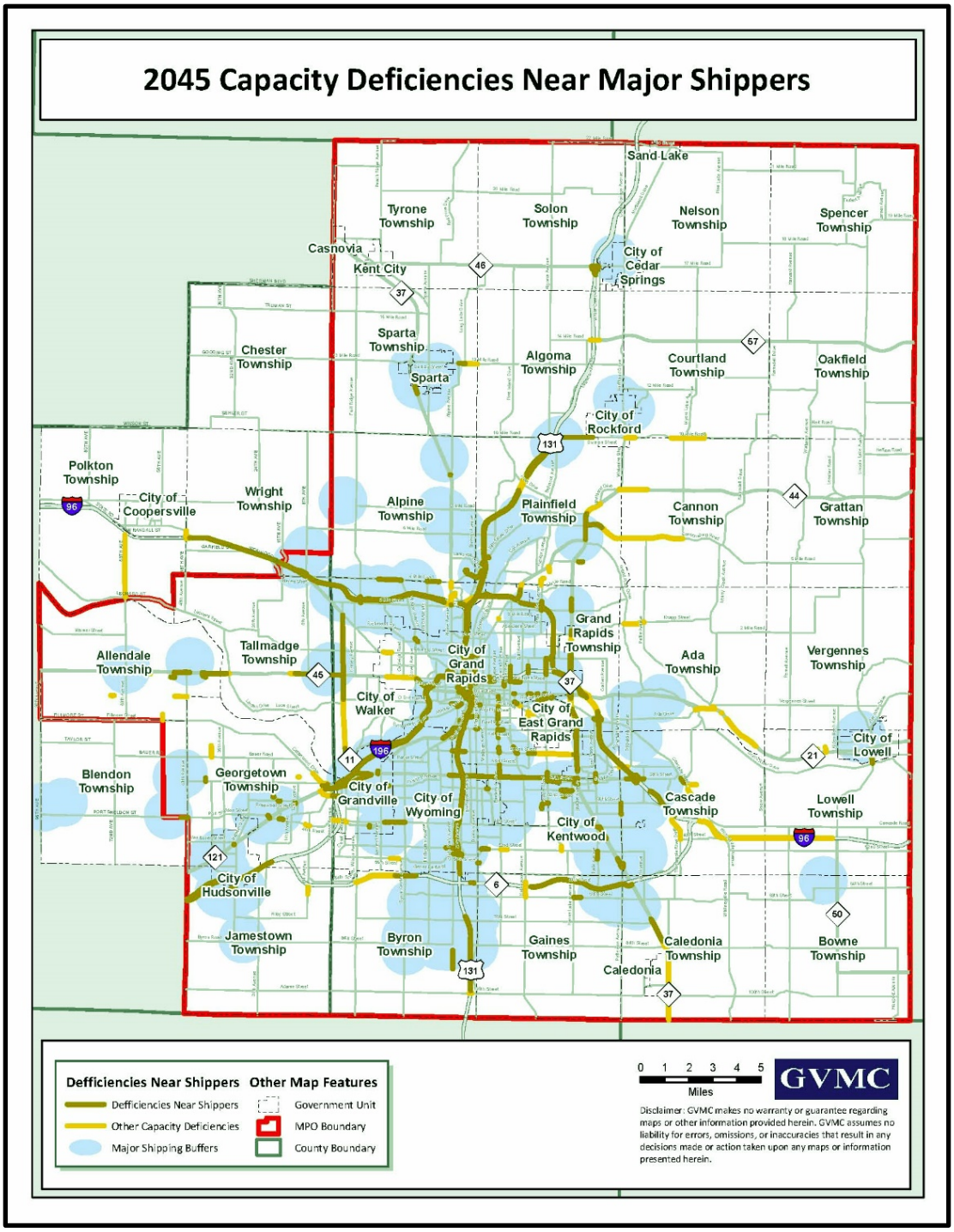
Truck Travel Time Reliability (TTTR) is the ratio of the 95th percentile truck travel time to the 50th percentile truck travel time. The recommended TTTR target set by MDOT in 2018 for the year 2021 is 1.75. The TTTR for the GVMC area on interstate roads from 2017-2021 can be seen in the following table:

Year	Performance
2017	1.51
2018	1.68
2019	1.78
2020	1.29
2021	1.42

Truck Travel Time Reliability Performance 2017-2021 (NPMRDS RITIS Data)

Deficiencies Near Major Shippers

As part of the development of GVMC's 2045 MTP, staff overlaid some of the major employers/shippers in the MPO area with GVMC's congestion deficient segments as determined by the Transportation Demand Model. Staff then put in a buffer of one mile. The map that follows is a preliminary result of road segments that may inhibit these employers/shippers from moving freight in an efficient manner.



Map 18: Capacity deficiencies near major shippers

6. Freight and Land Use

6.1 Introduction

According to the Federal Highway Administration (FHWA), economic projections show sustained growth from 2010 to 2035. And in 2021, projections still prove to be accurate in the GVMC region. Planning for the inclusion of freight facilities right now could help prepare the region for growth and simultaneously address negative aspects of increased freight volumes on residents and the environment.

From 2012 to 2019, the oldest and newest applicable data from the Census Bureau Annual Economic Survey, freight establishments in Kent County have grown from 135 to 223, their employees from 4,952 to 6,113, and annual payroll from $214,877,000 to $328,547,000. Assuming this growth continues through the current decade, there will likely be a need for additional capacity demands on the highway, rail, air cargo, and marine systems. This increased demand will have to compete with growing passenger vehicle miles traveled (VMT) on the same transportation infrastructure. In addition, there will likely be the need for expanded freight land uses – particularly those closely tied to transportation, such as rail yards and distribution centers.

The following goals and objectives in the 2045 MTP also support transportation planning and land use:

Goal 4: Strengthen Land Use and Transportation Policies

Objective 4a: Link transportation and land use policies to encourage people and businesses to live and work in a manner that improves equitable access to the entire system for all users and streamlines number and length of trips when possible.

Objective 4b: Coordinate land use decisions with transportation plans to increase accessibility and mobility of people and freight.

Objective 4c: Develop transportation plan data and projections using up-to-date local land use data and regional population and employment forecasts.

Keeping freight in mind, the region can grow to better serve its residents as it continues to change.

6.2 Factors That Influence Freight Facility Location Decisions

Freight facility locations are determined by several factors that can be broken into physical geographical features, regional and local policies, and population concentrations. Optimal facility locations are important in planning for the best economic, environmental, and life qualities.

Factors that influence freight facility locations include the following:

- Tax incentives
- Air quality permitting
- Zoning
- Space
- Commute times

How these factors influence freight facility locations is described in the paragraphs that follow.

Tax Incentives

Tax incentives can be used to encourage the preservation of industrial activity on existing industrial sites or new locations. Recognizing the public purpose provided by private rail services (such as job creation or retention, reduced congestion, reduced fuel consumption and emissions reductions), some states grant property tax relief for certain rail properties. The Federal Government offers tax credits (ranging from 10 to 20 percent) to businesses that rehabilitate existing and/or historic industrial buildings[3].

Air Quality Permitting

Many areas, especially dense urban zones, must follow rules set by the Michigan Department of Environment, Great Lakes, and Energy (MDEGLE). The MDEGLE has rules to negate negative air impacts. Often, these rules relate to vehicles on roadways, as they are often major contributors to this problem. Air quality permitting can play a

[3] Source: FHWA Freight and Land Use Handbook; 2.2 Appropriate and Coordinated Land Use Policies

major role in where a freight facility will be able to locate, as idle times for trucks may be limited[4].

Zoning

Zoning can be used to guide the development of industrial land uses, such as new freight warehouses or intermodal facilities, near major highway access points. It is recommended to locate new warehousing facilities close to major truck routes, such as interstates. The closer these freight generators are to major highway infrastructure, the fewer miles trucks will need to move on local roads before moving onto highways. The same can be said for intermodal facilities. Airports, rail/truck terminals, and seaports should have proximate and adequate freeway access to avoid truck movements on local roads[5].

Space

Some regions have found that dedicated, preserved space in which to foster manufacturing and industrial land uses is a good way to support the development of freight generating land uses. In addition, by designating this space as industrial land and explicitly discouraging other land uses (such as residential or commercial), it is easier to build infrastructure and policies to support freight land uses. Supporting brownfield redevelopment for industrial use is another strategy that municipalities can consider. This can be accomplished through incentives and assistance to foster freight intensive activities in suitable locations, as well as to maintain some freight generating land uses within the urban core[6]. Utilizing brownfield redevelopment is also a good measure to preserve existing green space and other undeveloped land.

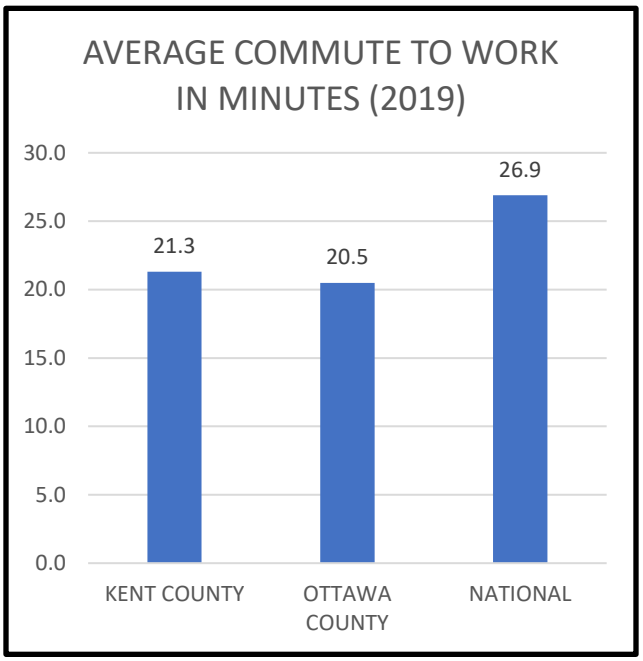
Commute Times

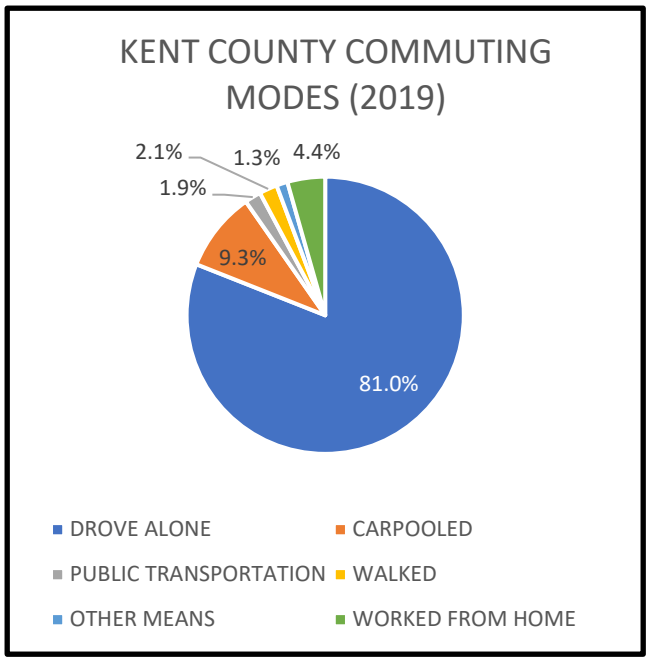
Research shows that long commutes have negative impacts on worker health and wellbeing. Workers with long commutes may have decreased productivity, increased absenteeism and turnover, and limited labor pool options, which results in economic losses for the employer. Long commute times or distances to jobs and housing can be particularly challenging for low-income workers who may not own cars or have trouble affording housing close to their place of work or near sufficient public transit[7]. Therefore, ensuring employee access to affordable housing and transportation near the freight facility is critically important when choosing a location.

[4] Source: Department of Environmental Quality; Air Quality Division; Air Pollution Control
[5] Source: FHWA Freight and Land Use Handbook; 2.2 Appropriate and Coordinated Land Use Policies
[6] Source: FHWA Freight and Land Use Handbook; 2.2 Appropriate and Coordinated Land Use Policies
[7] Source: https://www.cmap.illinois.gov/updates/all/-/asset_publisher/UIMfSLnFfMB6/content/commute-trends-of-cmap-region-freight-and-manufacturing-workers

Regional Commute Time Analysis

In the 2045 MTP and Public Freight Survey, respondents displayed a focus on congestion and loss of time waiting in traffic as negatives of commuting. However, the average commute time in Kent County is 21.3 minutes, 5.6 minutes shorter than the national average according to the 2019 Census Bureau ACS 5-year estimate. Ottawa County residents enjoy even shorter commute times of 20.5 minutes. As seen in the image above, in Kent County, 81% of commuters drove alone, while just over 9% carpooled.





6.3 Truck Parking

The entire country is facing a major issue in the lack of truck parking, especially with the rise in e-commerce and the promise for immediate deliveries. The Federal Motor Carrier Safety Administration houses the current HOS (Hours of Service Regulations) that limit the number of hours a truck driver can be behind the wheel. While technology has helped to determine drive times and expected distances, unplanned circumstances such as crashes, congestion, and weather may prevent a driver from getting to their planned destination for the day.

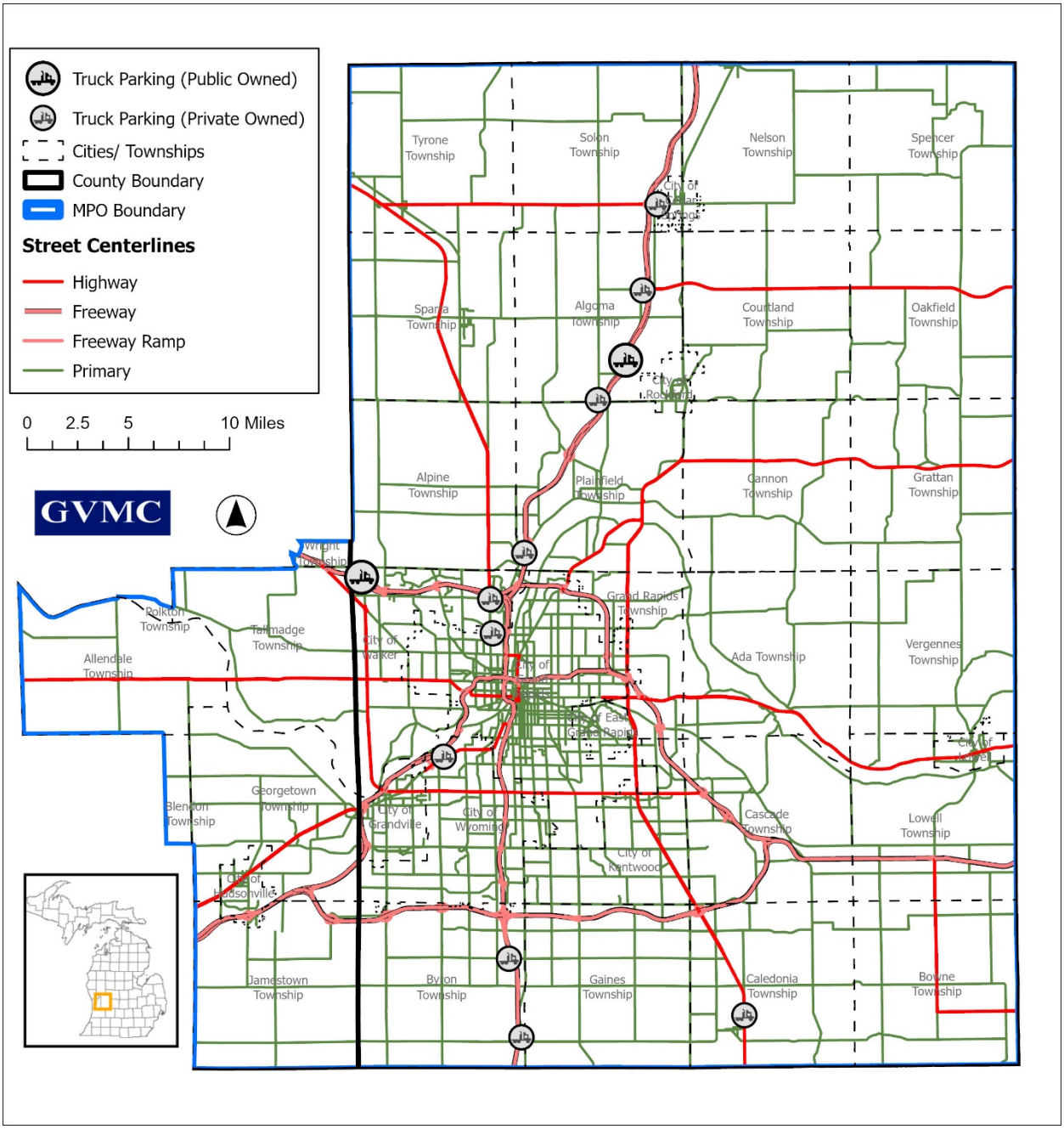
In 2009 Congress enacted "Jason's Law" providing a "national priority on addressing the shortage of long-term parking for commercial motor vehicles on the National Highway system to improve the safety of motorized and non-motorized users and for commercial motor vehicle operators." Jason's Law requires the implementation of a survey that evaluates the capability of the State to provide adequate parking and rest facilities for commercial motor vehicles engaged in interstate transportation, assesses the volume of commercial motor vehicle traffic in the state, and develops a system of metrics to measure the adequacy of commercial motor vehicle parking facilities in the state.

More than 75 percent of truck drivers reported regularly experiencing problems with finding safe parking locations. [12]

There are several reasons why truck drivers must find parking including: long-haul drivers who spend days or weeks on the road; staging outside of manufacturers, distribution centers and warehouses; 30-minute breaks which are federally mandated; emergencies whether that be with their own vehicle or because of a blockage in the roadway; and time off between hauls where drivers do not need to be in their truck. With the lack of available parking, drivers are forced to park their trucks on exit ramps or sometimes along highway shoulders. GVMC has also received public comment on concerns over the lack of truck parking with the increase of warehousing being built in the area. This is something GVMC should take into consideration by monitoring the development of facilities that have high levels of freight movement.

There are thirteen identified truck parking locations throughout the area. The two National Highway System locations are the Rockford Rest Area 525 southbound on US-131 and the Walker Rest Area 503 east bound on I-96. These two locations have 26 and 9 truck parking spots, respectively.

Federal Highway Administration published the Truck Parking Development Handbook in September of 2022. This comprehensive guide outlines the need for truck parking down to a specific design guideline for truck parking sites. This is a useful tool for regional and state transportation planning agencies to effectively make use of potential truck parking related INFRA grant projects. 2022 INFRA program projects included I-4 West Central Florida Truck Parking Facility that will construct approximately 120 truck spaces and I-40 Truck Parking and Bridge Replacement in Tennessee that will create approximately 125 truck parking spaces.



Map 19: GVMC Area Truck Parking

7. Freight Routes

Photo courtesy of Pixabay.

The MPO has worked with MDOT to identify Critical Urban and Rural Freight Corridors within the MPO boundary to support the National Highway Freight Network. Due to the limited mileage allowed for the Urban and Rural Freight Corridors in the FAST Act, the MPO worked with MDOT to identify candidate Freight routes, which serve critical local industries or provide connections to the formal Freight Network. These candidate routes could be formally designated if a project eligible for federal freight funding is identified and proposed in the future. Freight-related projects and funding will target the formal and candidate MPO Freight Network corridors and applicable performance measure targets. GVMC maintains an area freight network map which lists National Highway System (NHS) and critical urban and rural freight network and network candidates, the state and county truck routes, all season routes, rail lines, and intermodal facilities (such as the Gerald R. Ford International Airport and railroad freight yards), and major employers/shippers. (See map on page 59.) Please note that there are currently no formally designated critical urban/rural freight corridors in GVMC's region at this time. Critical urban/rural freight corridors are formally designated on a rolling basis to help with mileage limitations. With the passing of the Bipartisan Infrastructure Bill in August of 2021 state mileage allotments increased from 150 to 300 miles for critical rural freight corridors and 75 to 150 miles for critical urban freight corridors.

7.1 Route Designation Criteria

FHWA developed the following criteria for selecting CUFCs and CRFCs. Proposed routes must meet at least one of the required elements to be eligible for designation.

Critical Rural Freight Corridors:

1. A rural principal arterial roadway that has a minimum of 25 percent of the annual average daily traffic of the road measured in passenger vehicle equivalent units from trucks.
2. Provides access to energy exploration, development, installation, or production areas.
3. Connects the Primary Highway Freight System (PHFS) or the Interstate System to facilities that handle more than 50,000 20-foot equivalent units per year (containers) or 500,000 tons per year of bulk commodities.
4. Provides access to a grain elevator, an agricultural facility, a mining facility, a forestry facility, or an intermodal facility.
5. Connects to an international port of entry.
6. Provides access to significant air, rail, water, or other freight facilities in the state.
7. Is determined by the state to be vital to improving the efficient movement of freight and is of importance to the economy of the state.

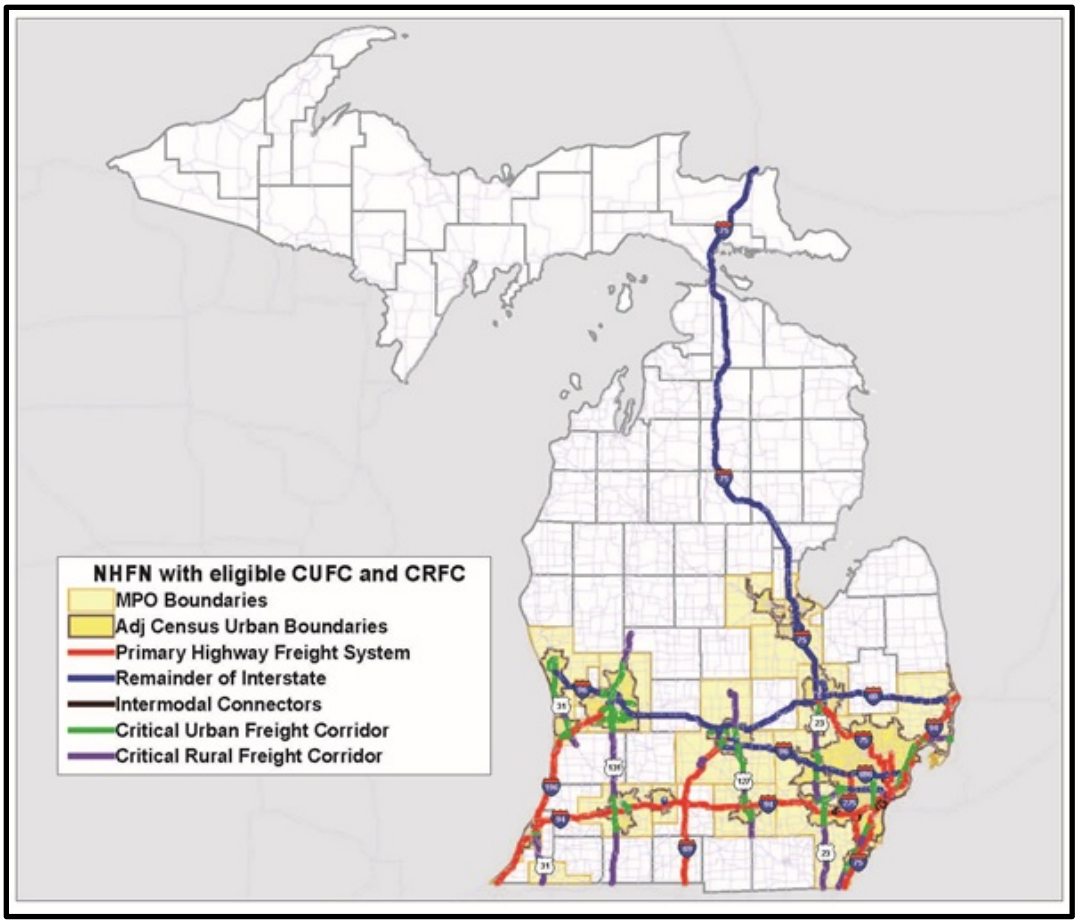
Critical Urban Freight Corridors:

Connects an intermodal facility to the PHFS, the Interstate System or an intermodal freight facility.

1. Is located within a corridor of a route on the PHFS and provides an alternative highway option important to goods movement.
2. Serves a major freight generator, logistic center, or manufacturing and warehouse industrial land.
3. Is important to the movement of freight within the region, as determined by the MPO or the state.

7.2 Michigan's Approach to Designation

Given the limited mileage, Michigan has identified qualifying routes in the state, based on the FHWA criteria above. The map below shows eligible routes that meet the required criteria.



Map 20: National Highway Freight Network and Eligible CUFC/CRFC; Map courtesy of MDOT

As projects are proposed on these routes that need freight formula funds or will request an Infrastructure for Rebuilding America (INFRA) grant, formal designation of the route will need to occur, and FHWA concurrence requested. The designated CRFCs/CUFCs will be a rolling set of routes. A formal process for revisiting the designations will be necessary when the mileage limit is reached.

There is no deadline for designation of CUFCs or CRFCs. Using this approach, Michigan defined a set of qualifying CUFCs and CRFCs without regard to mileage and will seek formal designation of those routes as necessary based on funding needs. This approach helped Michigan arrive at statewide agreement as to which routes should be designated, since the mileage limits posed a challenge. MDOT worked in close coordination with the MPOs and other transportation partners on developing the approach and eligible route list.

8. Environmental Justice, Equity, and Transportation Access

8.1 Introduction

Environmental Justice (EJ) is defined as the fair treatment and meaningful involvement of all people, regardless of race, ethnicity, income, national origin, or educational level with respect to the development, implementation and enforcement of environmental laws, regulations, and policies. GVMC is committed to ensuring that our transportation system is safe, efficient, accessible, and equitable and therefore brings environmental justice (EJ) considerations into the development of our short- and long-range planning documents, the Transportation Improvement Program (TIP) and the Metropolitan Transportation Plan (MTP). GVMC conducts an analysis on the project lists for both documents to ensure that environmental justice communities, which include minority and low-income populations, do not receive disproportionately high and adverse impacts due to these projects. GVMC also makes additional efforts to involve EJ communities to ensure that these individuals have opportunities to influence the transportation planning and decision-making process through enhanced engagement and meaningful input.

Environmental Justice: the fair treatment and meaningful involvement of all people, regardless of race, ethnicity, income, national origin, or educational level with respect to the development, implementation and enforcement of environmental laws, regulations and policies

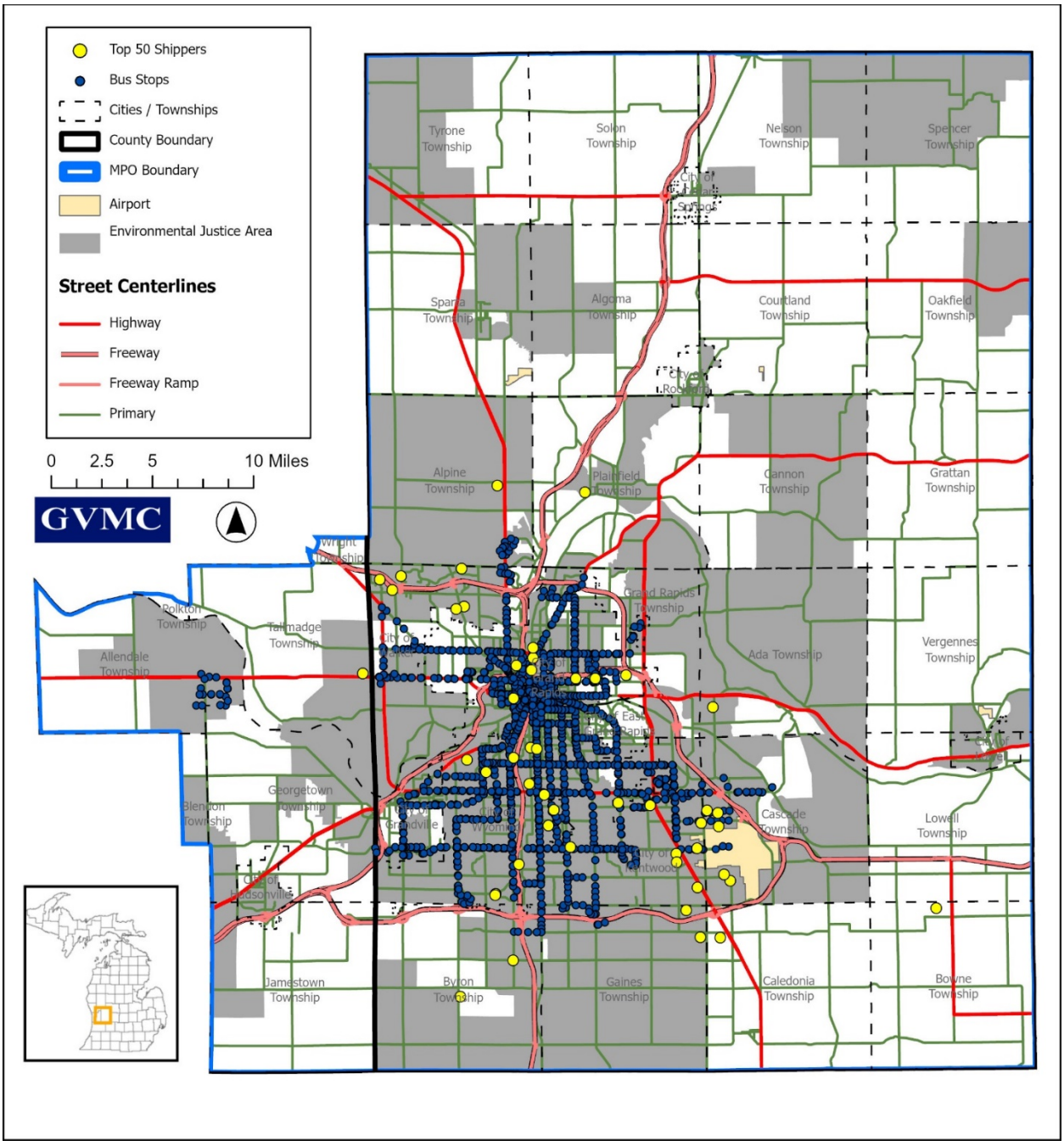
For this document, GVMC has analyzed the relationship between logistical employment locations and EJ populations to ensure that access to jobs and transportation is equitable compared to non-EJ communities and to determine areas where EJ communities may be receiving disproportionate impacts from nearby industries and related traffic, as well as additional areas for improvement.

8.2 Logistical Employment Locations and EJ Communities

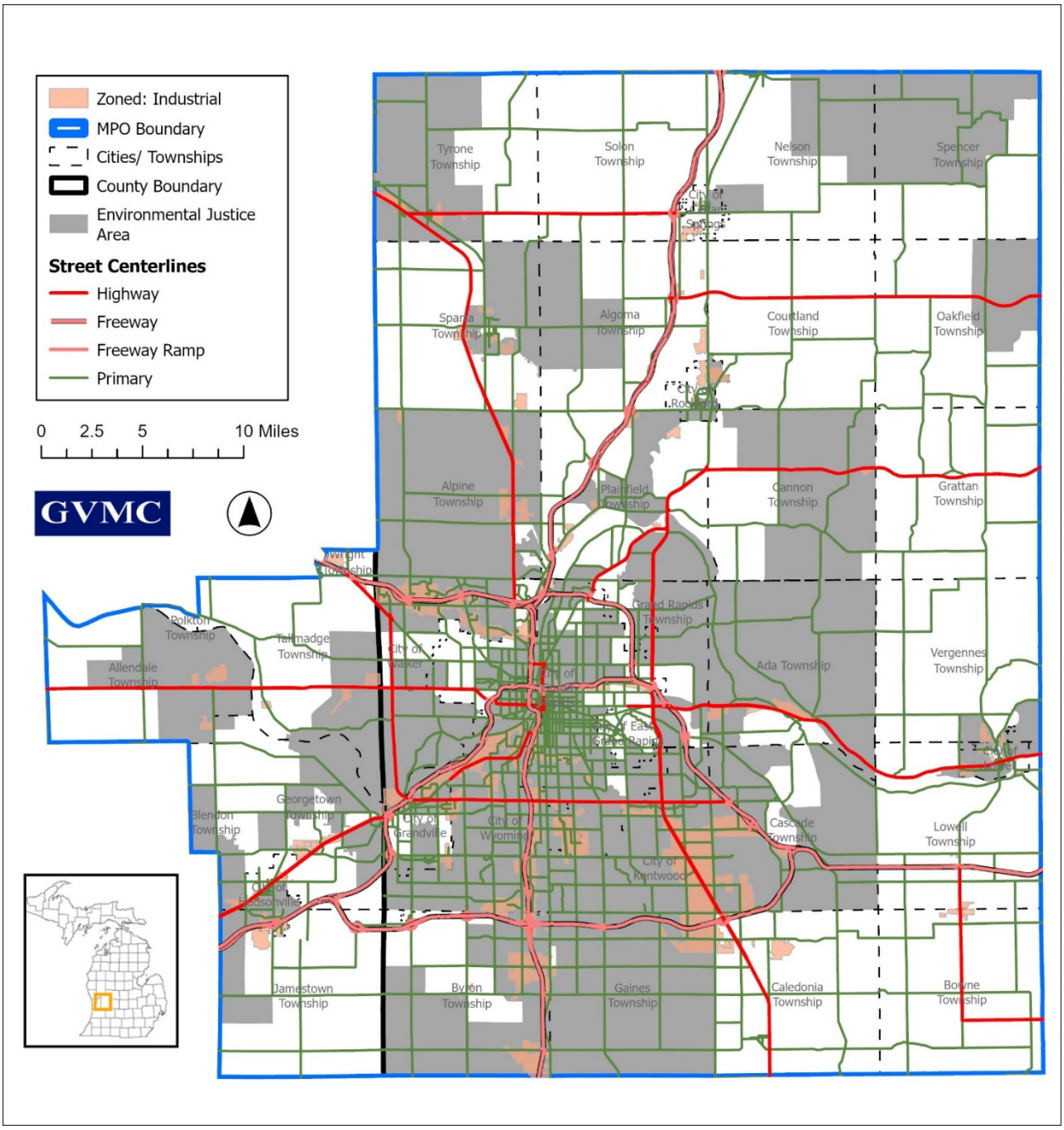
Historically, manufacturing facilities have often been in communities that have many minorities or lower-income residents ("EJ areas"). This holds true for GVMC's area as well. Most of the top 50 shippers in GVMC's MPO area are in or near an EJ area. Most of these locations are also near a bus stop and therefore accessible by transit, which is beneficial for access to employment (see map 21 on page 58). However, residents living near manufacturing and shipping facilities often experience significant negative impacts from them, such as:

- Noise
- Light pollution
- Odors
- Lower property values
- Eyesores
- Roadway congestion
- Pavement maintenance issues due to additional wear and tear from heavy trucks
- Parking issues
- Air and water quality concerns

Expanding freight operations or infrastructure in these communities requires taking strategies to reduce or mitigate these impacts into consideration. A map of industrial areas overlaid with EJ areas is located on page 59.



Map 21: EJ Areas and Locations of Top 50 Shippers and Bus Stops

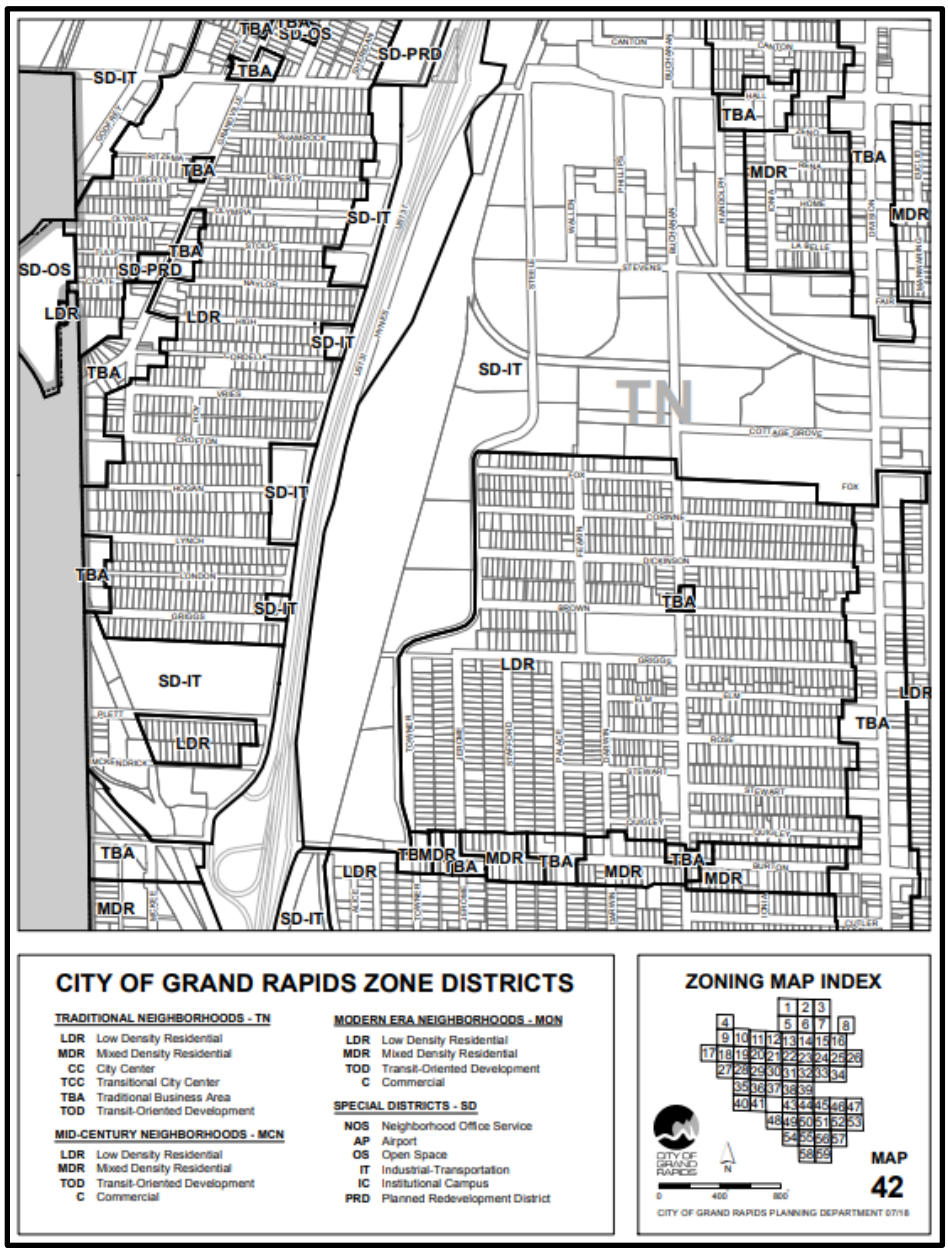


Map 22: Industrial Zones and EJ Areas

Residents of Grand Rapids' Roosevelt Park neighborhood along US-131 are an example of an EJ area faced with exacerbated negative effects of freight shipping on roadways in an urban landscape. In 2019, the University of Michigan conducted a study identifying areas in the state with the highest environmental injustice. One of the highest sectors of the entire state was Roosevelt Park. The study went on to explain the major contributor was traffic emissions from vehicles on US-131 creating excess air pollution[8].

[8] "Assessing the State of Environmental Justice in Michigan, 2019"

The map below shows the southern half of Roosevelt Park to the west of US-131, and one of the largest industrial transportation zones in the city directly to the east. Freight hubs located so close to residential areas exacerbate environmental injustice in the area.



Map 23: City of Grand Rapids zoning map, including the Roosevelt Park area

8.3 EJ Communities and Access to Transportation

According to GVMC's 2017 Environmental Justice Analysis, "about 93% of all households region-wide have access to at least one vehicle."

Some conclusions made in the Environmental Justice Analysis include:

- 69.3% of EJ areas are within 15 minutes of a bus stop
- 83.5% of all areas (EJ and Non-EJ) are within 5 miles of a bus stop
- 58% of EJ areas are within ½ mile of a bus stop
- EJ areas have a higher accessibility to the fixed-route bus system than non-EJ areas

EJ areas, as defined in the 2040 MTP, have higher transportation accessibility to fixed-route transit and nonmotorized transportation networks, as well as to key regional destinations and employment, than non-EJ areas

8.4 EJ Communities and Access to Jobs

The "Sum of Employment Accessible to EJ and Non-EJ Areas" from GVMC's 2017 Environmental Justice analysis is included in the table below. As evidenced by the data, EJ and non-EJ populations with access to the roadway network can reach virtually all employment in the region within a reasonable commute time, with the average commute time for the region at about 20 minutes.

	15 min			
	EJ Areas	**Non-EJ Areas**	**EJ % of Total Employment**	**Non-EJ % of Total Employment**
Roadway	463,478	462,841	99.99%	99.85%
Transit	268,696	50,884	57.97%	10.98%
Bicycle	430,982	260,525	92.98%	56.20%
Pedestrian	254,242	43,672	54.85%	9.42%

The analysis shows accessibility to be in a good state currently. The biggest challenge regarding transportation access is maintaining system resiliency as the region continues to expand outward.

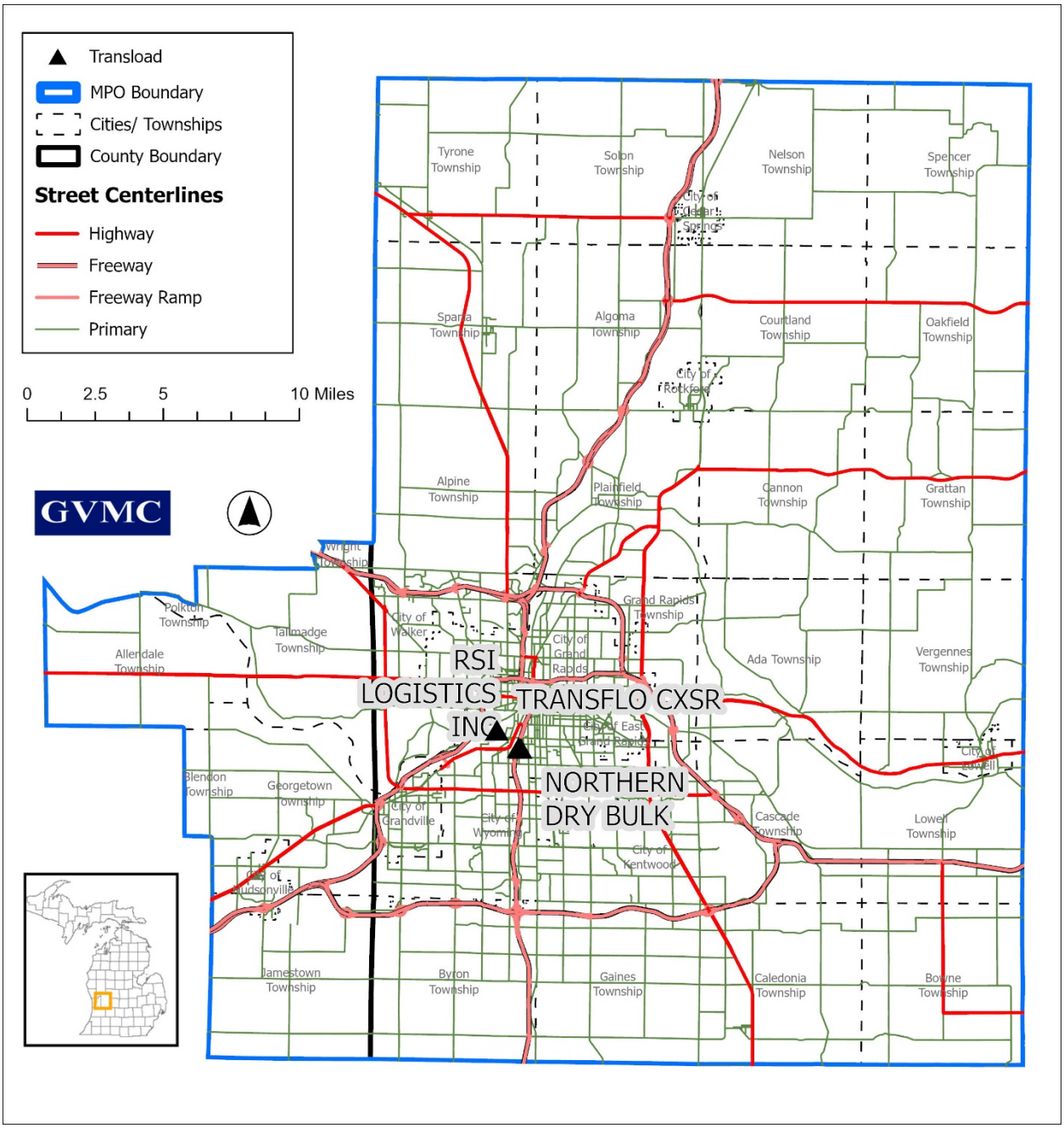
9. Freight, Rail, and Intermodal Opportunities

Canadian National Train; Photo courtesy of MDOT Photography Unit

9.1 Introduction

As defined in Chapter 3, intermodal shipping involves transportation by more than one mode during a single journey. Intermodal shipping often takes advantage of cost savings available by rail to move goods partway to their destination. According to Inbound Logistics, "In many rail corridors, intermodal provides a much better value proposition than highway. Rail transportation is often more energy efficient, so 'going green' in intermodal means freight costs less."[9] Inbound Logistics also notes that the current truck driver shortages, increased fuel prices, and government policies that restrict hours of service on the road make truck capacity a challenge. Shippers may find reduced costs and improved service by taking advantage of intermodal shipping opportunities—including rail. There are three transloading facilities in the GVMC area. All three of these are in southwest Grand Rapids. These facilities allow for the transfer of a shipment from one mode of transportation to another.

[9] https://www.inboundlogistics.com/cms/article/intermodal-transportations-strategic-advantage/



Map 24: Transload Facilities in Grand Rapids

9.2 Regional Intermodal Connectivity

Intermodal freight facilities have several benefits including lower cost alternative to truckload, sustainability, increased level of security, reduced highway congestion, reliable capacity, optimization in the efficiency of truck and rail, improved safety, and straightforward monitoring.[10]

GVMC is also supportive of methods that enhance the connectivity of the transportation system and help ensure the reliable and safe movement of goods. The following goal and objectives in GVMC's 2045 MTP support this effort:

Goal 1: Further Develop an Efficient Multimodal System

Objective 1a: Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight

Objective 1b: Promote a balanced transportation system that stimulates and supports long-term economic vitality, travel and tourism, global competitiveness, productivity, and efficiency through directed investments across modes

Objective 1c: Implement strategies to promote efficient and reliable system management and operation that result in the reliable and safe movement of people and freight

[10] https://blog.intekfreight-logistics.com/benefits-of-intermodal-transportation

10. Freight and New Emerging Technology

Image courtesy of Pixabay

10.1 Introduction

Over the last several decades, many technological advancements have made their way into our daily lives. This includes changes that have impacted the transportation system, such as dynamic message signs on highways, GPS navigation in vehicles, back-up cameras and blind spot/lane departure warning systems. Services like OnStar offer automatic crash response, emergency services, roadside assistance and more. And the development of electric vehicles has changed how vehicles are powered and lowered emissions.

Technology continues to evolve at a rapid pace, and technological advancements that were once considered to be futuristic ideas have now become a reality. Not only are these advancements impacting our transportation system and how people get from one location to another, but also the movement of goods and their delivery. Companies are now testing delivery service by drone as well as autonomous long-haul driving, and zero emission electric trucks are starting to emerge on North American highways.

In order to embrace these changes, GVMC has integrated technological advancements on the transportation system into our planning process. GVMC's most recent Metropolitan Transportation Plan included a section on Preparing for New and Emerging Vehicle Operation and Propulsion Technology. One of the goals of our

MTP, to "Further Develop an Efficient Multimodal System," includes objectives that support the use of emerging technology on the transportation system, as well as related safety and security. These objectives include:

Goal 1: Further Develop an Efficient Multimodal System

Objective 1d: Increase the security of the transportation system by incorporating applicable emergency relief and disaster preparedness plans, strategies and policies that support homeland security, as appropriate, to safeguard the security of all motorized and nonmotorized users.

Objective 1e: Prepare for new and emerging operation and propulsion technology in support of the goals and objectives of the Metropolitan Transportation Plan

10.2 New and Emerging Technology and the Movement of Freight

While advancements in technology are continuing to occur at a rapid rate in many areas, according to the Victoria Transport Policy Institute, "Vehicle innovations tend to be implemented more slowly than other technological change due to high costs, strict safety requirements, and slow fleet turnover. Automobiles typically cost fifty times as much and last ten times as long as personal computers and mobile phones….Most vehicle innovations are initially costly and imperfect. It usually takes decades before they are common in the fleet."[11] Because of this, it is expected that technological advancements in freight movement will be incorporated slowly. Several new, or newer, methods of moving freight that incorporate technology are below. These innovations are already being used or tested on our local transportation network or across North America as a whole or are in research phases and may be implemented at some point in the future.

Autonomous Long-Haul Driving

There are currently five levels of vehicle autonomous trucking:

- Level 1: Driver assistance—cruise control
- Level 2: Partial automation—Acceleration/deceleration are automated, with the driver always ready to take control of the vehicle
- Level 3: Conditional automation—Automation for all safety-critical functions, but the driver is still present for some environmental and traffic conditions
- Level 4: High automation—All safety-critical functions as well as roadway conditions are automated for a full trip (driver is still present)
- Level 5: Full automation—Performs the full functions of a human driver in all conditions and scenarios (no driver present)

[11] Eno Center for Transportation: "The New Mobilities: Smart Planning for Emerging Transportation Technologies" Webinar

Autonomous Trucks: Commercial vehicles that use artificial intelligence to automate everything from shipping yard operations to long-haul deliveries.

Industry giants such as Diamler are investing heavily in the development of a Level 4 high autonomous truck (defined below). Other industry truck manufactures, such as Volvo and Peterbilt, are also working toward incorporating automated technology into their future vehicles.[12]

Technology is currently being optimized specifically for highways, with self-driving trucks taking on long highway miles with first-mile and last-mile pickup and delivery left to a human driver.[13]

Benefits: Using autonomous trucks for long-haul driving helps mitigate the shortage of truck drivers. Truck drivers may be able to stay in their region and handle first-mile and last-mile pickup and delivery or serve local routes, meaning less time away from home and families. Autonomous long-haul driving may also improve safety and efficiency for logistics while reducing the need for available truck parking

Challenges: The shift to autonomous vehicles will likely be gradual and dependent on public acceptance, regulations, and other factors. Autonomous vehicles may also result in job losses. According to NACTO's Blueprint for Autonomous Urbanism, "the trucking, taxi, and ride-hail industries employ almost 3% of the total American workforce, providing over 4.1 million jobs. People of color are overrepresented in this industry, and automation's potential to displace these workers risk exacerbating financial hardship along racial lines." Costs to support the necessary infrastructure may also remain significantly high. Lastly, autonomous vehicles are vulnerable to cyberattacks from hackers or malicious parties, which could compromise safety.

Electric Trucks

As stated previously, zero emission electric trucks are beginning to emerge on North America's highways, including Freightliner's eCascadia heavy duty truck and Volvo's VNR electric trucks. Tesla hopes to be producing its electric Semi in 2023. Many local companies, such as Amazon and FedEx, have pledged net-zero carbon emissions by 2040, and electric vehicles are part of their strategy to achieve this goal. According to Amazon, the company delivered more than 20 million packages to customers in electric delivery vehicles across North America and Europe in 2020 and plans to continue to build on that effort.

Benefits: The cost of running trucks on electric energy is expected to be significantly less over diesel fuel, which would lead to increased revenue for the company. These trucks are often "whisper quiet," reducing noise. Freightliner says that semi drivers often prefer electric semis because they are easier on their bodies, and drivers report reduced driving fatigue as well, which could lead to improved safety on the roadway. The use of zero emission trucks will also improve air quality, thereby contributing toward mitigating the impacts of climate change, and potentially providing cleaner

[12] https://www.summittruckgroup.com/blog/five-levels-of-autonomous-trucking--33262
[13] https://www.fleetowner.com/technology/article/21159463/level-4-autonomous-trucks-closer-than-you-think

air, especially for EJ communities located near industrial areas, all while creating a positive, pro-environment image for the company.

Challenges: Electric commercial vehicles cost more up front than traditional vehicles, and the length of time it takes a company to achieve their desired return on investment could be significant. The limited driving range per battery charge will likely make these vehicles preferable only for companies with shorter, local deliveries. For instance, the eCascadia has a maximum range of 250 miles on a full battery and requires at least 90 minutes to charge the battery to 80%. Tesla's Semis have ranges of up to 500-600 miles in trucks with the largest batteries and require 30 minutes for the batteries to charge to 80%. In comparison, diesel trucks can reach 1,000 to 1,500 miles before needing to fill up, which can be completed in 15 minutes.[14] Electric truck batteries are also significantly heavier than a full tank of diesel fuel, which can reduce the carrying capacity of the vehicle.

Hydrogen-Powered Trucks

Another possible alternative is to replace diesel engines with hydrogen fuel cells and diesel fuel tanks with hydrogen tanks. Nikola currently offers the Nikola Two hydrogen fuel cell semi-tractor truck, and Anheuser-Busch reported in 2018 that they had ordered up to 800 of these zero-emission vehicles, which can travel between 500 and 1,200 miles and be refilled within 20 minutes. Integration of these vehicles into their fleet was expected to begin in 2020.[15] Kenworth and Toyota are also developing the Kenworth T68os, which will be powered by Toyota hydrogen fuel cell powertrains.[16]

Benefits: The weight difference between the hydrogen fuel cells and hydrogen tanks is similar to the weight of diesel engines and diesel fuel, so the carrying capacity of the vehicle isn't compromised.

Challenges: The biggest challenge is the lack of infrastructure to refuel the vehicles. Currently, there are only 47 hydrogen refueling stations, 42 of which are in California. Nikola plans to build an additional 7,000 hydrogen refueling stations for its trucks. However, it is not likely that an investment in hydrogen infrastructure will meet or exceed that of electric charging infrastructure in the immediate future. Hydrogen fuel cell trucks will likely be best used on dedicated routes with easy access to refueling facilities.

Intelligent Transportation Systems (ITS)

According to MDOT, there is no single accepted definition of ITS, but a general description is below:

> ***Intelligent Transportation Systems (ITS):*** a combination of electronics, telecommunications, and information technology in the transportation sector that is used for improving safety and travel times on the transportation system. It is not highways only, but includes all modes of transportation.

[14] https://www.fleetowner.com/equipment/article/21126842/why-we-shouldnt-and-cant-ever-do-away-with-diesel-18wheelers
[15] https://www.anheuser-busch.com/newsroom/20071/05/anheuser-busch-continues-leadership-in-clean-energy---places-ord.html
[16]https://www.fleetowner.com/equipment/article/21126842/why-we-shouldnt-and-cant-ever-do-away-with-diesel-18wheelers

In general, ITS involves people using technology in transportation to save lives, time, or money. The concepts included within ITS are evolving, although a number of them are now established that are giving definition to the discipline. Examples include systems for traffic management, public transportation management, emergency management, traveler information, advanced vehicle control and safety, commercial vehicle operations, electronic payment, and railroad grade crossing safety. ITS infrastructure investments are also a precursor to connected vehicles by laying the groundwork for communications technology.

One application area is the use of dynamic message signs, which are defined below.

Dynamic Message Signs (DMS): this center-to-field application area covers the interface between a traffic management center or maintenance and construction management center and a specific type of roadway equipment that provides information to motorists—the dynamic message sign (DMS).

These signs can furnish motorists with real-time information, including alerts and advisories, early warning messages, alternate route information, travel times, and work zone information. Additionally, some of the most prominent ITS technologies already deployed across the country include electronic toll collection, ramp meters, red light cameras, traffic signal coordination, transit signal priority, and traveler information systems.[17]

A dynamic message sign advertising expected travel times. Photo courtesy of MDOT.

Benefits: ITS benefits include the ability to process and share information that can prevent or reduce potential crashes, keep traffic moving, and decrease the negative environmental impacts of the transportation sector on society. DMS signs boast exceptionally high annual mobility benefit estimates of over $500 million dollars.[18]

Challenges: Wireless communication technology involved in ITS can lead to security and privacy challenges related to confidentiality, location privacy, identity privacy, and anonymity.[19]

[17] https://www.its.dot.gov/factsheets/benefits_factsheet.htm
[18] https://www.its.dot.gov/factsheets/benefits_factsheet.htm
[19] "Issues, Challenges, and Research Opportunities in Intelligent Transport System for Security and Privacy" file:///C:/Users/fabera/Downloads/Issues_Challenges_and_Research_Opportunities_in_In.pdf

Internet of Things (IoT)

Internet of Things (IoT) is defined as follows:

> ***Internet of Things:*** An expansive system of connected remote sensors that can communicate real-time information, both to one another and a central controller, and perform remote control functions.

According to MDOT, an example of an IoT application could be a large office building that can monitor and control the pace of its elevators to optimize departures of cars from an attached parking structure and sync with traffic lights, as well as with intelligent vehicles to minimize traffic congestion during rush hour. These technologies will depend on communications infrastructure that can adapt to new demands and the changing nature of technology.

Benefits: Benefits include reduced fuel consumption, fewer greenhouse gas emissions, less time spent in traffic, and possibly fewer collisions.

Challenges: We will need to ensure changes are developed deliberately to protect the safety and security of individuals while balancing with concerns about privacy and autonomy. Providing a simple, automated process for IoT device onboarding, providing a secure environment against cyberattack and data loss, and supplying the correct network resources for the IoT system to run properly and efficiently are all potential challenges.[20] Unreliable communication networks and connectivity issues could also be problematic.

Self-Driving Delivery Robots:

Cartken Delivery Robot; photo from Cartken's website

Several companies are building and piloting autonomous robotic vehicles capable of using sidewalks to carry and deliver cargo. In 2022, UberEats started to use automated, self-driving robots to deliver orders in Miami-Dade County area. Uber partnered with Cartken, a robotics company, whose robots are currently being used for neighborhood food and grocery delivery, campus meal delivery and curbside pickup across the country. Christian Bersch, co-founder and CEO at Cartken stated, "Together, we have the opportunity to reduce traffic congestion, help local merchants to increase delivery capacity, and bring consumers fast, convenient, and emission-free deliveries." [21]

Benefits: These self-driving robots are primarily used for urgent and semi-urgent delivery and may eventually become more commonplace replacements for food delivery companies like UberEats and DoorDash, as they cost less than a driver,

[20] https://www.al-enterprise.com/-/media/assets/internet/documents/iot-for-transportation-solutionbrief-en.pdf

[21] https://www.convenience.org/Media/Daily/2022/Dec/19/2-Uber-Eats-Launches-Robotic-Delivery-Miami-Tech#:~:text=The%20company%20has%20partnered%20with%20Cartken%2C%20a%20leading%20robotics%20company,to%20additional%20cities%20in%202023.

thereby improving profit margins for restaurants. Self-driving delivery robots have low cost and energy usage, safety benefits, and may assist people with disabilities who aren't able to walk or drive to stores easily.

Challenges: Some areas, such as Toronto, have essentially banned delivery robots because of projected traffic increases on the sidewalks. These robots are likely best suited for lightly used sidewalks and for last-mile or short deliveries versus long distance deliveries.

Truck Platooning

The Smart Belt Coalition (SBC), a collaboration between the Michigan Department of Transportation (MDOT), transportation agencies in Ohio and Pennsylvania, and academic institutions in all three states, conducted an automated truck platooning demonstration on October 22, 2020, that began in Pittsburgh and ended in Michigan. The SBC partnered with Pittsburgh-based technology firm Locomation to complete the demonstration. Truck platooning is defined below.
Previous platooning demonstrations in Michigan highlighted a partnership between MDOT and the U.S. Army Combat Capabilities Development Command (CCDC) Ground Vehicle Systems Center (GVSC) in Warren.[22]

> ***Truck Platooning:*** The linking of two or more trucks in a convoy using technology and automated driving support systems. These vehicles automatically maintain a set, close distance between each other when they are connected.

The Federal Highway Administration's (FHWA's) Exploratory Advanced Research (EAR) Program has also funded research on technology and strategies to allow two and three long-distance trucks to travel close together in platoons using cooperative adaptive cruise control (CACC). CACC allows trucks to travel together more smoothly, exchanging information between trucks and automatically adjusting engine and brakes in real time as conditions vary.

Benefits: Truck platooning has the potential to lead to new levels of freight fleet efficiency and improved mobility for all highway travelers, including reduced congestion. In addition, freight platooning could substantially improve trucking-based emissions and fuel efficiency by reducing aerodynamic drag, as well as enhance the vehicle-to-everything communications environment.

Challenges: Most self-driving startups are moving forward with platooning, but not all are on board. Industry giant Diamler piloted various platooning projects for a year before releasing a statement that the company sees "no business case" for platooning. The expected fuel savings were marginal in their studies. Instead, the company is focusing on more advanced autonomous trucking solutions. Maintaining a pre-set following distance between vehicles can be difficult, and not all industry standards are currently aligned to mix different equipment brands when platooning. Truck

[22] https://www.michigan.gov/mdot/0,4616,7-151-9620_11057-543508--rss,00.html#:~:text=MDOT%20joins%20neighboring%20states%20in%20automated%20truck%20platooning%20demonstration,-Contact%3A%20Jeff%20Cranson&text=Truck%20platooning%20is%20the%20linking,other%20when%20they%20are%20connected.

platooning may also lead to an increase in crash severity and involve more vehicles should a crash occur.[23] While autonomous options may ease the need of drivers or pressure on the driver, policies must be put into place about how computers running vehicles will react to unexpected hazardous situations on the roadway. Lastly, truck platoons may be vulnerable to cyberattacks that could also compromise safety.

Unmanned Aerial Systems (UAS) "Drones"

Photo of a trial Amazon Prime Air delivery drone from Amazon's website

According to MDOT, Unmanned Aerial Systems, or "drones," are poised to revolutionize the efficient movement of goods across a multi-modal transportation system. Rapidly advancing technological capabilities, coupled with new and refined federal and state policies, ensure not only safe integration of UAS into an existing transportation framework, but also attempts to spur further innovation in the movement of goods and passengers in an autonomous system. The Federal Aviation Administration began allowing companies to test drones for commercial use in the US in 2016, and it is likely to expand. According to their website, in August 2020, Amazon received a Part 135 Air Carrier Certificate from the United States Federal Aviation Administration. This certification is an important step forward in the development of Prime Air, a service that will deliver packages up to five pounds in 30 minutes or less using small drones. Amazon is currently testing many different designs and delivery mechanisms for Prime Air.

Benefits: Drones could potentially increase the speed of package delivery and lead to consumer cost savings. By their nature, they provide a contactless delivery experience. Their use would also expand the transportation network and allow remote areas not accessible by vehicle to be easily reachable, which could have tremendous benefits for humanitarian purposes, including medical deliveries.

Challenges: Delivery drones in urban areas lead to concerns about noise and questions about jurisdiction, drop-off logistics, privacy, and extending management of the public right-of-way to spaces other than streets. As seen in our public survey, drones also lead to concerns about job losses for delivery drivers.

[23] https://www.truckinginfo.com/334081/does-truck-platooning-work-in-the-real-world

11. Freight and System Resiliency

Photo courtesy of Pixabay

11.1 Introduction

23 U.S.C. 503(b)(3)(B)(viii) directs the U.S. Department of Transportation to "to carry out research and development activities…to study vulnerabilities of the transportation system to … extreme events and methods to reduce those vulnerabilities." The Fixing

> ***Resilience:*** The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.

America's Surface Transportation (FAST) Act, signed into law on December 4, 2015, included a new planning factor to "Improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation," thereby requiring MPOs to focus planning efforts on resiliency. This planning factor remains in the current surface transportation legislation. Additionally in 2021, FHWA and FTA introduced a planning emphasis area of "Tackling the Climate Crisis" that targets MPO's to reduce greenhouse gas emissions and develop infrastructure resiliency to extreme weather events that have been increasing from the effects of climate change. FHWA's definition of resilience is below.

According to ICF International's[24] "Freight Transportation Resilience Needs," disruptions on the transportation system may be caused by:

- Extreme weather events, such as storms, high winds, intense precipitation, wildfires, or excessive heat
- Geophysical events, such as earthquakes, volcanoes, tsunamis, and landslides
- Human activities, such as crashes, communications failures, cyber-attacks, terrorism, or economic failure

As evidenced during the COVID-19 pandemic, public health emergencies can also impact freight movement.

All these disruptions can prohibit the efficient and reliable movement of goods. For example, flooding, heavy downpours, and winter storms can increase the risk of trucking crashes. Flooding and extreme heat can also damage critical stretches of pavement. Having a transportation system that fosters resilience is pivotal to quickly recovering from such events so that freight can continue to move, and aid can be delivered to impacted areas during crises.

11.2 Freight and System Resiliency Analysis

Transportation System Security

To achieve system security, GVMC collaborates with MDOT. MDOT has a statewide Emergency Management Steering Committee in place to address Homeland Security Issues. Any threats or potential threats identified by the federal Department of Homeland Security (DHS) or Michigan State Police (MSP) are then communicated to MDOT field staff to monitor specific or categories of targeted facilities, structures, etc. Monitoring can be accomplished visually by MDOT staff, local law enforcement, or using the ITS cameras, which are now covering a greater proportion of the state transportation system. Any unusual activities observed are reported to the MSP and/or the federal DHS. State of Michigan efforts are also coordinated with the Federal Highway Administration and DHS activities. In addition, any potential threats identified to local facilities are communicated to local officials and/or law enforcement agencies. Generally, transportation emergency and disaster situations are initially identified by local agencies and then communicated and coordinated with local MDOT and MSP offices; if needed, the Governor may request federal disaster emergency declarations, which then can make federal resources available.

In December of 2021, FHWA and FTA released the Strategic Highway Network (STRAHNET)/ U.S. Department of Defense (DOD) Coordination planning emphasis area. GVMC should consider connectivity needs in the STRAHNET or other public roads in planning efforts as well as the need for transportation connectivity with the large employment numbers at DOD facilities including military bases, ports, and depots.

GVMC also consults with officials responsible for natural disaster risk reduction when developing our Transportation Improvement Plan (TIP) and Metropolitan Transportation Plan (MTP).

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[24] https://www.fhwa.dot.gov/Planning/freight_planning/talking_freight/january_2016/talkingfreight1_20_16ms.pdf

Energy Conservation and the Environment

The impacts of a changing climate and related extreme weather events are one of the hazards that threaten federal, state, and local investments on the transportation systems across the nation. Data continue to show that Michigan's climate is changing. According to the EPA, "Most of the state has warmed two to three degrees (F) in the last century. Heavy rainstorms are becoming more frequent, and ice cover on the Great Lakes is forming later or melting sooner. In the coming decades, the state will have more extremely hot days." As the atmosphere warms, evaporation increases, which increases humidity, average rainfall, and heavy rainstorm frequency in some areas while contributing to drought in others. The average annual precipitation in most of the Midwest has increased 5 to 10 percent. During the next century, it is expected that spring rainfall and annual precipitation will increase and that severe rainstorms will likely intensify, leading to more frequent floods in Michigan.[25] GVMC is already seeing impacts from climate change across the area with warmer, wetter winters increasing flooding instances and the freeze/thaw cycle, which leads to more potholes and deteriorating pavement conditions.

To address the impact of climate change, many State Departments of Transportation (DOTs) and MPOs across the country are conducting vulnerability assessments on their transportation system to understand areas and current and future projects that may be at risk in the event of extreme weather. GVMC has included a study of our region's transportation infrastructure resiliency in our FY2023 Unified Planning Work Program, and has also backed many initiatives to conserve energy and reduce emissions that lead to climate change, which include:

- A recommendation in GVMC's 2045 MTP to work to create a mode shift from single occupancy vehicles (SOVs) to more active forms of transportation
- Participation on the West Michigan Clean Air Coalition and running the Clean Air Action program in our area, which encourages individuals to voluntarily reduce energy usage and emissions that lead to climate change
- Participation in the EPA's Advance Program for ground-level ozone and fine particulate matter, which provides access to additional assistance, grant opportunities, and connections with other air quality initiatives around the U.S

Moving forward, GVMC will need to stay aware of areas that could be impacted during an extreme weather event and help identify and address roadways and infrastructure that are damaged due to climate change. GVMC will also continue to work to reduce local emissions.

Land Use and Transportation Coordination

While the topic of freight and land use is covered in Chapter 7, it is still very relevant to discussions on resiliency. Coordinating land use and transportation decisions will be important to consider going into the future. Once a facility is built, it can be difficult to accommodate needed changes to the transportation system. While it is outside the scope of the MPO's work to determine where freight facilities are located, we can

[25] https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-mi.pdf

coordinate with local units of government to provide data, projections, and information about access.

As far as the network itself, road diets are changing the face of many local streets. While this concept has many positive attributes, adjusting to the redesigned street scape may take time when being utilized by different types of users. Road diets and complete streets are defined below.

Complete Streets: Streets designed and operated to enable safe use and support mobility for all users. Those include people of all ages and abilities, regardless of whether they are travelling as drivers, pedestrians, bicyclists, or public transportation riders.

Road Diet: Narrowing travel lanes or shoulders or eliminating some of them to provide more space for pedestrians and bicyclists. A typical road diet consists of converting a four-lane roadway (two in each direction) to a three-lane (one in each direction plus a center turn lane) and adding sidewalks and/or bicycle lanes.

In a resilient transportation system, roads can adjust to their environment as time goes on. Lanes are added and taken away, bike lanes become more prevalent, intersections change and so forth. While the current system is not perfect, data presented in Chapter 7 shows the GVMC region is doing well compared to a national scale in terms of transportation access and efficiency. It will be important to maintain this system going forward so as not to fall behind in the coming decades.

Operational and Other Concerns

A number of operational and other concerns can contribute to the standstill of goods, congestion, or create other issues when it comes to efficiently moving freight. These include:

Food and Good Shortages—During the COVID-19 pandemic, there were shortages from basic goods to personal protective equipment (PPE). There are still deficiencies in the food and good supply chains that have yet to recover from the pandemic.

Noise Ordinances—Waste haulers start at 3:00 am for garbage pickup to reduce congestion from vehicles traveling behind them. However, some locations have noise ordinances in place that restrict operating times, which can make it difficult for refuse/waste trucks to avoid hauling trash at peak times. Congestion, and the resulting delays, can further shorten the refuse/waste trucks' operational window in communities where there are noise ordinances.

Truck Driver Shortages—Due to the grueling schedule and time away from family, there is, and has been for years, a shortage of truck drivers across the nation. This issue will need to be addressed by turning to alternative methods of delivery, finding incentives to hire more drivers, or investigating other reasons for this shortage to improve efficiency and resiliency.

Moving forward, GVMC will need to maintain coordination with our stakeholders to address operational and other concerns that are inhibiting the efficient movement of freight.

Managing Unpredictable Delays Due to Emergencies, Construction, and Weather

According to MDOT's Michigan Freight Plan, "Unpredictable delay, often weather-related or crash induced, can cause higher costs in plant operations and supply chains, bringing a stop to manufacturing activity and damaging the viability of Michigan's freight-dependent industries."

Prevention and efficient management of incidents associated with sporadic delays on the highway, aviation, port, and rail systems are likely to enhance the efficiency of freight movement in Michigan, removing barriers to Michigan's optimal economic performance.

Emergency Response Times—One area of focus in reducing delays is improving emergency and cleanup response times to crashes when they occur. GVMC has very limited ability to influence emergency response times to crashes but is working to reduce crashes through a new safety education and outreach program and by encouraging our members to submit projects to receive safety funding. GVMC's REGIS Department also uses Geographic Information System (GIS) mapping to help our member communities effectively position their emergency response resources. This includes determining opportunities for mutual aid—where one community responds to an emergency in another community if they can get there faster, as well as locations for fire stations and other pivotal resources. REGIS's work supports our member communities in achieving and maintaining an emergency response time of 4.5 minutes. Additionally, GVMC works with MDOT and other stakeholders on ITS projects. Dynamic Message Signs, defined in the previous chapter, can be used to notify drivers of delays, and encourage them to seek an alternate route to avoid delay.

Construction Coordination Meetings

Construction zones can slow traffic and cause delay, which leads to financial loss for freight shippers. To help improve communication between agencies regarding projects, GVMC works alongside MDOT to host construction coordination meetings twice a year—in the early spring and in the fall. These meetings are held at an MDOT office, and our members are invited to share information on projects they have planned for the upcoming construction season. This process helps avoid conflicts between projects and ensures that traffic can flow efficiently on our roadways through detour routes during construction.

Weather-Related Response Times

MDOT and Act 51 implementing road agencies have operation and maintenance budgets to help address many weather-related concerns. Local operations and maintenance funds are used for items such as snow plowing, mowing, pothole patching, crack sealing, signage, and other expenses deemed necessary to operate and maintain the overall transportation network. MDOT's list of eligible operations and maintenance activities is more extensive and includes roadway surface and shoulder maintenance, tree and shrub removal, winter maintenance (snow plowing, etc.,), bridge and structure maintenance, heavy maintenance (skip-patching, minor

resurfacing), ITS and TOC operations and maintenance, and others. A complete list of MDOT's eligible operations and maintenance activities is included in the 2045 MTP.

Addressing major snowfall events quickly is pivotal in keeping traffic moving safely. It is also critical to address weather-related damage, such as washed-out pavement, immediately. As the climate continues to change and extreme weather events may become more common and severe, it will be important to review operations and maintenance budgets to ensure funding is available for unforeseen expenses.

Disaster Preparedness Plan

GVMC has historically supported the development of disaster preparedness plans in West Michigan and will continue to do so in the future. Current plans include the following:

GVMC Continuity of Operations Plan (COOP). This plan outlines how GVMC will protect our network data files from a range of data loss disasters and continue our operations in case of emergency. From simple data loss caused by user error to complete loss of all GVMC information systems hardware, the COOP ensures that our data can be recovered in a timely manner. In the event that the GVMC office cannot be used, employees can still continue work- related tasks. GVMC's phone systems are on a Voice over Internet Protocol (VoIP) system located off site. These VoIP phones can be accessed through the internet, and a GVMC employee's phone number can be routed to that employee's personal phone. Every employee also has a laptop that can access GVMC's server. If the server is no longer available, a new server can be created from the offsite backups, and GVMC employees can access this new server from their laptops. Finally, many GVMC members have expressed that we may use rooms in their building if the GVMC office is not available for use due to an emergency.

Hazard Mitigation Plan for Kent and Ottawa Counties (2017). This document is the result of a regional effort across Kent and Ottawa Counties that included local jurisdictions within the counties. Local governments participated by reviewing and supplying information about area hazards, concerns and priorities, current prevention measures, and planned mitigation projects. This effort represented the second update to the original Pre-Hazard Mitigation Plan that was approved by FEMA in 2006 and subsequently updated in 2011 and adopted by most jurisdictions. This plan can be found at www.gvmc.org/safety.

MDOT's Emergency Response Plan. This plan "provides for MDOT actions during all-hazards incidents that indirectly or directly affect the traveling public, local and/or MDOT resources, particularly as these incidents escalate." These hazards may include flooding, severe weather, power outages, fires, civil disturbances, MDOT or local facility damage, mass transportation service interruption and more which "trigger actions to prevent or minimize loss of life, injuries, damage to property and/or the environment as well as preserve public health or safety, and to minimize disruptions of government, social or economic activities." This plan can expand and contract as appropriate in direct proportion to the level of the incident and outlines MDOT's responsibility to expedite core functions as incidents escalate. This plan complies with all applicable provisions under the authority of Michigan Emergency Management, Act 390 of 1976, as amended, as well as components of the Michigan Emergency Management Plan and MDOT Emergency Management Manual. MDOT's Business

Continuity Plan (BCP) supports this plan by providing guidance during all-hazards incidents that disrupt operations and/or prevent occupancy of normal workplaces. These focused efforts will ensure that security issues are integrated into the GVMC transportation planning process.

PART B: REGIONAL RESPONSE TO FREIGHT

1. Introduction

1.1 Qualitative Data Collection

GVMC has collected valuable feedback related to freight in the region through surveys coordinated through the production of the 2045 MTP (Metropolitan Transportation Plan). Residents voiced their concerns and considerations of freight related priorities within the region relating to service, safety, congestion, environmental considerations, and emerging technologies. The survey was open from October 2020 through March 2021 with 110 responses. GVMC also received participation from relevant stakeholders that comprised the Freight Subcommittee during the development of the 2045 MTP. This group provided feedback and relevant freight needs for the region.

**Members of the Freight Subcommittee included:*

• Kristin Kelly	Amway
• Jennifer Rikkers	Arrowaste
• Maxwell Monroe	Bradford White
• Blair Thomas	Colombian Logistics
• Matt Czarnecki	Founder's Brewing
• Josh Lunger	Grand Rapids Chamber of Commerce
• Dennis Kent	MDOT
• Tyler Kent	MDOT
• Tim Mroz	The Right Place
• Kirk Small	Watco Companies

COVID 19: The pandemic drastically altered the freight industry with supply chain demands, changes in traffic patterns and car volumes on the road, and high demands for at home delivery. Additionally, social distancing and modifications to traditional in office work environments have changed usage patterns of the transportation network. (All of the responses and concerns expressed in this report were received prior to or during the initial onset of COVID 19.)

2. Regional Responses

The public survey responses provide some insight on the population's experience with freight in the region. Twenty questions were asked in the survey resulting in about 100 participants. (Specific survey question and answers can be found in *Appendix I: Freight Public Survey Results*). The specific feedback provided by survey participants related to congestion, safety, multimodal freight, new and emerging technologies, and economic implications.

2.1 Congestion

Survey participants noted they experienced at least a small to a high level of congestion on a daily basis. Furthermore, almost 15% of participants said that congestion is due to truck traffic and at least 46% of participants stated that their experience with congestion is due somewhat to truck traffic. Participants also expressed that traffic congestion is the second largest frustration they experience involving freight movement in the area.

Featured Public Comments on Congestion and Quality of Life:

"We live on Pine Island Drive, by 7 mile road. We have way too much semi traffic on this road - enough that they rattle the house, several times daily."

"Takes time away from family and personal life."

"Es estresante los embotellamientos de tráficos en horas de la tarde"

2.2 Safety

Ensuring the safe movement of goods is not only a priority for GVMC, but for the public as well. GVMC's Freight Public Survey asked the public to rank a series of freight-related priorities based on their personal preferences from not important to very important. These priorities included:

- Using the most cost-effective mode (air, rail, truck) possible to ship/receive goods for the greatest consumer savings
- Using the timeliest mode (air, rail, truck, or new technology) possible to ship/receive goods in the shortest amount of time
- Shifting freight shipped by truck to other modes (such as rail) to reduce congestion on area roadways
- Reducing noise generated by freight movement (air, rail, or truck)
- Using the cleanest form of shipping/receiving freight to protect our air quality
- Using the safest mode (air, rail, truck, new technology) possible to ship/receive freight
- Using new and emerging technology (such as delivery drones) to reduce congestion or wear and tear on area roadways
- Using new and emerging technology to reduce in-person contact or avoid disruptions in the supply chain due to worker absences during the COVID-19 pandemic.

The public chose *"Using the safest mode (air, rail, truck, new technology) possible to ship/receive freight"* as their second top priority based on a weighted average, just two hundredths of a point behind "Using the most cost-effective mode possible to ship/receive goods for the greatest consumer savings." 83 out of 97 respondents ranked this option as either "important" or "very important."

Featured Public Comment on Freight and Safety:

"Need to ensure the safe transport of petroleum, flammable, and poisonous products via rail and highway. Safest method of transport should be used."

2.3 Multimodal Interest and Land Use

GVMC's Freight Public Survey asked, "Should we, as an area, be pursuing ways to shift truck freight shipments to other modes (such as rail) in order to improve congestion, safety, pavement condition, or air quality, if or when possible?"

Out of 110 participants:

- 47% answered yes
- 30% answered maybe
- 15% answered no
- 8% were unsure

There is a clear realization among residents that freight shipment on roadways can lead to adverse effects impacts on the traveling public. Survey results also indicated that the public feels there is a high level of importance in strategizing the location of major place of employment with access to the transportation system, as well as

infrastructure for multiple modes (air, truck, rail) at major places of employment that ship or receive a significant number of goods.

2.4 New and Emerging Technologies

Based on the results from GVMC's recent freight survey, it may be best to integrate new freight movement technology slowly and based on need and public demand, as many members of the public do not appear ready to fully embrace all advancements—especially emerging methods of delivery such as drones or robots. The questions and responses below provide additional insight into the thoughts of the public on integrating new and emerging technology into package delivery to their homes.

The first of these questions was: "Are you interested in, either now or in the future, having goods delivered to your home by modes other than delivery truck?" Out of the 110 respondents:

- 36% said "maybe"
- 29% said "yes"
- 18% said "no"
- 17% were unsure

Those who answered "yes" or "maybe" were then asked: "If so, which modes are you interested in? Check all that apply." Options included delivery bike, delivery drone, robotic vehicle, autonomous vehicle, and "other." Out of 60 respondents:

- 58% selected autonomous vehicle
- 55% selected drone
- 53% selected delivery bike
- 52% selected robotic vehicles
- 10% selected "other"

"Other" responses included Uber, jet packs, railroads, messenger pigeon, vans, postal vehicles, and cars.

The same 60 respondents were also asked: "Which of the following benefits to using new and emerging forms of technology to deliver goods to residences are the most important to you?" Respondents could choose up to four responses, which included:

- Reduced wear and tear on area roadways (73%)
- Cleaner air (68%)
- Reduced congestion (62%)
- Ability to protect the supply chain from disruptions in staffing levels during major events, such as severe weather or pandemics (40%)
- Safer delivery of goods (38%)
- Speedier delivery of goods (25%)
- Contactless delivery (13%)
- Less damage to goods during shipment (13%)
- Other (5%)

Responses show that the public is most interested in embracing new and emerging technology that results in reduced wear and tear on area roadways, cleaner air, and less congestion.

All respondents were also asked: "Do you have concerns about using new and emerging forms of technology (such as drones or robots) to receive packages at home? If so, what are they?" GVMC received 76 responses to this question, with most concerns relating to the loss of jobs due to technological advancements, safety/security and privacy issues, accuracy/reliability, congestion in the air space, environmental impacts to wildlife, and noise. A sampling of these responses is included in the text box at right.

Featured Public Comments on Freight and New and Emerging Technology:

"I don't want to live in a world where drones or robots deliver goods - or drive on city streets and highways. I want real people to have real jobs."

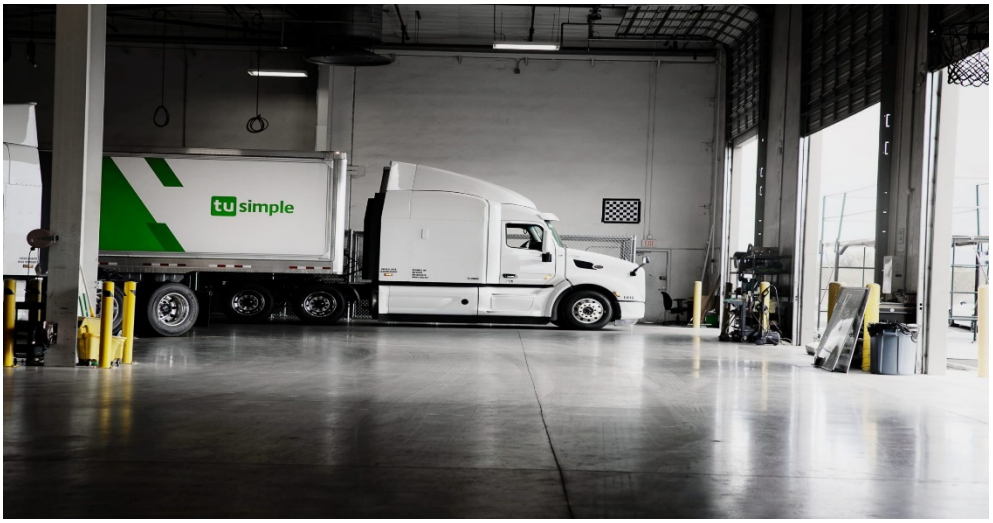
"I would like to know if there are risks to kids or adults from drones. Could the drones hit people & injure them?"

"My concerns using drones or robots is their ability to be hacked by outside criminals. Or a glitch in their hardware/ programming causes them to crash."

"Air traffic control is already too complicated. Adding a bunch of unmanned aircraft into the mix could present significant life-safety challenges."

"I'm a big fan of technology...but this seems like a big step... and I'm not sure we're there yet."

3. Next Steps



GVMC will be using previously collected freight stakeholder recommendations and feedback in conjunction with this document to relaunch a freight advisory committee with the task of creating a regional freight plan. The new efforts will now be able to incorporate changes that have occurred within the freight transportation network since the onset of COVID 19.

Additionally, a questionnaire has been developed to gather more regional specific data to produce a freight plan. All stakeholders, both those who are willing to participate as a member of the freight advisory committee and those who may have limited capacity in availability, will be given the chance to complete the following *Freight Consultation Guide*:

Freight System Background Questions

1. *Where does your organization operate (facility locations/headquarters)? What scale do you operate on? (Local, regional, nationwide, international?)*
2. *What commodities do you handle?*
3. *What modes of transport does your organization use? Or What modes of transport do you see important to the GVMC region?*

Background Questions for Entity

1. *Briefly describe what your organization does.*
2. *Does your organization have freight-related investment plans in the future? (Are there any that will directly impact the GVMC region?)*

Challenges and Concerns

1. *What is your biggest obstacle or concern related to freight in the GVMC region?*
2. *If at all, how have your operations changed over the past few years? Did any of the following affect your organization's operations?*
    a. *COVID-19*

b. *Climate Resiliency*
c. *Supply chain, population shifts, etc.*
d. *Technology*
e. *Societal shifts towards E-commerce*
f. *Other?*

3. *From your perspective, what are the three most significant transportation issues in the region? How do these impact the movement of freight?*
    a. *Physical Infrastructure – (Ex. Congested locations, access to other modes/regions, safety issues, geometric issues, truck parking, modal conflicts)*
    b. *Policy Issues – (Ex. Delivery restrictions, route restrictions (e.g. truck-prohibitive bridge weight limits, truck route restrictions), transportation system funding, hours of service requirements, available/skilled workforce, business incentives, or other issues.*
4. *What are the top three transportation system improvements or solutions to remedy these issues.*
5. *Are there any specific construction projects needed for the future?*

**Would your organization be interested in working with local governments and the MPO to help fund transportation infrastructure projects?*

6. *What transportation policies or assets are working well in the region?*

Key Routes

1. *What are the most heavily relied-upon routes and corridors for long-distance movements (i.e. truckline system)? Why are those routes important?*
2. *What are the most heavily relied upon routes and corridors for local delivery within the region (i.e., first/last mile routes critical to getting to points of drop-off and pick-up) Why are these routes important?*
3. *What are the most critical connections with other modes of transportation in the GVMC region?*

Additional Comments:

1. *Are there any other trends you see impacting the freight system?*
2. *Are there any other entities you think GVMC should consult with to receive input on the regional freight plan?*
3. *Any other additional comments?*

The results of this document, the preceding consultation results from key freight stakeholders, and input from the public will be able to pair with the goals and objectives of the MTP to create a freight specific plan for the GVMC region.

Appendix A: Glossary of Terms

Access: The ability to enter or leave a residence, business, or parcel of land from a roadway by way of a connecting driveway. Alternatively, it means the opportunity to reach a given point within a certain time frame, or without being impeded by physical, social, or economic barriers.

Access Management: Limiting the ability of traffic to enter, leave, or cross thoroughfares; regulating the spacing and design of driveways, medians, intersections, and traffic signals to promote the efficient flow of through traffic.

Allocation: An administrative distribution of funds among States which do not have statutory distribution formulas.

Arterial: A controlled access highway designed for through traffic (longer trips, higher volume and speed); arterials are typically on a continuous route and are often divided; the right-of-way is usually 120 feet.

Autonomous Vehicle: A vehicle that has features that allow the vehicle to guide itself without human interaction. Examples include cruisbase control, self-parking, and lane centering. Autonomous vehicles may also be referred to as a driverless vehicle.

Bottleneck Areas: A place where a road becomes narrow or where it meets another road so that the traffic slows down or stops, often causing traffic jams.

Bridge: A structure that stands 20 feet or greater in length.

Brownfield Redevelopment: Revitalization of a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.

Capacity Deficiency: Emergency situations whereby load temporarily exceeds the capacity of the transportation system to sustain volumes commensurate with such load, but such that the full design capacity of the system is unaffected

CMAQ: **Congestion Mitigation and Air Quality Improvement Program -** Program which directs funding to projects that contribute to meeting national air quality standards.

Complete Streets: Streets designed and operated to enable safe use and support mobility for all users. Those include people of all ages and abilities, regardless of whether they are travelling as drivers, pedestrians, bicyclists, or public transportation riders.

Congestion Management Process (CMP): One of six management systems originally required by ISTEA and subsequent transportation legislation. Future highway projects that significantly increase capacity for single occupant vehicles (SOV) should be part of a CMP or those projects may be ineligible for federal funding.

Connected Vehicle: A vehicle or a device that communicates with other vehicles and/or other devices alongside the roadway. Examples include in-vehicle navigation and sending/receiving road condition information.

Corridor: Transportation pathway allowing movement between activity centers; a corridor may encompass single or multiple transportation routes and facilities, adjacent land uses, and the connecting street network.

Dynamic Message Signs (DMS): this center-to-field application area covers the interface between a traffic management center or maintenance and construction management center and a specific type of roadway equipment that provides information to motorists—the dynamic message sign (DMS).

Emissions: The production and discharge of gas from vehicles.

Environmental Justice: The fair treatment and meaningful involvement of all people, regardless of race, ethnicity, income, national origin, or educational level with respect to the development, implementation and enforcement of environmental laws, regulations, and policies.

Federal Highway Administration (FHWA): Federal agency within the United States Department of Transportation that deals with roadway and highway issues.

Fiscal Year (FY): Year in which public and private agencies use for conducting business; it usually differs from the calendar year. Most State and Federal agencies use an October 1 through September 30 fiscal year.

Free Flow Travel Time: Used to describe the average amount of time a motorist would travel if there were no congestion or other adverse conditions (such as bad weather).

Freeway: A divided highway for through traffic with full access control and interchanges at selected public roads.

Freight: any good, product, or raw material, carried by a commercial means of transportation—including air, highway, rail, water, and pipeline

Grand Valley Metropolitan Council (GVMC): Agency that serves as the Metropolitan Planning Organization (MPO) for the Grand Rapids area. The Council is made up of members, all local units of government, that want to work cooperatively on issues that have a multi-jurisdictional or regional scope. Those issues include transportation, the environment, economics, and those with social impact.

Infrastructure: The built facilities required to serve a community's development and operational needs, e.g. roads, water, and sewer systems.

Intermodal: being or involving transportation by more than one mode during a single journey

Intelligent Transportation Systems (ITS): A combination of electronics, telecommunications, and information technology in the transportation sector that is used for improving safety and travel times on the transportation system.. It includes all modes of transportation, not just highways.

Internet of Things: An expansive system of connected remote sensors that can communicate real-time information, both to one another and a central controller, and perform remote control functions.

Interstate System: The system of highways that connects the principal metropolitan areas, cities, and industrial centers of the United States. The Interstate System also connects the U.S. to internationally significant routes in the Mexico and Canada.

Land Use: The way in which a parcel of land is used or occupied, i.e. the types of buildings or activities, and/or the purpose for which it is designed, arranged, intended, or maintained.

Level of Service (LOS): A qualitative rating system used to describe the adequacy of the road network at a specific intersection or street segment, based on factors including travel time, freedom to maneuver, driver comfort, and interruptions; LOS A is used to describe the best traffic conditions while LOS F denotes gridlock. LOS can also be used to describe transit and bicycle/pedestrian networks.

Metropolitan Planning Organization (MPO): A federally required planning entity responsible for transportation planning and project selection in its region; every urbanized area with a population over 50,000 should have an MPO, designated by the governor. The Grand Valley Metropolitan Council (GVMC) is the MPO for the Grand Rapids area.

Metropolitan Transportation Plan: GVMC's long-range planning document with a 20+ year horizon

Michigan Department of Environment, Great Lakes, and Energy (MDEGLE): State agency dedicated to environmental improvements and policies that impact public health and natural resources such as air quality, water quality, and waste management.

Michigan Department of Transportation (MDOT): State agency responsible for monitoring and improving the transportation system in Michigan.

Mobility: Movement of people or goods within the transportation system.

Mode: Form of transportation, such as automobile, transit, bicycle, and walking.

Model: A mathematical and geometric projection of activity and interactions in the transportation system of an area.

Multimodal: A system or corridor providing a range of transportation options including walking, bicycling, driving, and transit.

National Highway System (NHS): Included in the NHS are public roads defined by the NFC as Interstate, Other Freeways, and Other Principal Arterials (both state and local facilities). FHWA defines this system as important to the nation's economy, defense, and mobility. All NHS roads must comply with applicable Federal regulations, including design standards, contract administration, State-FHWA oversight procedures, Highway Performance Monitoring System (HPMS) reporting, National Bridge Inventory reporting, national performance measure targets and data collection, and outdoor advertisement/junkyard control. Not all NFC roads are classed as part of NHS.

Network: A graphic and/or mathematical representation of multimodal paths in a transportation system.

Particulate Matter: Particulate Matter less than or equal to 10 microns. Consists of matter suspended in the atmosphere such as dust, chemicals, etc.

Peak Hour: The 60-minute period in the morning and evening in which the largest volume of travel is experienced.

Provider: An agency that causes clients to be transported, as opposed to an agency whose role is limited to funding programs.

Reconstruction: When a distressed road requires a subgrade fix, a complete reconstruction is required. This type of project brings the roadway back to dirt temporarily in order to add a new road base. Reconstruction projects can last several months or longer and may involve significant delays to the traveling public. Reconstruction projects also cost more than a standard rehabilitation or preservation project. However, the fix life of a reconstruction project is much longer than rehabilitation or preservation maintenance projects.

Recurring Congestion: The relatively predictable congestion caused by routine traffic volumes operating in a typical environment.

Region: An entire metropolitan area including designated urban and rural subregions.

Resilience: The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.

Resurfacing: Restoring pavement by addressing surface issues and adding a fresh layer of asphalt. For concrete surfaces, this can be in the form of joint replacements, diamond grinding, inlay, or other rehabilitation fixes. Resurfacing projects are also known as overlay projects.

Road Diet: Narrowing travel lanes or shoulders or eliminating some of them to provide more space for pedestrians and bicyclists. A typical road diet consists of converting a four-lane roadway (two in each direction) to a three-lane (one in each direction plus a center turn lane) and adding sidewalks and/or bicycle lanes.

Shoulder: The portion of the roadway to the right of the rightmost travel lane, excluding curbs, buffers, and sidewalks; shoulders can be paved, gravel, dirt, or grass, and serve several different purposes, (bicycle and pedestrian travel, structural roadway support, space for emergency vehicles to pass, stopped/disabled vehicle pull-off, space for vehicles to slow and turn right) typically dictated by their width and composition. Transportation Demand Model: Computerized current travel behavior used to predict future travel patterns from a sample of travel behavior data.

Sidewalk: A paved pathway paralleling a highway, road, or street that is intended for pedestrians. Most sidewalks are separated from the curb by trees, grass, landscaping, lights, or other streetscape elements and are most common in areas of higher land use densities.

Single Occupancy Vehicle (SOV): The use of a vehicle to get one person to a destination.

Transit: Passenger transportation service provided to the general public along established routes with fixed or variable schedules at published fares.

Transportation Improvement Program (TIP): GVMC's short-range planning document that includes projects with dedicated funding to be constructed in our MPO area over a four-year period.

Transportation System Management (TSM): The element of a TIP that proposes non-capital-intensive steps toward the improvement of a transportation system.

Travel Time: Customarily calculated as the time it takes to travel from place to place.

Truck Platooning: The linking of two or more trucks in a convoy using technology and automated driving support systems. These vehicles automatically maintain a set, close distance between each other when they are connected.

Urban Core: The commercial, cultural, and often the historical, political, and geographic heart of a region.

Urbanized Area: An area which contains a city of 50,000 or more in population plus adjacent surrounding areas having a density of at least 1,000 people per square mile as determined by the U.S. Census.***Vehicle Miles Traveled (VMT):*** The number of vehicle miles traveled within a specified geographic area during a given period of time; one vehicle traveling one mile constitutes one vehicle mile, regardless of its size or the number of passengers.

Zoning: Classification system based on permitted and prohibited land uses, densities, and intensities used to promote land use compatibility

APPENDIX ITEMS

Appendix B: Shipping Data

Top 10 Destinations of Freight by Weight by State and FAF Zone

2017 FAF GR Zone Outbound Freight Weight Top 10 Destination by State

Rank	Destination	Ktons	Percentile	Tonnage by Mode (Ktons)						
				Truck	Rail	Water	Air	Multiple Modes	Pipeline	Other
1	Michigan	48,930	80.71%	45,247	2951			653	74	4
2	Indiana	2,680	4.42%	2,590	63		0.015	8.4	18.4	0.04
3	Illinois	1,251	2.06%	1,240			0.0005	10.5		0.006
4	Ohio	1,121	1.85%	1,075	34		0.1	10.4		1.4
5	Texas	1,103	1.82%	927	157		0.3	19.1		0.2
6	Pennsylvania	971	1.6%	632	1.9	324.7	0.3	11.8		
7	Wisconsin	543	0.9%	490	35		0.0004	4.4	13.5	
8	California	457	0.75%	376.2	10.1		0.1	66.8		3.3
9	Florida	337	0.56%	325.6	1.0		1.0	9.4		
10	New York	281	0.46%	262	0.5		0.5	17		*0.8*
Total Top 10		**57,674**	**95.13%**							
Total		**60,624**	**100%**							

2017 FAF GR Zone Outbound Freight Weight Top 10 Destination by FAF zone

Rank	Destination	Ktons	Percentile	Tonnage by Mode(Ktons)						
				Truck	Rail	Water	Air	Multiple Modes	Pipeline	Other
1	Grand Rapids	30,627	50.52%	29335	807			462	23	0.002
2	Detroit	3,521	5.81%	3250	103			121	43	4.3
3	Chicago	861	1.42%	849	0.002			8.6	2.3	0.006
4	Pittsburgh	595	0.98%	264	0.13	325	0.007	5.9		
5	Fort Wayne	496	0.82%	430	63			2	1.7	
6	Laredo, TX	453	0.75%	309	141			1.7		0.2
7	New York	350	0.58%	330	0.07		0.47	19.45		
8	Dallas	334	0.55%	328			0.2	6.1		0.0002
9	Los Angeles	290	0.48%	231	10		0.1	46		3.3
10	Columbus	254	0.42%	251	0.005		0.04	2.6		
Total Top 10		**37,781**	**62.32%**							
Total		**60,624**	**100%**							

Top 10 Destinations of Freight by Value by State and FAF Zone

2017 FAF GR Zone Outbound Freight Value Top Destination by State

Rank	Destination	Value (M$)	Percentile	Value by Mode (M $ in 2017)						
				Truck	Rail	Water	Air	Multiple Modes	Pipeline	Other
1	Michigan	53,299	50.74%	49,089	1305			2,820	18.9	67.6
2	Indiana	5,688	5.42%	5,170	18		2.5	494.6	2.9	
3	Texas	5,450	5.19%	4,145	495		38.6	771		1.1
4	Illinois	4,748	4.52%	4,325			0.1	423.6		
5	Ohio	4,242	4.04%	3,463	19.2		14.6	744.4		0.1
6	Wisconsin	2,526	2.40%	2,019	9.2		0.019	496.4		2.1
7	Pennsylvania	2,264	2.16%	1,767	6	81.4	19.9	389.5		
8	Florida	1,844	1.76%	1,202	8.3		44.3	590		
9	Kentucky	1,758	1.67%	1,003			119.4	633.8		1.2
10	New York	1,625	1.55%	1,220	1.2		30.6	364.7		9.2
Total Top 10		**83,444**	**79.44%**							
Total		**105,041**	**100%**							

2017 FAF GR Zone Outbound Freight Value Top Destination by FAF zone

Rank	Destination	Value (M$)	Percentile	Value by Mode (M $ in 2017)						
				Truck	Rail	Water	Air	Multiple Modes	Pipeline	Other
1	Grand Rapids	28,306	26.95%	27,048	102			1,149	3.7	2.9
2	Detroit	11,214	10.68%	9,409	866			865	14	60
3	Chicago	3,871	3.69%	3,528	0.1			343.9	0.4	
4	New York	2,381	2.27%	1,743	0.4		30.8	607.8		
5	Laredo	2,110	2.01%	1,635	456			18.3		1.1
6	Los Angeles	2,022	1.92%	1,348	51.3		6.9	606.3		9.4
6	Dallas	1,521	1.45%	1,127			25.2	369.3		
7	Atlanta	1,201	1.14%	1,006			5	190		
8	Cincinnati	1,159	1.10%	784	13		18.7	342.6		1.2
9	Cleveland	968	0.92%	717	0.2		9.0	241		0.1
10	Indianapolis	949	0.90%	834			1.6	112	1.1	
Total Top 10		**55,702**	**53.03%**							
Total		**105,041**	**100%**							

Top 10 Origins of Inbound Freight by Weight by State and FAF Zone

2017 FAF GR Zone Inbound Freight Weight Top Origination by State

Rank	Origination	Ktons	Percentile	Tonnage by Mode(Ktons)						
				Truck	Rail	Water	Air	Multiple Modes	Pipeline	Other
1	Michigan	48,474	62.66%	40,468	1,168	3,918		1,437	1483	0.01
2	Wyoming	8,325	10.76%	30.2	8,294					0.018
3	Indiana	5,645	7.3%	3,058	19			58	2510	
4	Ohio	4,304	5.56%	1,432	92		0.1	96	2684	
5	Illinois	2,350	3.04%	2,290	20			40		0.008
6	Texas	1,733	2.24%	836	747		0.4	150		
7	Wisconsin	1,469	1.9%	501	9.5		0.1	8.7	950	
8	Pennsylvania	384	0.5%	362	7.3		0.3	14		
9	New York	383	0.5%	342	15		0.8	25.2		
10	Iowa	335	0.43%	303	26		0.1	6.8		
Total Top 10		**73,402**	**94.89%**							
Total		**77,360**	**100%**							

2017 FAF GR Zone Inbound Freight Weight Top Destination by FAF Zone

Rank	Origination	Ktons	Percentile	Tonnage by Mode(Ktons)						
				Truck	Rail	Water	Air	Multiple Modes	Pipeline	Other
1	Grand Rapids	30,627	39.59%	29,335	807			462	23	0.002
2	Detroit	6,307	8.15%	5,672	314			293	28	
3	Chicago	2,825	3.65%	2,738	25			61.5		
4	Fort Wayne	641	0.83%	639.4				1.3		
5	Laredo	638	0.82%	267.8	366.1			3.9		0.006
6	Cleveland	500	0.65%	203	15			53.3	228.3	
7	Columbus	372	0.48%	263.4			0.1	17	91.6	
8	Cincinnati	351	0.45%	348.2			0.1	2.9		
9	Indianapolis	326	0.42%	314				11.8		
10	New York	295	0.38%	263.5	0.1		0.8	30.6		
Total Top 10		**42,882**	**55.43%**							
Total		**77,360**	**100%**							

Top 10 Origins of Inbound Freight by Value by State and FAF Zone

2017 FAF GR Zone Inbound Freight Value Top Destination by State

Rank	Origination	Value (M$)	Percentile	Value by Mode (M$)						
				Truck	Rail	Water	Air	Multiple Modes	Pipeline	Other
1	Michigan	48,525	50.6%	42,568	1,682	43		3989	240	3
2	Texas	8,232	8.58%	3,531	4,285		36.8	377.8		0.8
3	Illinois	6,516	6.79%	5,741	25			750		0.2
4	Ohio	4,550	4.74%	3,458	77		1.4	544	470	
5	Indiana	4,161	4.34%	3,343	0.1			392	426.9	
6	California	2,331	2.43%	1,423	19.5		59.5	826		2.5
7	New York	1,826	1.9%	1,413	137		68	208		0.2
8	New Jersey	1,619	1.69%	1,197			1.6	420		0.3
9	Wisconsin	1,584	1.65%	1,184	4		14.9	203	178	
10	Pennsylvania	1,489	1.55%	1,123	10.8		4.1	351		
Total Top 10		**80,833**	**84.29%**							
Total		**95,896**	**100%**							

2017 FAF GR Zone Inbound Freight Value Top Destination by FAF Zone

Rank	Origination	Value (M$)	Percentile	Value by Mode(M$)						
				Truck	Rail	Water	Air	Multiple Modes	Pipeline	Other
1	Grand Rapids	28,306	29.52%	27,048	102			1,149	3.7	2.9
2	Detroit	12,093	12.61%	8,294	1558			2,232	10.1	0.2
3	Chicago	5,742	5.99%	5,051	5.2			685		0.2
4	Laredo	4,077	4.25%	1,665	2371		0.0014	41		0.03
5	New York	2,479	2.59%	1,778	0.1		65.3	635		0.5
6	Cleveland	1,099	1.15%	892	24.8		0.01	142.7	39.9	
7	Los Angeles	960	1.00%	427.4	19.5		31.1	479.4		2.5
8	Columbus	926	0.97%	680.9			1.3	228.1	16	
9	Fort Wayne	896	0.93%	844.7				51.2		
10	Buffalo	869	0.91%	689.3	135.9		2.4	41.9		
Total Top 10		**57,447**	**59.91%**							
Total		**95,896**	**100%**							

Top 10 Inbound, Outbound, and Internal Commodities by Weight (in Tons) and Value

2017 FAF5 GR Zone Inbound Top 10 Commodities by Weight and Value

Commodity	KTons	Percent of Total	Commodity	Value (M$ in 2017)	Percent of Total
Coal	8,333	17.83%	Motorized vehicles	16,197	23.96%
Coal-n.e.c.	7,741	16.56%	Machinery	6,906	10.22%
Nonmetallic minerals	4,464	9.55%	Mixed freight	5,578	8.25%
Gravel	3,098	6.63%	Electronics	4,530	6.7%
Base metals	2,333	4.99%	Plastics/rubber	4,024	5.95%
Motorized vehicles	2,286	4.89%	Base metals	3,466	5.13%
Other foodstuffs	1,829	3.91%	Pharmaceuticals	2,836	4.2%
Mixed freight	1,761	3.77%	Misc. mfg. prods.	2,527	3.74%
Animal feed	1,683	3.6%	Articles-base metal	2,424	3.59%
Nonmetal min. prods.	1,501	3.21%	Other foodstuffs	2,159	3.19%
Total Top 10	**35,029**	**74.94%**	***Total Top 10***	**50,647**	**74.93%**
Total All Other Goods	**11,703**	**25.06%**	***Total All Other Goods***	**16,942**	**25.07%**
Total All Goods	**46,732**	**100%**	***Total All Goods***	**67,589**	**100%**

2017 FAF5 GR Zone Outbound Top 10 Commodities by Weight and Value

Commodity	KTons	Percent of Total	Commodity	Value (M$ in 2017)	Percent of Total
Cereal grains	3,928	13.09%	Motorized vehicles	16,901.0	22.02
Other foodstuffs	3,002	10.01%	Machinery	9,344.8	12.18
Motorized vehicles	2,524	8.41%	Mixed freight	7,356.7	9.59
Other ag prods.	2,343	7.81%	Furniture	5,188.7	6.76
Mixed freight	2,305	7.68%	Plastics/rubber	4,422.3	5.76
Waste/scrap	1,510	5.03%	Electronics	3,713.0	4.84
Gravel	1,421	4.74%	Textiles/leather	3,095.8	4.03
Nonmetal min. prods.	1,364	4.55%	Milled grain prods.	3,054.5	3.98
Milled grain prods.	1,271	4.24%	Other foodstuffs	2,550.3	3.32
Gasoline	891	2.97%	Misc. mfg. prods.	2,524.7	3.29
Total Top 10	**20,559**	**68.53%**	***Total Top 10***	**58,152**	**75.77%**
Total All Other Goods	**9,438**	**31.47%**	***Total All Other Goods***	**18,584**	**24.23%**
Total All Goods	**29,997**	**100%**	***Total All Goods***	**76,736**	**100%**

2017 FAF5 GR Zone Internal Top 10 Commodities by Weight and Value

Commodity	KTons	Percent of Total	Commodity	Value (M$ in 2017)	Percent of Total
Gravel	8,361	27.3%	Motorized vehicles	5,429	19.18%
Nonmetal min. prods.	4,512	14.73%	Electronics	2,646	9.35%
Gasoline	3,575	11.67%	Machinery	2,547	9.00%
Natural sands	1,902	6.21%	Gasoline	1,847	6.53%
Waste/scrap	1,562	5.1%	Mixed freight	1,782	6.30%
Wood prods.	1,222	3.99%	Furniture	1,556	5.50%
Other foodstuffs	1,213	3.96%	Plastics/rubber	1,146	4.05%
Logs	797	2.6%	Articles-base metal	990	3.50%
Fuel oils	784	2.56%	Milled grain prods.	987	3.49%
Coal-n.e.c.	750	2.45%	Wood prods.	967	3.42%
Total Top 10	**24676**	**80.57%**	***Total Top 10***	**19897**	**70.32%**
Total All Other Goods	**5951**	**18.43%**	***Total All Other Goods***	**8409**	**29.68%**
Total All Goods	**30627**	**100%**	***Total All Goods***	**28306**	**100%**

The table that follows show the top inbound, outbound, and internal commodities by weight and value.

Inbound		Outbound		Internal	
Tons	**Value**	**Tons**	**Value**	**Tons**	**Value**
Coal	Motorized vehicles	Cereal grains	Motorized vehicles	Gravel	Motorized vehicles
Coal-n.e.c.	Machinery	Other foodstuffs	Machinery	Nonmetal min. prods.	Electronics
Nonmetallic minerals	Mixed freight	Motorized vehicles	Mixed freight	Gasoline	Machinery
Gravel	Electronics	Other ag prods.	Furniture	Natural sands	Gasoline
Base metals	Plastics/rubber	Mixed freight	Plastics/rubber	Waste/scrap	Mixed freight
Motorized vehicles	Base metals	Waste/scrap	Electronics	Wood prods.	Furniture
Other foodstuffs	Pharmaceuticals	Gravel	Textiles/leather	Other foodstuffs	Plastics/rubber
Mixed freight	Misc. mfg. prods.	Nonmetal min. prods.	Milled grain prods.	Logs	Articles-base metal
Animal feed	Articles-base metal	Milled grain prods.	Other foodstuffs	Fuel oils	Milled grain prods.
Nonmetal min. prods.	Other foodstuffs	Gasoline	Misc. mfg. prods.	Coal-n.e.c.	Wood prods.

Appendix C: Bottlenecks

The tables that follow display the top 20 bottlenecks in the GVMC area in 2018,2019, 2020, and 2021 respectively. The total delay in the table shows the total hours of travel delay per year for each bottleneck. As is shown in the table, bottlenecks are concentrated on major truck corridors such as US-131, I-196, M-37, M-11 and I-96.

2018 GVMC Bottleneck Rank				
Rank	**Corridor Name**	**Location**	**Road Type**	**Total Delay (hours per year)**
1	US-131	US-131 N @ I-196 BUS/FRANKLIN ST/EXIT 83	Freeway	56,748,738
2	US-131	US-131 N @ LEONARD ST/EXIT 87	Freeway	51,323,534
3	US-131	US-131 N @ 10 MILE RD/EXIT 97	Freeway	50,238,141
4	M-37	M-37 N @ 4 MILE RD	Principal Arterial	45,400,475
5	M-37	M-37 N @ I-96	Principal Arterial	44,241,989
6	I-196	I-196 E @ I-96/MI-37	Freeway	38,658,527
7	M-37	M-37 S @ MI-11/28TH ST	Principal Arterial	38,594,425
8	US-131	US-131 N @ MI-57/CR-B72/EXIT 101	Freeway	34,707,276
9	M-37	M-37 N @ BURTON ST	Principal Arterial	32,323,386
10	US-131	US-131 N @ HALL ST/EXIT 83	Freeway	30,694,153
11	I-96	I-96 W @ MI-21/EXIT 39	Freeway	30,200,835
12	M-37	M-37 N @ LAMOREAUX DR	Principal Arterial	21,395,233
13	M-44	M-44 N @ LEONARD ST	Principal Arterial	21,167,928
14	I-196	I-196 W @ OTTAWA AVE/EXIT 77	Freeway	20,705,157
15	M-11	M-11 W @ EASTERN AVE	Principal Arterial	20,314,385
16	M-11	M-11 W @ MI-37/BELTLINE AVE/BROADMOOR AVE	Principal Arterial	19,506,916
17	US-131	US-131 N @ 22 MILE RD/EXIT 110	Freeway	18,514,132

18	M-11	M-11 W @ BUCHANAN AVE	Principal Arterial	18,300,159
19	I-196	I-196 E @ 32ND AVE/EXIT 62	Freeway	17,019,844
20	US-131	US-131 N @ I-196 BUS/FRANKLIN ST/EXIT 83	Freeway	16,566,069

2019 GVMC Bottleneck Rank

Rank	Corridor Name	Location	Road Type	Total Delay (hours)
1	I-196	I-196 E @ I-96/M-37	Freeway	143,182,833
2	M-44	M-44 S @ I-96/M-37/EXIT 38	Principal Arterial	78,200,811
3	US-131	US-131 N @ I-196-BR/FRANKLIN ST/EXIT 83	Freeway	43,288,302
4	M-37	M-37 S @ M-11/28TH ST SE	Principal Arterial	39,707,681
5	US-131	US-131 N @ I-196/GERALD R FORD FWY/EXIT 86	Freeway	34,943,110
6	M-11	M-11 W @ M-37/BROADMOOR AVE SE/BELTLINE AVE	Principal Arterial	34,667,300
7	M-37	M-37 N @ BURTON ST SE	Principal Arterial	29,180,331
8	I-96	I-96 W @ CR-B31/EXIT 10	Freeway	28,707,691
9	M-37	M-37 N @ 4 MILE RD NW	Principal Arterial	26,604,169
10	US-131	US-131 S @ LEONARD ST/EXIT 87	Freeway	23,958,662
11	I-96	I-96 E @ M-37/M-44/BELTLINE AVE/EXIT 38	Freeway	23,207,789
12	M-37	M-37 N @ I-96	Principal Arterial	22,838,678
13	M-11	M-11 W @ BUCHANAN AVE SW	Principal Arterial	22,156,840
14	I-96	I-96 E @ CR-B31/EXIT 10	Freeway	21,891,421
15	I-96	I-96 E @ LEONARD ST/EXIT 36	Freeway	21,147,194
16	M-37	M-37 N @ M-11/28TH ST SE	Principal Arterial	20,115,764
17	US-131	US-131 S @ ANN ST/EXIT 88	Freeway	19,711,149
18	M-11	M-11 E @ M-37/BROADMOOR AVE SE/BELTLINE AVE	Principal Arterial	19,130,351

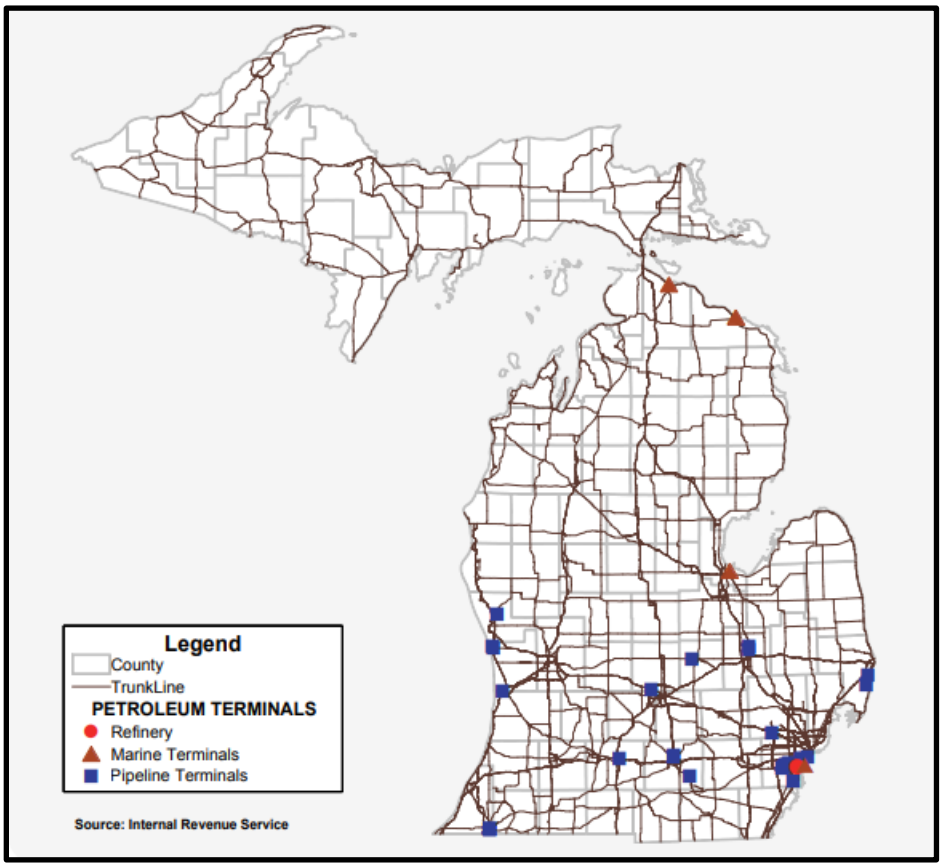
19	Kalamazoo Ave	KALAMAZOO AVE SE S @ 68TH ST SE	Principal Arterial	18,811,558
20	US-131	US-131 N @ HALL ST/EXIT 83	Freeway	18,441,264

2020 GVMC Bottleneck Rank				
Rank	**Corridor Name**	**Location**	**Road Type**	**Total Delay (hours)**
1	M-37	M-37 @ MI-11/28th ST	Principal Arterial	35,094,638
2	3 Mile Road	3 MILE RD NW E @ I-96/ALPINE AVE NW	Principal Arterial	19,075,032
3	US-131	US-131 N @ RIVER DR/EXIT83	Freeway	18,034,999
4	US-131	US-131 @ I-196 BUS/FRANKLIN ST/EXIT 83	Freeway	17,085,915
5	I-196	I-196 E @ MARKET ST/EXIT 73	Freeway	44,241,989
6	M-37	M-37 S @ BURTON ST	Principal Arterial	16,458,183
7	CASCADE RD	CASCADE RD SE E @I-96	Minor Arterial	16,274,294
8	M-11	M-11 W@ MI-37/BELTLINE AVE/BROADMOOR AVE	Principal Arterial	15,494,869
9	M-11	M-11 S @ CHICAGO DR	Principal Arterial	15,189,932
10	KALAMAZOO AVE	KALAMAZOO AVE SE @68TH ST	Principal Arterial	14,724,381
11	US-131	I-96 W @ MI-21/EXIT 39	Freeway	14,352,862
12	FULLER AVE	FULLER AVE S @ MICHIGAN ST	Principal Arterial	13,169,400
13	MONROE AVE	MONROE AVE N @ LEONARD ST	Minor Arterial	12,502,335
14	28TH ST	28th ST E @ CASCADE RD SE	Principal Arterial	12,333,961
15	WILSON AVE	WILSON AVE SW S @ CHICAGO DR	Principal Arterial	11,545,987
16	KALAMAZOO AVE	KALAMAZOO AVE SE N @MI-6	Principal Arterial	11,475,456
17	M-37	M-37 @ I-96	Principal Arterial	10,884,945
18	US-131	US 131 N @ WEALTHY ST/EXIT 84	Freeway	10,836,791
19	M-11	M-11 E @ MI-37/BELTLINE AVE/BROADMORE AVE	Principal Arterial	10,694,367
20	M-11	M-11 E @ BRETON RD	Principal Arterial	10,499,423

2021 GVMC Bottleneck Rank				
Rank	**Corridor Name**	**Location**	**Road Type**	**Total Delay (hours per year)**
1	US-131	US-131 @ WEALTHY ST/EXIT 84	Freeway	137,936,034
2	US-131	US-131 @ WEALTHY ST/EXIT 84	Freeway	99,654,759
3	M-37	M-37 @ MI-11/28th ST	Principal Arterial	51,672,017
4	I-96	I-96 W @MI-6/SOUTH BELTLINE/PAUL B HENRY FWY	Freeway	34,457,450
5	I-96	I-96 W @ MI-21/EXIT 39	Freeway	31,358,721
6	I-96	I-96 W @ MI-50/EXIT 52	Freeway	22,899,225
7	I-196	I-196 @ ALLEGAN/OTTOWA COUNTY LINE	Freeway	21,128,395
8	CASCADE RD	CASCADE RD SE E @196	Minor Arterial	19,880,407
9	M-37	M-37 @ 4 MILE RD	Principal Arterial	16,839,402
10	M-11	M-11 E @ DIVISION AVE	Principal Arterial	15,987,594
11	US-131	US-131 N @ POST DR/EXIT 95	Freeway	15,077,091
12	I-196	I-196 AW @ BYRON RD/EXIT 55	Principal Arterial	15,001,116
13	M-11	M-11 @ MI-37/BELTLINE AVE/BROADMOOR AVE	Minor Arterial	14,431,026
14	JOHN J OOSTEMA BLVD	JOHN J OOSTEMA BLVD SE E @ GERALD R FORD INT'L'AIRPORT	Principal Arterial	13,528,037
15	M-11	M-11 S @ I-196 BUS/GERALD R FORD FWY	Principal Arterial	13,520,462
16	M-37	M-37 @ 10 MILE RD (SPARTA)	Principal Arterial	13,402,694
17	M-37	M-37 @ 84th ST	Principal Arterial	12,832,333
18	M-37	M-37 @ BURTON ST	Principal Arterial	12,628,459
19	US-131	US-131 N @ I-196 BUS/FRANKLIN ST/ EXIT 83	Principal Arterial	12,125,147
20	M-6	M-6 E @ MI-37 BROADMOOR AVE/EXIT 15	Principal Arterial	11,854,971

Appendix D: Petroleum Pipeline Terminal Locations

MDOT does not oversee pipeline infrastructure. However, it maintains a geographic database of petroleum pipeline terminal locations (see map below). These sites are major generators of petroleum movements to consumption areas. Keeping updated location information benefits the MDOT's freight modeling efforts by allowing the simulation of origin/destination patterns on state highway infrastructure.



Map 30: Petroleum Terminals and Refineries in Michigan; Graphic from MDOT's Michigan Freight Plan

Appendix E: Truck Crash Data

The table below provides a brief description of truck-involved fatal and serious injury crashes from 2015-2019 in the GVMC region.

Fatal and Serious Injury Truck/Bus-Involved Crashes Analysis		
Number	**Year**	**Brief Crash Description**
1	2015	Truck overturned on curve ramp because it was traveling too fast for the curved ramp
2	2015	Truck overturned on a ramp due to wet road
3	2016	failed to stop at stop sign
4	2016	Tow truck on freeway shoulder rear ended by a vehicle which was unable to stop in assured clear distance
5	2016	Rear ended due to unable to stop in assured clear distance
6	2017	Rear ended due to unable to stop in assured clear distance
7	2017	Traveling too fast for wet road on freeway ramp
8	2017	Traveling too fast on freeway ramp and lost control
9	2017	Truck hit guardrail due to driver distraction
10	2017	Rear ended due to unable to stop in assured clear distance
11	2018	Truck traveled too fast on freeway and lost control for wet road condition
12	2018	Rear ended due to unable to stop in assured clear distance
13	2019	Careless driving and lane change
14	2019	Improper lane change

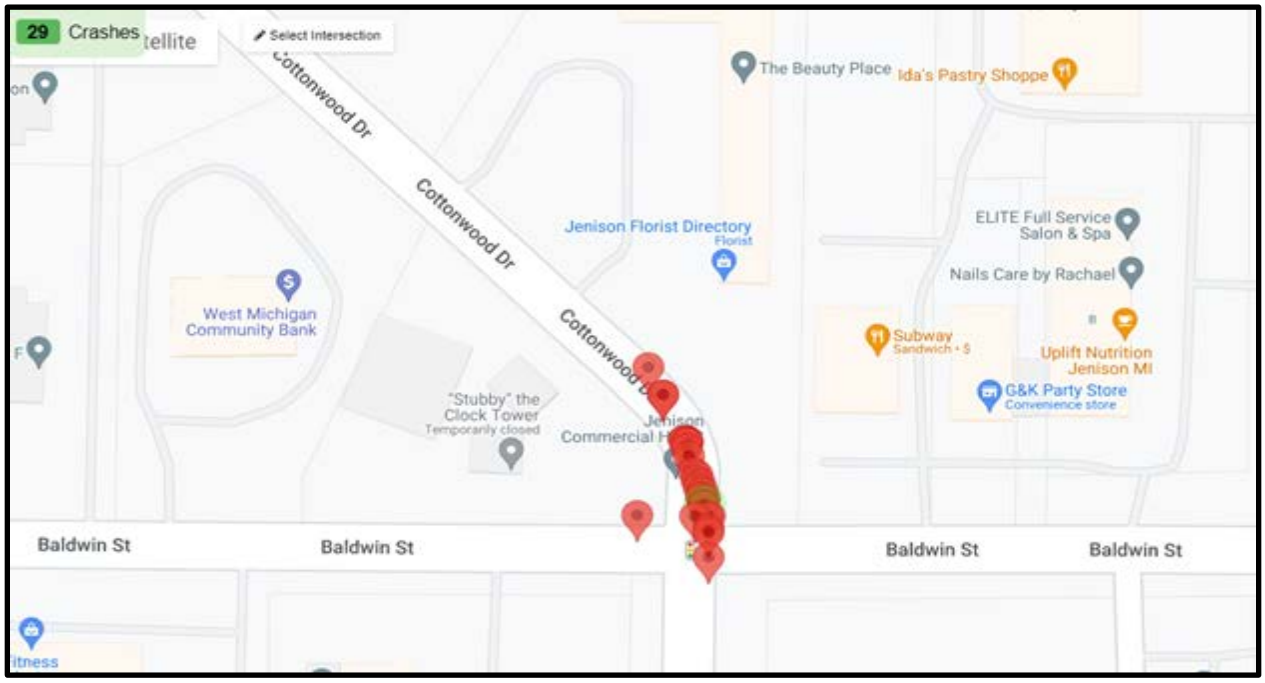
The table below displays the top 20 intersections where truck-involved crashes have occurred between 2017-2021.

2017-2021 Top 20 Truck-Involved Crashes Intersections		
Rank	**Location**	**Total Truck Crash**
1	Cottonwood Dr & Baldwin St (Ottawa County)	31
2	Broadmoor Ave SW & 28th St SW (Kent County)	15
3	Burlingame Ave SW & 28th St SW (Kent County)	15
4	Turner Ave NW & Leonard St NW (Kent County)	15
5	Wealthy/N US 131 RAMP & Wealthy St SW & N US 131/Wealthy RAMP (Kent County)	14
6	Hall St SW & Division Ave & Hall St SE (Kent County)	14
7	60th St SE & Broadmoor Ave SE (Kent County)	13
8	76th/ S US 131 RAMP & 76th St SW & S US 131/76th RAMP (Kent County)	13
9	Hudson Trails Dr & Corporate Grove Dr & 32nd Ave (Ottawa County)	13
10	W River Dr NE & Northland Dr NE & Cannonsburg Rd NE (Kent County)	13
11	Alpine Ave NW & 4 Mile Rd NW (Kent County)	13
12	S US 131/Wealthy RAMP & Wealthy St SW & Wealthy/S US 131 RAMP (Kent County)	12
13	Eastern Ave SE & 28th St SE (Kent County)	12
14	Lake Michigan Dr NW & Wilson Ave NW (Kent County)	12
15	28th St SW & S Division Ave & 28th St SE (Kent County)	11
16	Michigan St NE & E Beltline Ave NE (Kent County)	11
17	Pearl St NW & Monroe Center St NW & Monroe Ave NW (Kent County)	11
18	28th St SE & Brenton Rd SE (Kent County)	11
19	Burton/S US 131 RAMP & S US 131 (Kent County)	11
20	Broadmoor Ave SE & E M 6/M 37 RAMP (Kent County)	11

The table that follows shows the top 20 segments where truck-involved crashes occurred between 2017-2021.

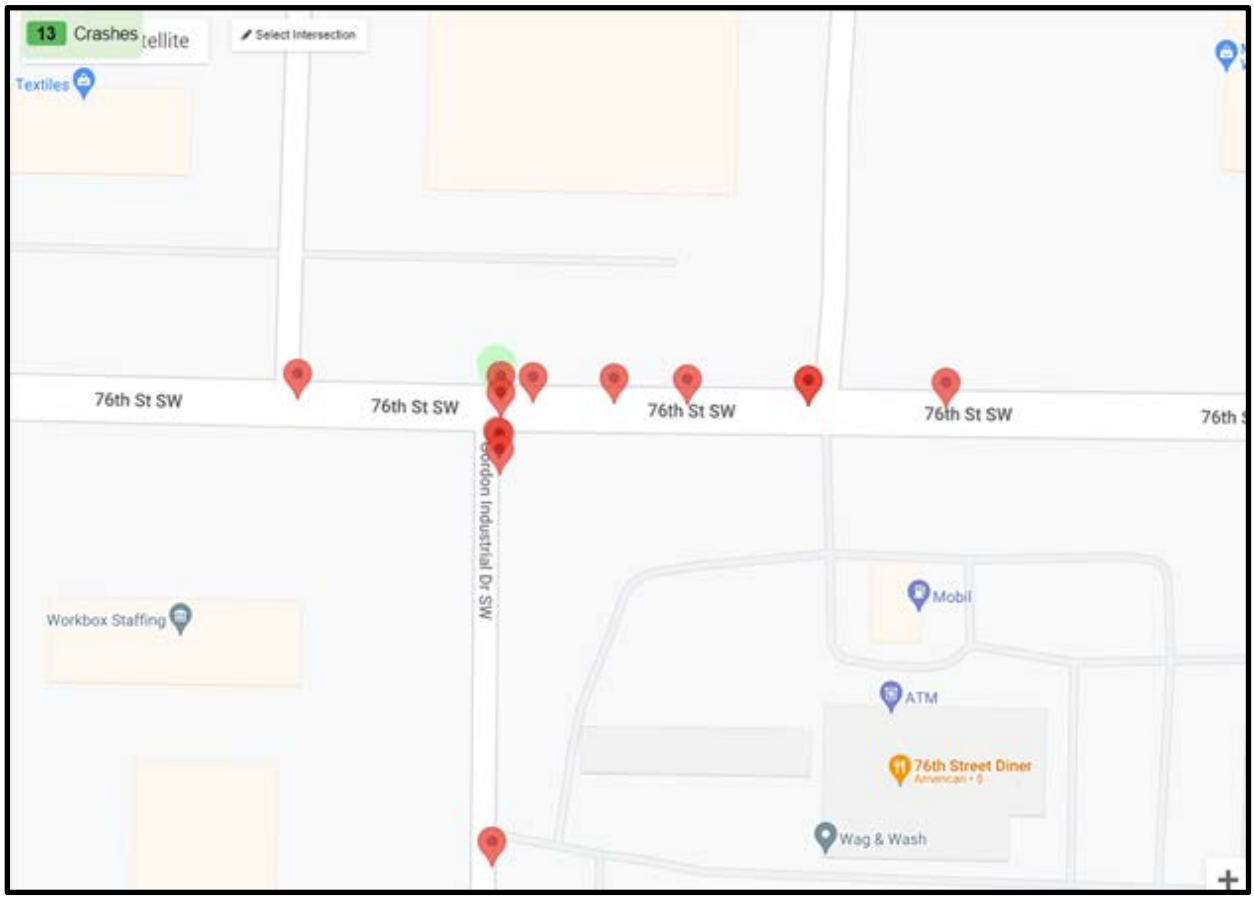
2017-2021 Top 20 Truck-Involved Crashes Road Segments		
Rank	**Location**	**Total Truck Crash**
1	Cottonwood Dr (on PR: 739405)	24
2	N US 131 (on PR: 410203)	18
3	76th St SW (on PR: 410302)	18
4	N US 131 (on PR: 410203)	15
5	Fuller Ave NE (on PR: 406803)	8
6	Northland Dr NE (on PR: 407503)	7
7	N US 131 (on PR: 410203)	7
8	Leonard St NW (on PR: 3415604)	7
9	Fuller Ave NE (on PR: 406803)	7
10	E Beltline Ave NE (on PR: 407204)	6
11	80th Ave (on PR: 749601)	6
12	Wilson Ave SW (on PR: 409008)	6
13	Michigan St NW (on PR: 407408)	6
14	Wealthy St SW (on PR: 408907)	5
15	Pearl St NW (on PR: 410509)	5
16	28th St SE (on PR: 409008)	5
17	S US 131 (on PR: 410907)	5
18	Eastern Ave SE (on PR: 3030180)	5
19	Sheridan Ave SW (on PR: 411202)	5
20	Roger B Chaffee Blvd SE (on PR: 6802008)	4

Baldwin St & Cottonwood Dr Truck-Involved Crashes (2017-2021)



60th St SE & Broadmore Ave SE Truck-Involved Crashes (2017-2021)

76th St SW & Gordon Industrial Dr. SW Truck-Involved Crashes (2017-2021)



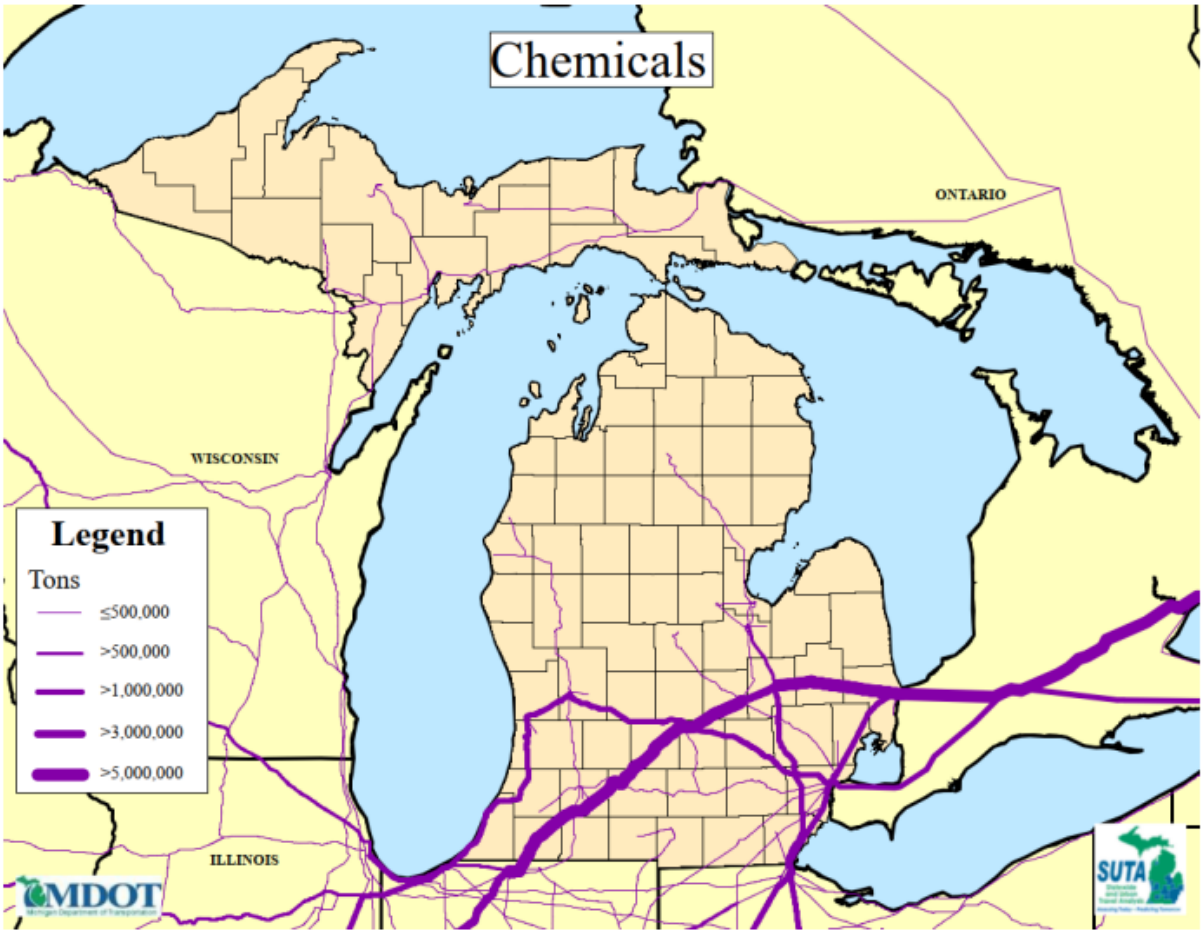
Appendix F: Railroad Crossing Crash Data

The table below provides a brief description of railroad crossing crashes from 2017-2021 in the GVMC region.

Train involved Crash 2017-2021		
Number	**Year**	**Brief Crash Description**
1	2017	Rear bumper clipped by drain due to careless driving
2	2018	Driver failed to yield to train
3	2018	Intoxicated driver disregarded traffic control
4	2018	Driver disregarded traffic control and failed to yield to train
5	2018	Driver disregarded traffic control and failed to yield to train
6	2019	Driver failed to see stopped train
7	2019	Driver failed to see flares indicating empty freight car movements
8	2020	Driver disregarded traffic control and failed to yield to train
9	2021	Bus stuck on track due to icy conditions
10	2021	Distracted driver failed to yield to train

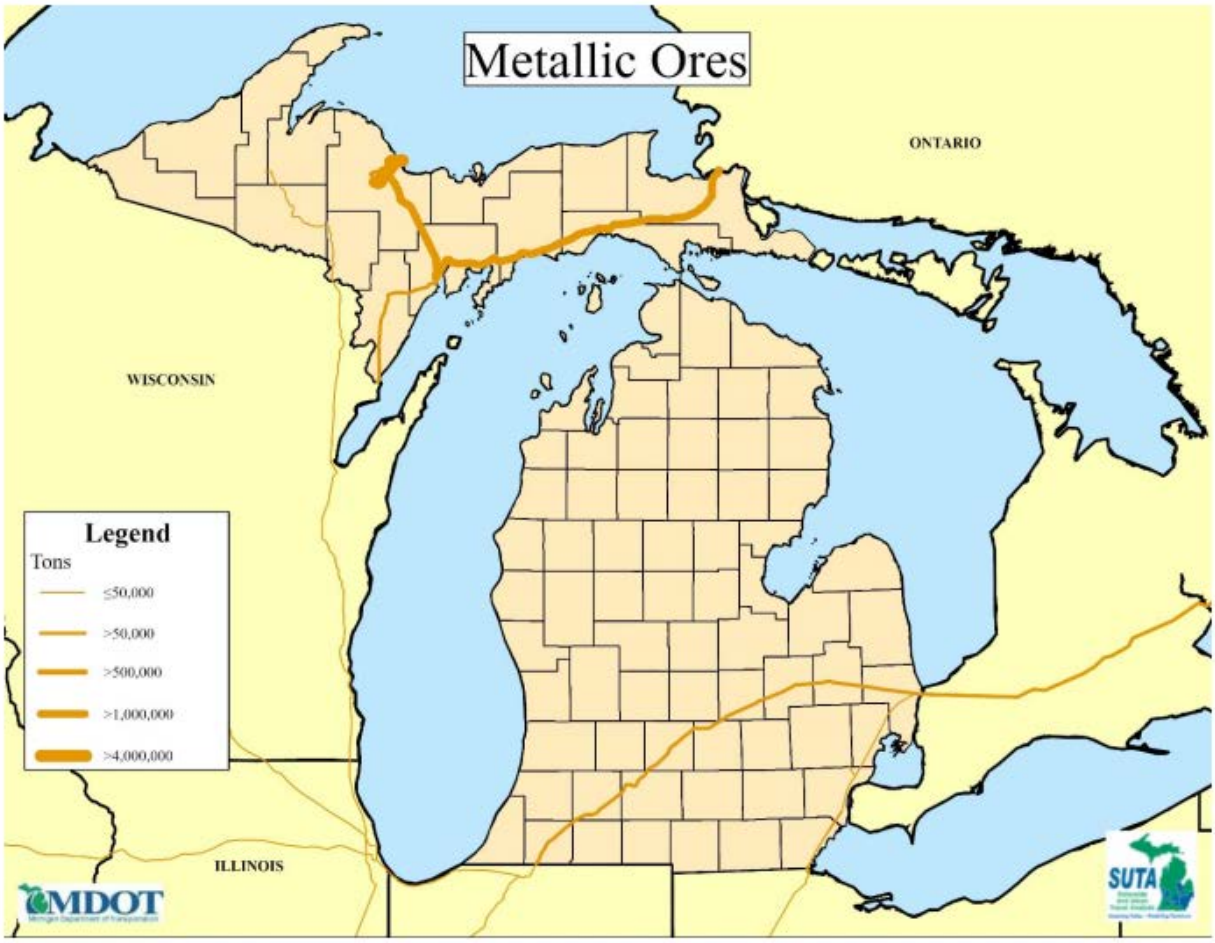
Appendix G: Rail Commodity Flow Maps

Source: 2018 Surface Transportation Board Waybill data, MDOT, IHS Markit Analysis



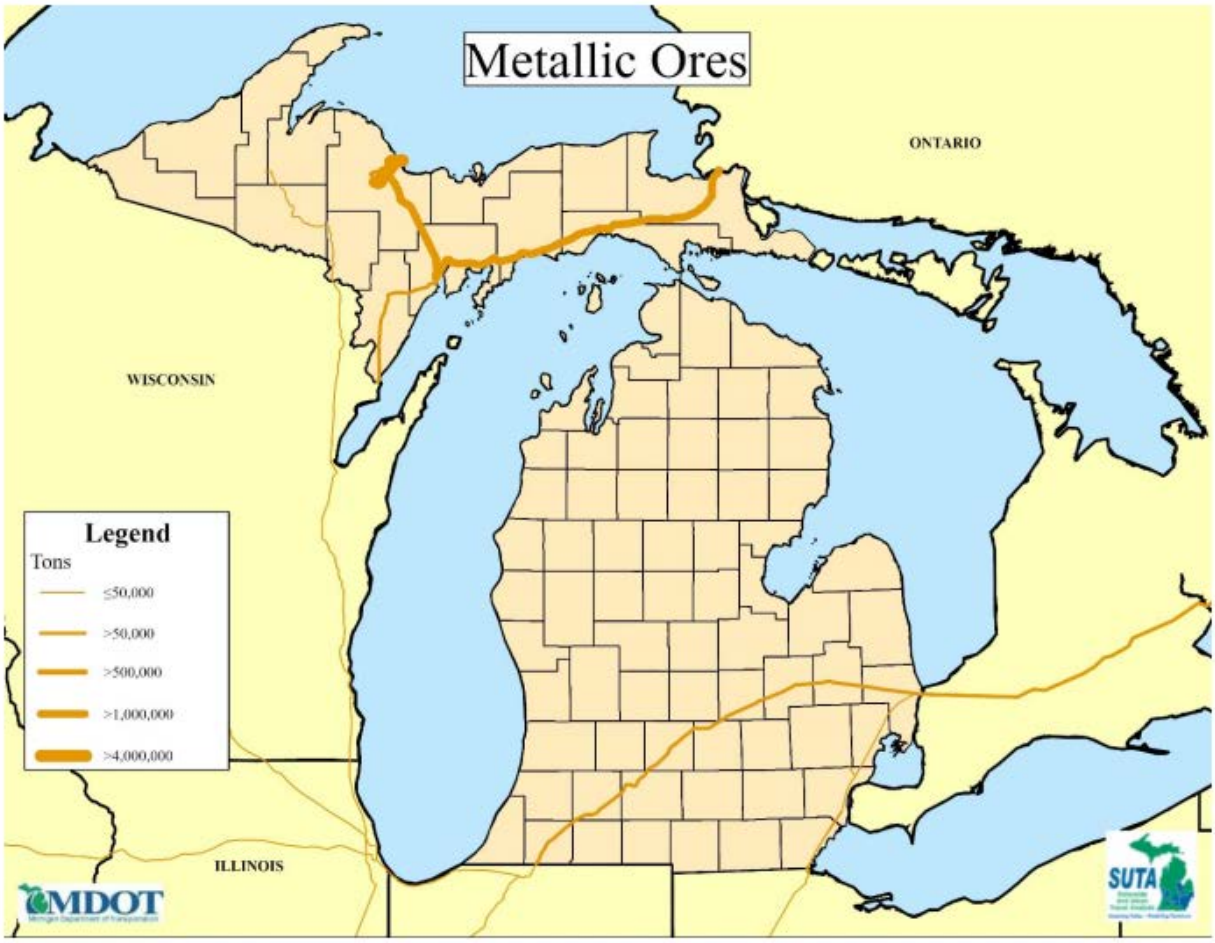
Source: 2018 Surface Transportation Board Waybill data, MDOT, IHS Markit Analysis

Source: 2018 Surface Transportation Board Waybill data, MDOT, IHS Markit Analysis



Source: 2018 Surface Transportation Board Waybill data, MDOT, IHS Markit Analysis

Source: 2018 Surface Transportation Board Waybill data, MDOT, IHS Markit Analysis

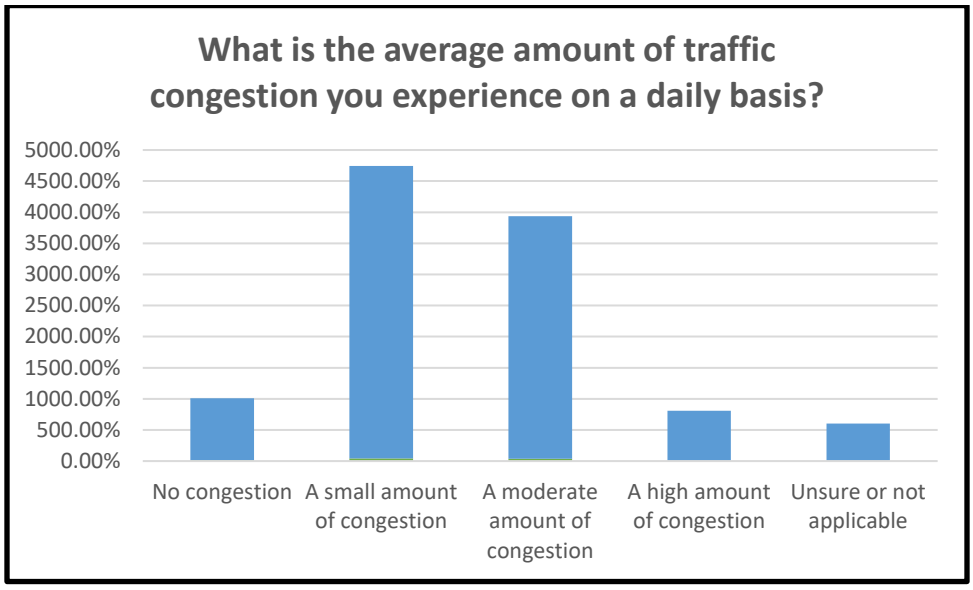


Source: 2018 Surface Transportation Board Waybill data, MDOT, IHS Markit Analysis

Appendix H: Freight Public Survey Results

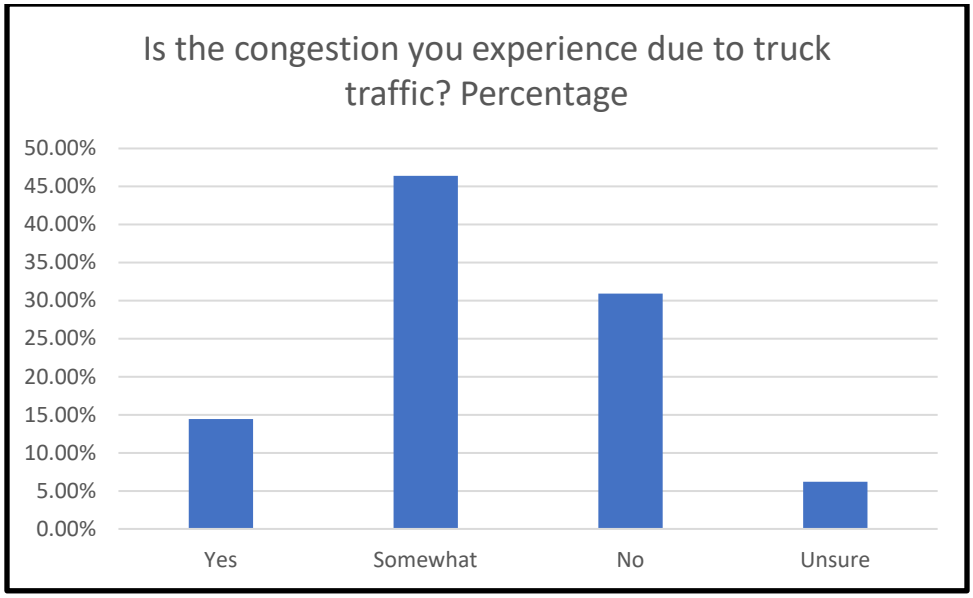
Question 1:

What is the average amount of traffic congestion you experience on a daily basis?		
Answer Choices	**Percentage**	**Total Number of Responses**
No congestion	9.09%	10
A small amount of congestion	42.73%	47
A moderate amount of congestion	35.45%	39
A high amount of congestion	7.27%	8
Unsure or not applicable	5.45%	6
Answered		***110***
Skipped		***0***



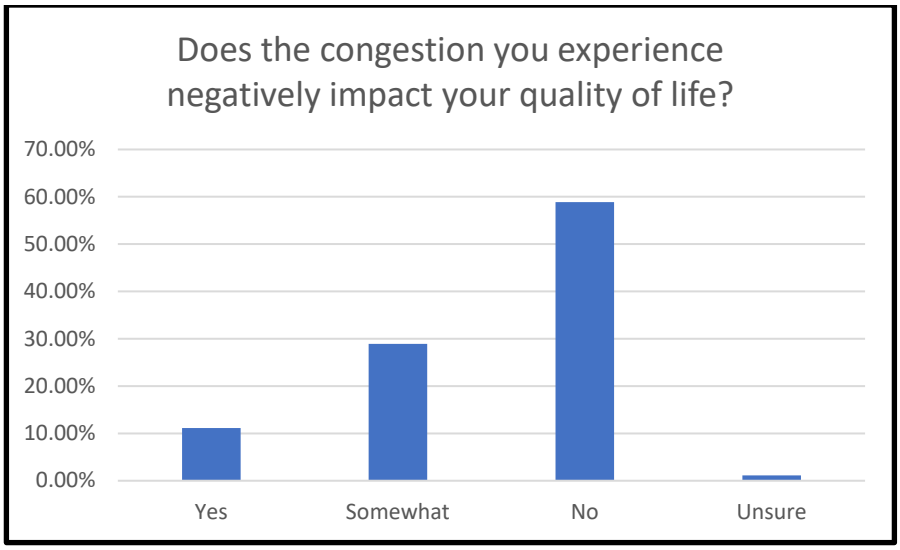
Question 2:

Is the congestion you experience due to truck traffic?		
Answer Choice	**Percentage**	**Responses**
Yes	14.43%	14
Somewhat	46.39%	45
No	30.93%	30
Unsure	6.19%	6
Answered		***97***
Skipped		***17***



Question 3:

Does the congestion you experience negatively impact your quality of life?		
Answer Choices	**Percentage**	**Responses**
Yes	10.87%	10
Somewhat	30.43%	28
No	57.61%	53
Unsure	1.09%	1
Answered		***92***
Skipped		***18***



Question 4:

How does the congestion you experience negatively impact your quality of life?	
Answered	*35*
Skipped	*75*

The comments below are written exactly as they were submitted to maintain the integrity of the comment.

Comments Received:

Time spent going slow on 131. Smelling diesel exhaust.

I drive expedite & food delivery so when traffic is bad it slows me down and impacts my income.

Need to leave earlier for work. Can cause stress.

Slowdowns

It is seasonal. I choose alternate routes and avoid certain places.

Easily getting to places

Time is valuable. Any time waiting in traffic backups is a loss of value.

Increased commute time = less time with my family

Traffic, pollution, noise

Stress that an accident could happen due to blind spots, bad driving, etc. Also adds to traffic and effects travel time, especially to work. Makes other drivers nervous and speed around trucks causin more anxiety for other drivers. I could go on for a while

stress and possible road rage incidents

Unexpected delays on commutes; Sometimes difficult to get out of my apartment complex It makes me late for work each day

I don't like driving slow

Increased travel times to work and other areas.

long delays

Increase travel time to destination. That time could be better spent than sitting behind the wheel moving slowly or not at all.

slow trucks entering have caused numerous near miss accidents

Noise

wastes time, forces me to change my schedule, often resulting in less productivity

We live on Pine Island Drive, by 7 mile road. We have way too much semi traffic on this road – enough that they rattle the house, several times daily.

Takes time away from family and personal life.

causes stress

Frustration, stress, lost time.

Spend more time driving

Time spent

Time wasted in traffic

Time, and smelling/inhaling diesel fumes

Causes delays, semi truck tires are scattered all over roadways leaving debris, semis pollute and are loud when engine braking near my house

Yes

Slow downs in traffic, then more backups. We are really dumb for not using rail service as we use to.

Spend more time in a car when time could be spent at home or working

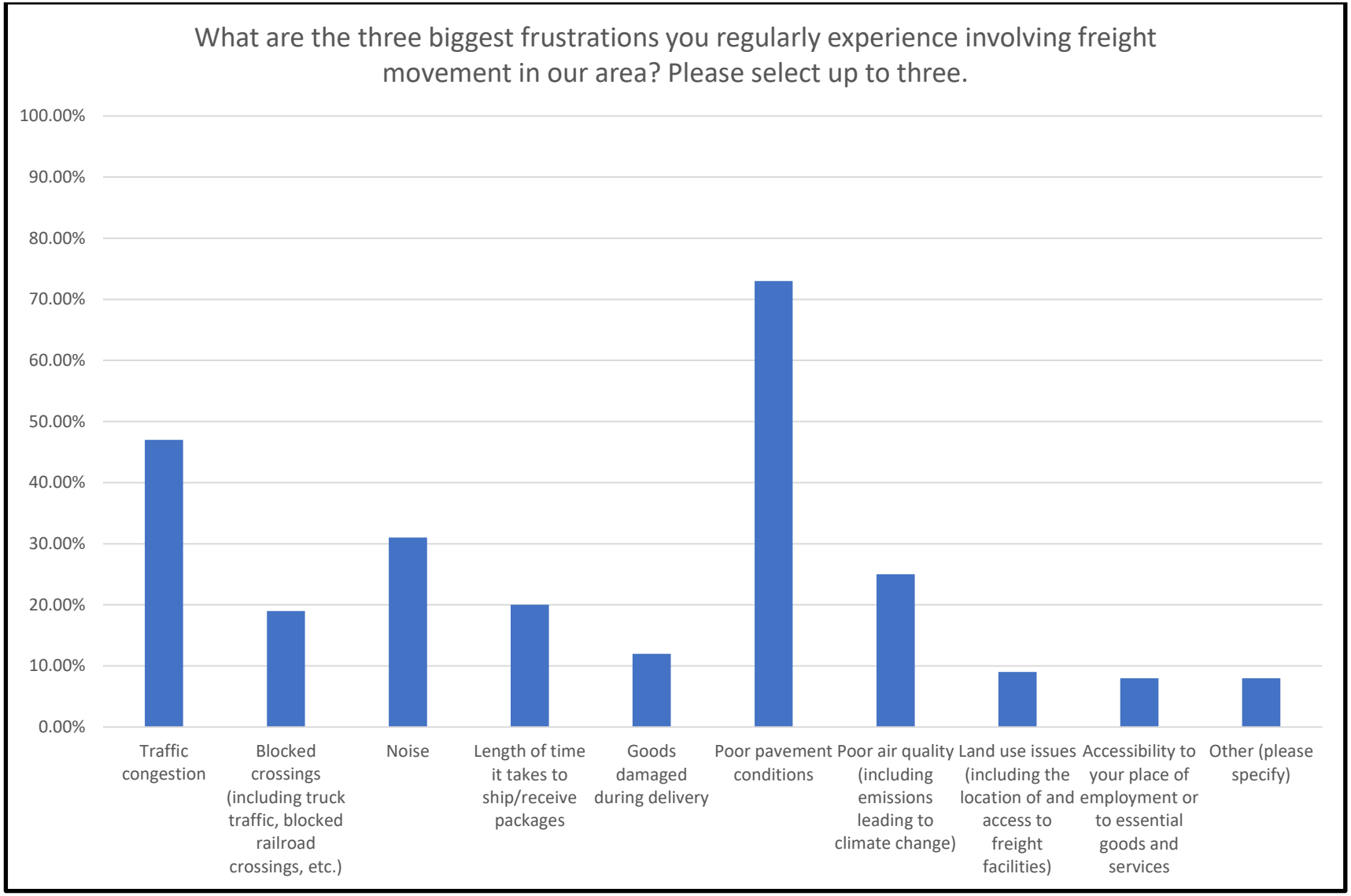
Time

Es estresante los embotellamientos de tráficos en horas de la tarde
***Translation**: Traffic jams during the afternoon hours are stressful.*

Yes

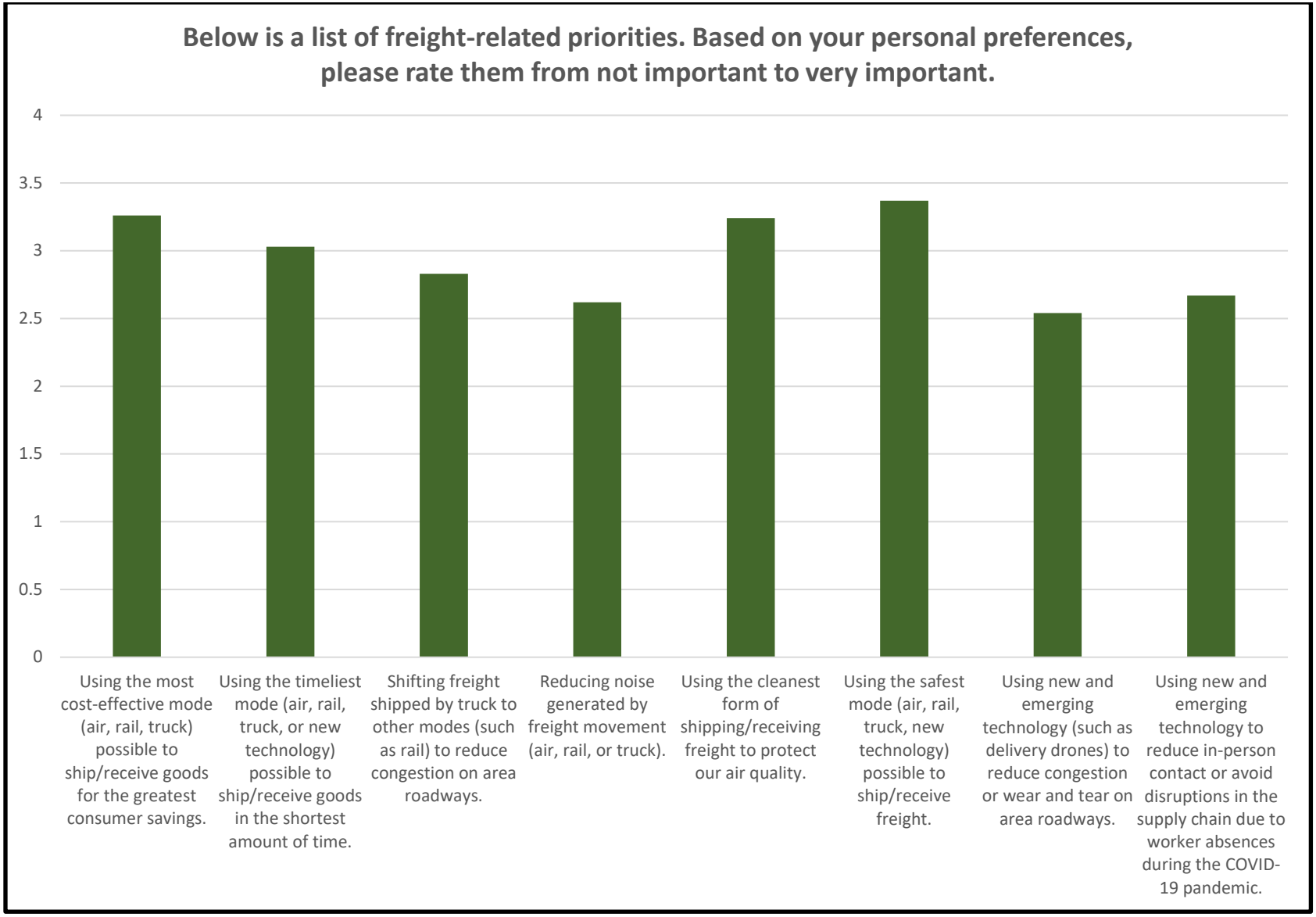
Question 5:

What are the three biggest frustrations you regularly experience involving freight movement in our area? Please select up to three.		
Answer Choice	**Percentage**	**Responses**
Traffic congestion	47.00%	47
Blocked crossings (including truck traffic, blocked railroad crossings, etc.)	19.00%	19
Noise	31.00%	31
Length of time it takes to ship/receive packages	20.00%	20
Goods damaged during delivery	12.00%	12
Poor pavement conditions	73.00%	73
Poor air quality (including emissions leading to climate change)	25.00%	25
Land use issues (including the location of and access to freight facilities)	9.00%	9
Accessibility to your place of employment or to essential goods and services	8.00%	8
Other (please specify)	8.00%	8
Answered		***100***
Skipped		***10***


What are the three biggest frustrations you regularly experience involving freight movement in our area? Please select up to three.
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Traffic congestion
Blocked crossings (including truck traffic, blocked railroad crossings, etc.)
Noise
Length of time it takes to ship/receive packages
Goods damaged during delivery
Poor pavement conditions
Poor air quality (including emissions leading to climate change)
Land use issues (including the location of and access to freight facilities)
Accessibility to your place of employment or to essential goods and services
Other (please specify)

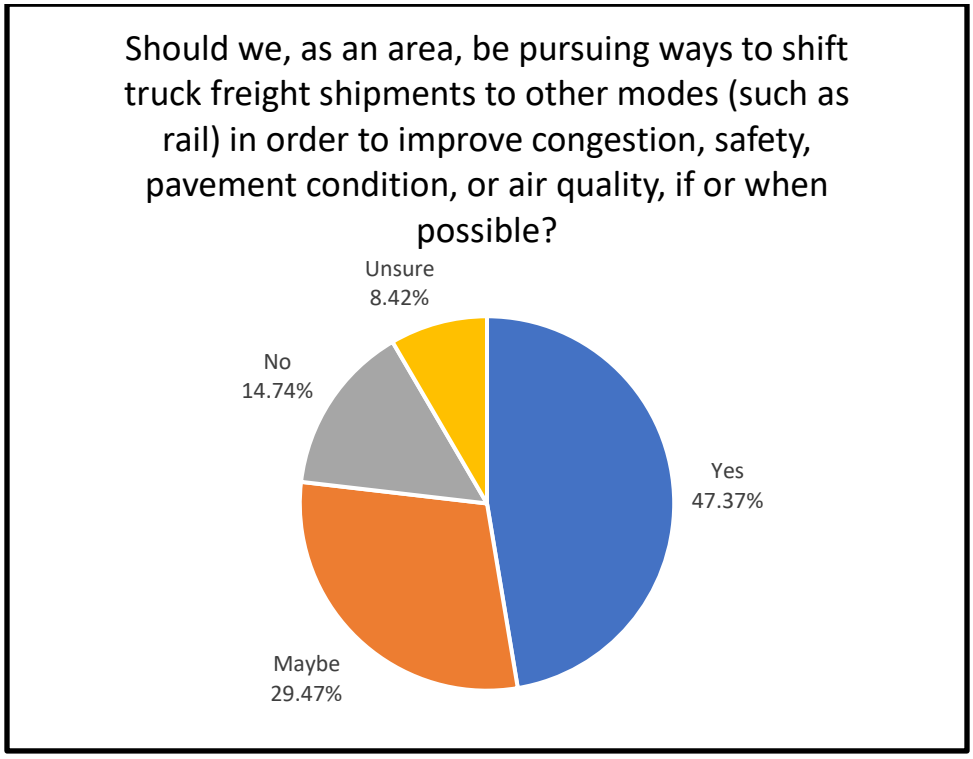
Question 6:

Below is a list of freight-related priorities. Based on your personal preferences, please rate them from not important to very important.											
	Not Important		Slightly important		Important		Very important		Undecided		Weighted Average
Using the most cost-effective mode (air, rail, truck) possible to ship/receive goods for the greatest consumer savings.	3.09%	3	12.37%	12	41.24%	40	43.30%	42	0.00%	0	3.25
Using the timeliest mode (air, rail, truck, or new technology) possible to ship/receive goods in the shortest amount of time.	2.06%	2	23.71%	23	45.36%	44	28.87%	28	0.00%	0	3.01
Shifting freight shipped by truck to other modes (such as rail) to reduce congestion on area roadways.	18.56%	18	24.74%	24	30.93%	30	25.77%	25	0.00%	0	2.64
Reducing noise generated by freight movement (air, rail, or truck).	20.62 %	20	34.02%	33	25.77%	25	18.56%	18	1.03%	1	2.40
Using the cleanest form of shipping/receiving freight to protect our air quality.	5.15%	5	17.53%	17	26.80%	26	46.39%	45	4.12%	4	3.06
Using the safest mode (air, rail, truck, new technology) possible to ship/receive freight.	4.12%	4	7.22%	7	38.14%	37	47.42%	46	3.09%	3	3.23
Using new and emerging technology (such as delivery drones) to reduce congestion or wear and tear on area roadways.	22.68%	22	27.84%	27	24.74%	24	11.34%	11	13.40%	13	1.98
Using new and emerging technology to reduce in-person contact or avoid disruptions in the supply chain due to worker absences during the COVID-19 pandemic.	19.59%	19	24.74%	24	37.11%	36	14.43%	14	4.12%	4	2.38
Answered											**97**
Skipped											**13**


Below is a list of freight-related priorities. Based on your personal preferences, please rate them from not important to very important.
4
3.5
3
2.5
2
1.5
1
0.5
0
Using the most cost-effective mode (air, rail, truck) possible to ship/receive goods for the greatest consumer savings.
Using the timeliest mode (air, rail, truck, or new technology) possible to ship/receive goods in the shortest amount of time.
Shifting freight shipped by truck to other modes (such as rail) to reduce congestion on area roadways.
Reducing noise generated by freight movement (air, rail, or truck).
Using the cleanest form of shipping/receiving freight to protect our air quality.
Using the safest mode (air, rail, truck, new technology) possible to ship/receive freight.
Using new and emerging technology (such as delivery drones) to reduce congestion or wear and tear on area roadways.
Using new and emerging technology to reduce in-person contact or avoid disruptions in the supply chain due to worker absences during the COVID-19 pandemic.

Question 7:

Should we, as an area, be pursuing ways to shift truck freight shipments to other modes (such as rail) in order to improve congestion, safety, pavement condition, or air quality, if or when possible?		
Answer Choices	**Percentage**	**Responses**
Yes	47.37%	45
Maybe	29.47%	28
No	14.74%	14
Unsure	8.42%	8
Answered		***95***
Skipped		***15***



Question 8:

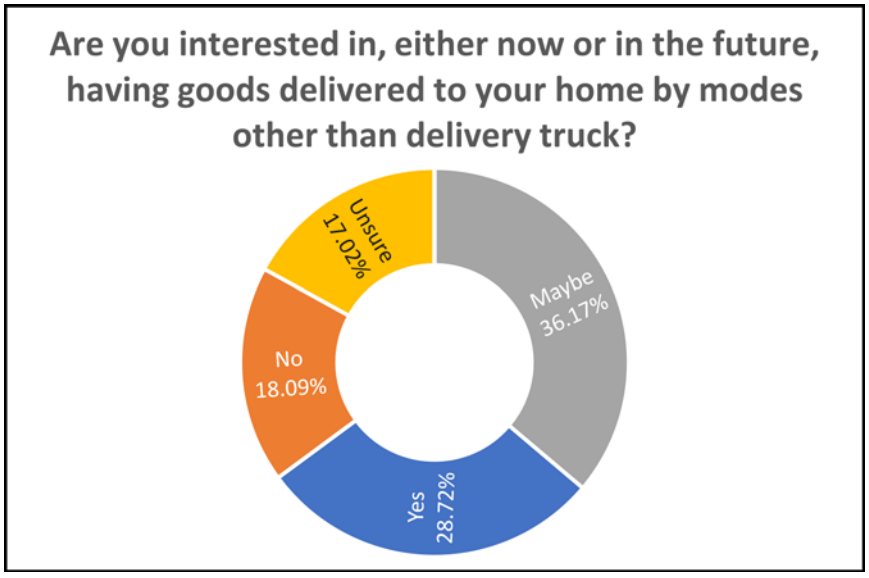
When determining where to build a major place of employment, how important is it that the location has easy access to the transportation system (including transit) so that employees have options to get to work?	
Answer Choices	**Average Number**
Importance on a scale of 0-100, with 100 being most important	76.42
Answered	***95***
Skipped	***15***

Question 9:

When determining where to build a major place of employment that ships or receives a significant number of goods, how important is access to the transportation system by more than one mode (air, rail, truck) to keep goods moving in case of disruptions (severe weather events, pandemics, etc.)?	
Importance on a scale of 0-100, with 100 being most important	75.63
Answered	***94***
Skipped	***16***

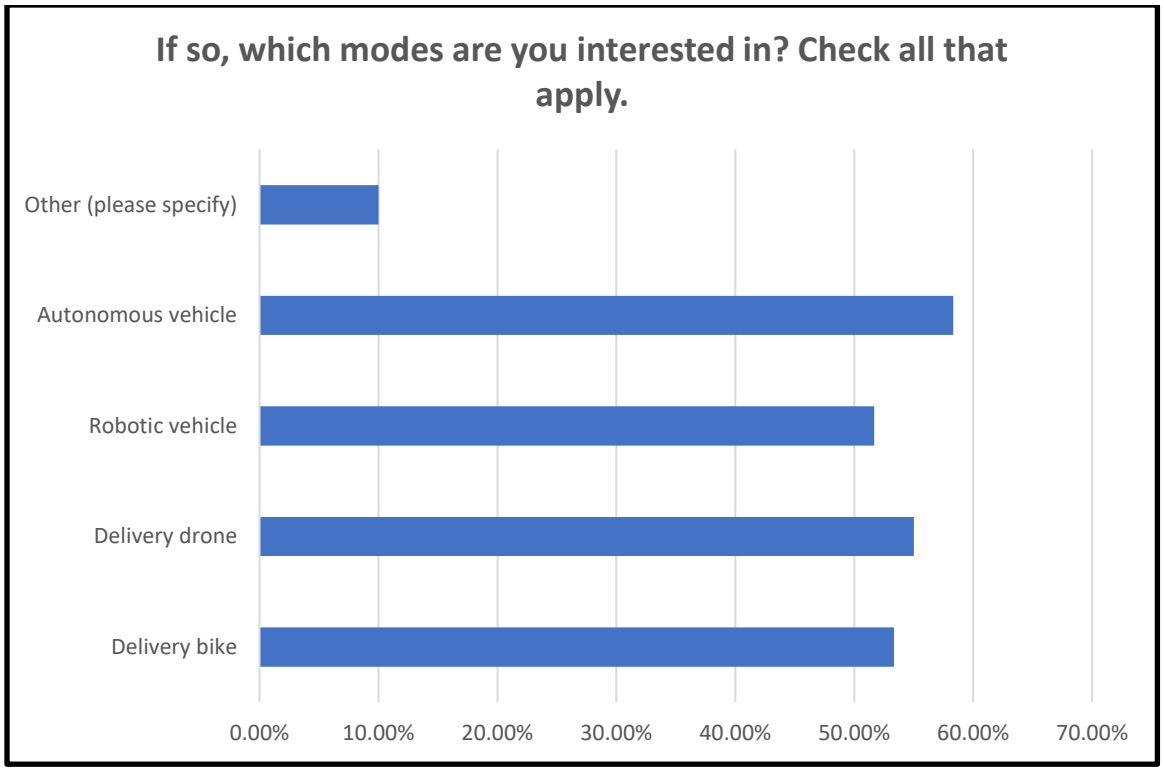
Question 10:

Are you interested in, either now or in the future, having goods delivered to your home by modes other than delivery truck?		
Answer Choices	**Percentage**	**Responses**
Yes	28.72%	27
No	18.09%	17
Maybe	36.17%	34
Unsure	17.02%	16
Answered		***94***
Skipped		***16***



Question 11:

If so, which modes are you interested in? Check all that apply.		
Answer Choices	**Percentage**	**Responses**
Delivery bike	53.33%	32
Delivery drone	55.00%	33
Robotic vehicle	51.67%	31
Autonomous vehicle	58.33%	35
Other (please specify)	10.00%	6
Answered		***60***
Skipped		***50***



"Other" responses:

Uber

Jet Packs

Railroads are underutilized.

Messenger pigeon

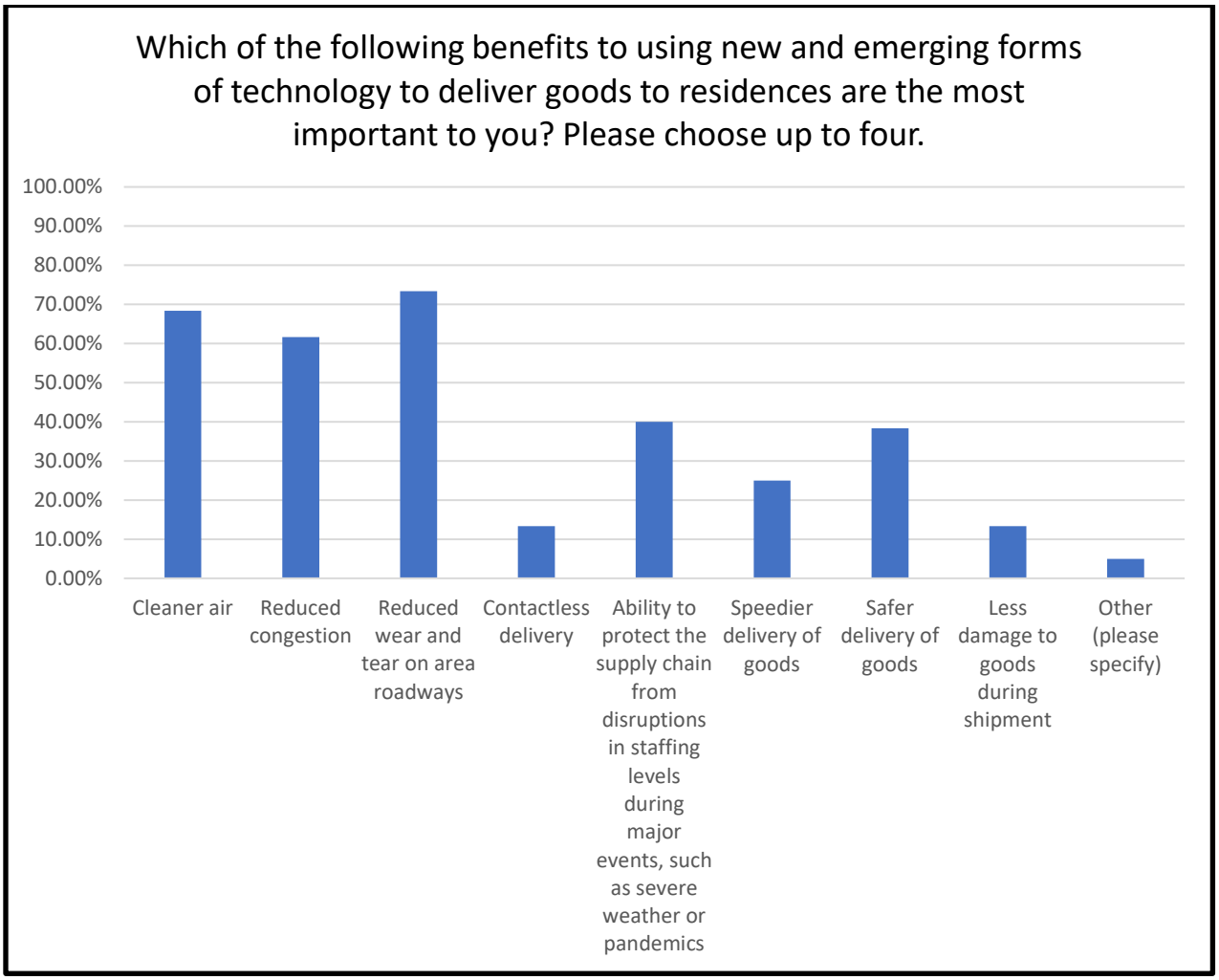
Vans

Postal, vans, cars

Question 12:

Which of the following benefits to using new and emerging forms of technology to deliver goods to residences are the most important to you? Please choose up to four.		
Answer Choices	**Percentages**	**Responses**
Cleaner air	68.33%	41
Reduced congestion	61.67%	37
Reduced wear and tear on area roadways	73.33%	44
Contactless delivery	13.33%	8
Ability to protect the supply chain from disruptions in staffing levels during major events, such as severe weather or pandemics	40.00%	24
Speedier delivery of goods	25.00%	15
Safer delivery of goods	38.33%	23

Less damage to goods during shipment	13.33%	8
Other (please specify)	5.00%	3
Answered		***60***
Skipped		***50***



Other Responses:

Other environmental benefits like reduced noise, reduced traffic by larger vehicles on lesser streets (this is different than congestion - we don't have much of that), reduced dirty run-off

Question 13:

Do you have concerns about using new and emerging forms of technology (such as drones or robots) to receive packages at home? If so, what are they?	
Answered	**76**
Skipped	**34**

Comments Received *(Please note that comments are written as received to ensure the integrity of the comment):*

I don't want to live in a world where drones or robots deliver goods - or drive on city streets and highways. I want real people to have real jobs.

Safety and loss of employment.

easier to hijack or steal packages or drones?

yes

Yes. I am uncomfortable with the idea of a drone dropping off a pkg to my home without a person being in a vehicle and also the potential impact the drone could have on air traffic safety and cogestion/noise.

Yes I think it is too easily compromised

Privacy issues

Safety is my highest concern

Reliability and practicality of drone technology as well as privacy concerns.

No

I would like to know if there are risks to kids or adults from drones. Could the drones hit people & injure them?

My concerns using drones or robots is their ability to be hacked by outside criminals. Or a glitch in their hardware/programming causes them to crash.

Yes. I'm not sure how I feel about a robot handling my packages.

safety and accuracy

No, But area location and time of year may be a problem

Kind of . Not sure of Drones and Robots .

Using airspace with drones would present too many unique challenges.

Yes, questions on reliability

No….concerns

Loss of jobs. Creating new forms of congestion. New safety hazards.

Drones and robots are creepy

Air traffic control is already too complicated. Adding a bunch of unmanned aircraft into the mix could present significant life-safety challenges.

Too many trees to navigate around our property

--Packages being damaged from dropping or the weather --Inaccurate delivery

I have concerns about unforseen circumstances (birds, power lines, weather, etc) affecting reliability of drones.

No.

Privacy

Privacy issues, technology-related job loss, environmental concerns such hazards to waterfowl. Concepts such as this should be put to bed faster than Joe Biden after a cup of tea.

Public safety and convenience

No

Just security. Ensuring parcels are delivered to right place/person without getting stolen (but that happens now so what does it matter) And privacy concerns since I am assuming a camera would be on it for security purposes. So as long as they can't enter a home or look into homes then I would be fine with that

are they as accurate and dependable as humans, job loss

Making sure the methods of delivery are accessible for all

Yes. I'm a big fan of technology…but this seems like a big step… and I'm not sure we're there yet

No

Yes. There is literally anything that could go wrong in so many ways.

yet to be determined

None.

reliability of drones to overcome unusual or unexpected obstacles.

Yes, privacy

Yes, noise and privacy.

congestion in the air space is likely to be far more dangerous than on roads.

No concerns

No concerns.

Yes, unsure about interruptions with privacy or knowledge of my home from such technology

Drones are noisy. Poor guidance systems for autonomous vehicles

The main concern would be loss of jobs due to the new technology.

Mostly home and family security.

Air & traffic congestion and safety

yes I like keeping jobs with people

What about jobs for people.

no

Security of the delivered items.

Using drones to deliver packages is about as foolish idea as anyone can imagine. Relying on automated processes and glitchy computer technology that can never do anything right. No thanks! Remember SkyNet anyone?

No

Air traffic, security, interaction with wild life, elimination of human contact and employment.

I have concerns that when we rely on technology, someone finds a way to hack our information creating chaos, loss of personal information, and loss of money fixing the problem.

none

I don't like the idea of autonomous or robotic vehicles on the roads.

Safety (how will it be regulated), environmental impacts to wild life.

Loss of employment

Don't trust drones or users. Robots are just ground drones

I don't want people to lose their jobs.

cost to the consumer

Noise of drones; possible impacts of drones on birds, other urban wildlife, domestic pets and also localized air traffic. How about use people and human powered (e-assist) vehicles? Let's not skip over attainable, cost effective, job creating options in the rush to get to drones and robots please.

No

Safety-unmaned machines flying around and big brother type tech….

Not sure

not yet

safety issues

Yes, opens the door for more theft from porches

Thief of deliveries because it's not delivered correctly

Potential damages, delivery cost increase

Will this just be another form of congestion and noise? As home deliveries increase, how much low flying air traffic will this create?

Yes, Invasion of privacy.

No muy bien la tennolojia (Not very good technology)

Question 14:

Do you have any further comments on the movement of freight within Kent and eastern Ottawa County that you would like us to know?	
Answered	***48***
Skipped	***62***

Comments Received *(Please note that comments are written as received to ensure the integrity of the comment):*

I certainly do not want to have more rail freight in Grand Rapids. The trains we have already block traffic at inconvenient times. They are WAY TOO noisy and should not be allowed to operate in the city limits after 11PM at night or before 6:30AM. And, if we really want to get rid of congestion, get rid of the bike lanes which are causing congestion.

Preserve and improve our rail infrastructure

CLEAN AIR

The biggest problem with traffic is the total lack of courtisness, politeness and distracted drivers in too much of a hurry, cutting in and out of traffic, speeding, disobeying traffic signs and pavement markings, especially in construction zones. The powers that be care more about the motoring public than they do about worker safety.

I would not be opposed to having more freight shipped by rail, but don't see how it's possible due to the constraints and locations of distribution centers and delivery needs/schedules. But, with the growing shortage of truck drivers, going back to shipping by rail might be a more reasonable option to keeping things more consistently in stock.

No

Nope

No

No

N/a

No.

No

Amazon should be restricted to delivering at night to reduce daytime congestion.

Truck routes are not adhered to with people using handheld phone GPS systems. Signage is poor and/or ignored.

Democrats ruin everything they touch.

Marketplace competition also needs to be considered when developing freight movement plans

I would worry about hacking ng if it we're too high tech.

Trucks just wreck the roads and trucking/transportation companies should be paying a higher tax towards fixing the roads. Maybe people would stop blaming the state and other municipalities for something they can't fix right away. Trucking companies should help fund road projects bottom line since they are the ones causing the most damage and deteriorating the road at a faster rate. Less trucks on the road the more safe I personally feel.

n/a

No

No

no

Perhaps a train to airplane interface would benefit our community.

Don't know why the railway was brought up....most tracks have been taken out.

US-131 on/off ramps between Leonard & 44th St are too short, and cause quick and dangerous backups

Get the delivery trucks off the roads when they are making a delivery stop. They are blocking the roads and walking the packages to deliver places.

Road damage from heavy trucks, lack of enforcement regarding weight limits.

Not at this time

Possibly more electric vehicles for delivery

semi traffic on Pine island Drive is too much. Semi's use it to bypass Alpine Avenue, when industrial parks are closer to Alpine than they are to Pine Island.

No.

No

no

BAN DRONES - a foolish nonsensical idea probably thought up by some millennial tech-zombie addicted to his screen, who has no idea how the real world actually works or what normal average people actually want

No

Need to ensure the safe transport of petroleum, flammable, and poisonous products via rail and highway. Safest method of transport should be used.

Not at this time.

would like to see I-196 expanded from 2 to 3 lanes, eastbound & westbound from US131 to Jenison 44th St. Would like to see better traffic enforcement in general, especially stopping use of hand held devices, speed of non-truck traffic, unsafe lane changes, and vehicles failing to come to complete stops.

na

Rail is a great asset that should be used equally for freight and passengers. Double tracking would help both.

We should invest in rail in moving freight within the region due to its low cost and environmental impact

Putting traffic police back on streets could improve traffic flow and eliminate poor drivers of automobiles and trucks. Better training for new drivers about driving around trucks.

access to freeways north and south on the kent ottawa border should be a priority

Think about using smaller trucks, human powered vehicles more to make final deliveries. Accommodating large trucks in dense urban areas is in conflict with good street design that manages speeds, improves safety. Trucks that serve Caledonia and Byron Center generally are not compatible with City of GR neighborhoods.

Speed limits need to be lowered for all traffic within the city limits. It's way out of hand.

Less trucks.

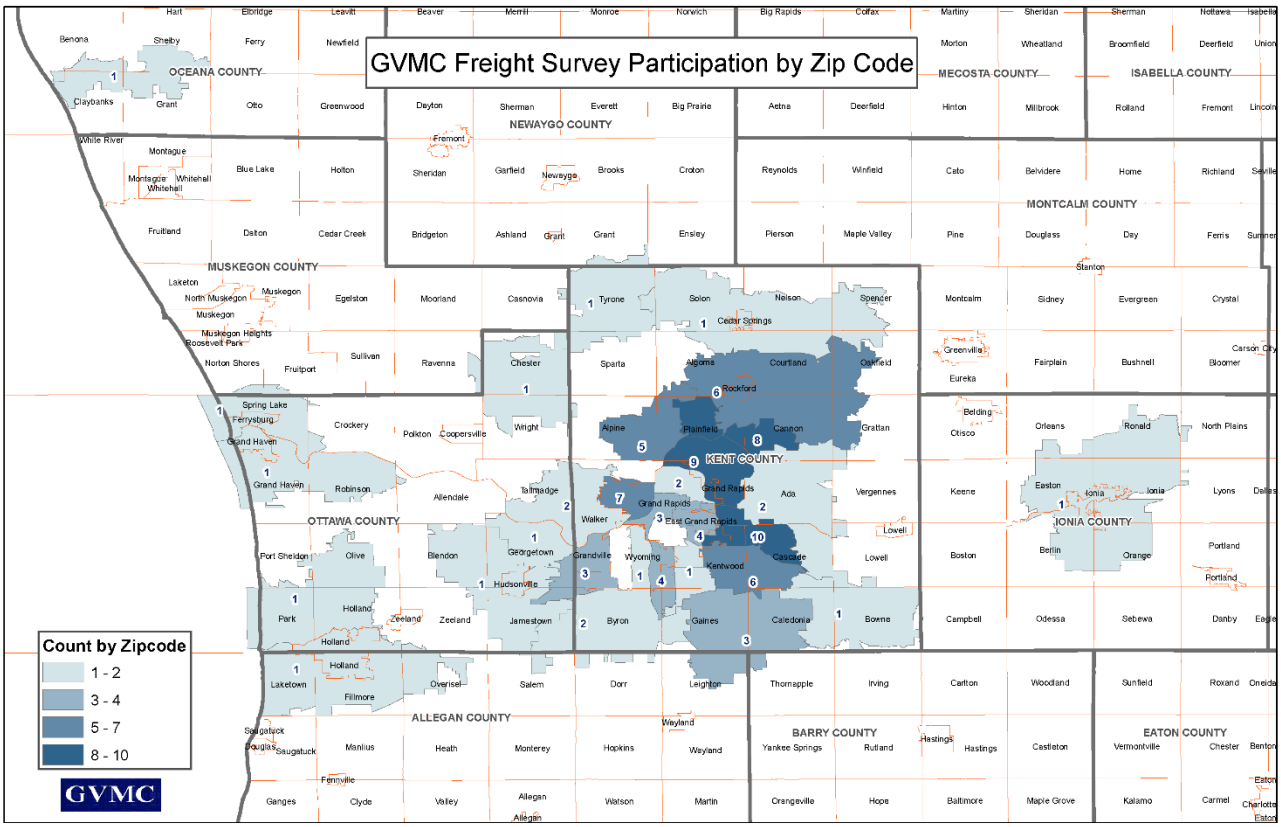
We need an interchange at either Plymouth or Maryland. The city of Grand Rapids/Kent County, needs to put more emphasis on who is actually paying the taxes. That is a small but important industrial center. Don't choke it. The future is always just a little different than predicted, so don't discount car and truck traffic yet.

I currently don't see an issue with how freight is currently moved and with facility locations.

Question 15:

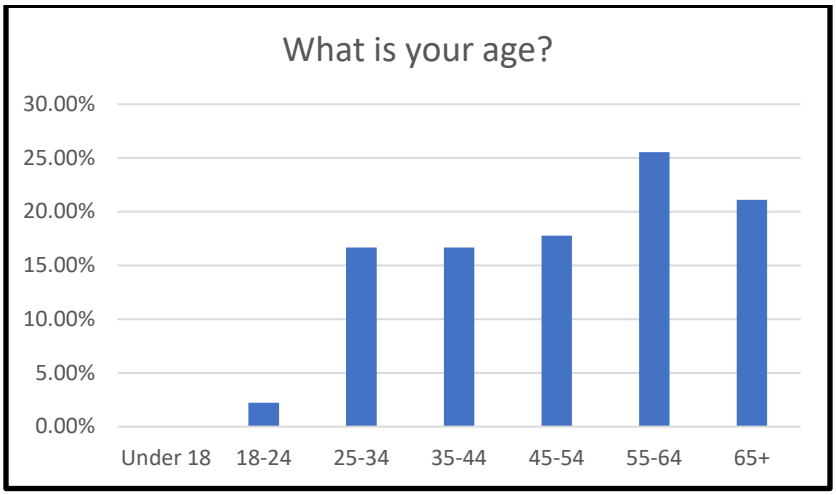
What is your zip code?	
Answered	***90***
Skipped	***20***

Please see map below for a breakdown of responses by zip code area.


GVMC Freight Survey Participation by Zip Code
OCEANA COUNTY
NEWAYGO COUNTY
MECOSTA COUNTY
ISABELLA COUNTY
MONTCALM COUNTY
MUSKEGON COUNTY
KENT COUNTY
OTTAWA COUNTY
IONIA COUNTY
ALLEGAN COUNTY
BARRY COUNTY
EATON COUNTY
Count by Zipcode
1 - 2
3 - 4
5 - 7
8 - 10
GVMC

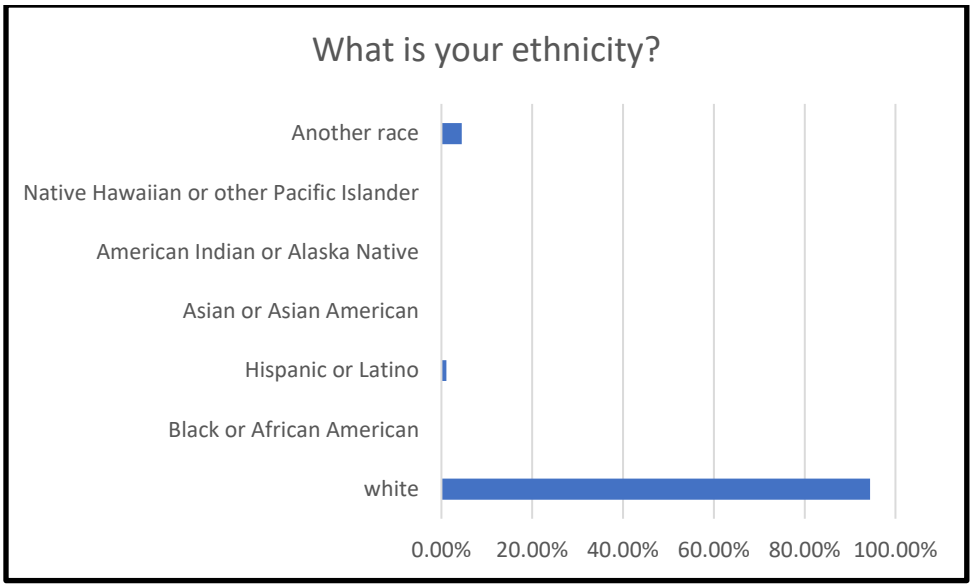
Question 16:

What is your age?		
Answer Choices	**Percentages**	**Responses**
Under 18	0.00%	0
18-24	2.22%	2
25-34	16.67%	15
35-44	16.67%	15
45-54	17.78%	16
55-64	25.56%	23
65+	21.11%	19
Answered		***90***
Skipped		***20***



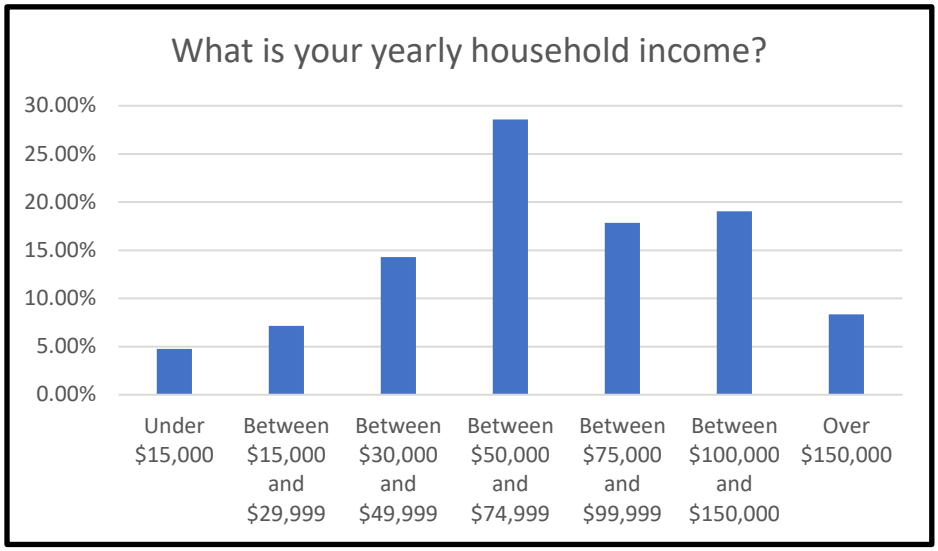
Question 17:

What is your ethnicity?		
Answer Choices	**Percentages**	**Responses**
white	94.38%	84
Black or African American	0.00%	0
Hispanic or Latino	1.12%	1
Asian or Asian American	0.00%	0
American Indian or Alaska Native	0.00%	0
Native Hawaiian or other Pacific Islander	0.00%	0
Another race	4.49%	4
Answered		***89***
Skipped		***21***



Question 18:

What is your yearly household income?		
Answer Choices	**Percentages**	**Responses**
Under $15,000	4.76%	4
Between $15,000 and $29,999	7.14%	6
Between $30,000 and $49,999	14.29%	12
Between $50,000 and $74,999	28.57%	24
Between $75,000 and $99,999	17.86%	15
Between $100,000 and $150,000	19.05%	16
Over $150,000	8.33%	7
Answered		84
Skipped		26



Question 19:

If you would like to be entered in a drawing for a $25 Meijer gift card, please enter your contact information below. If you win the drawing, your gift card will be mailed to the address provided below.	
Answered	*63*
Skipped	*47*

Question 20:

If you would like to be added to GVMC's public participation list to receive transportation-related emails, including updates and information on other public participation opportunities for our area, please enter your contact information below.	
Answered	*31*
Skipped	*79*

Appendix I: FAF Modes

Code	Mode	Description
1	Truck	Includes private and for-hire trucks. Does not include truck that is part of **Multiple Modes and Mail** or truck moves in conjunction with domestic air cargo.
2	Rail	Includes any common carrier or private railroad. Does not include rail that is part of **Multiple Modes and Mail**.
3	Water	Includes shallow draft, deep draft, Great Lakes, and intra-port shipments. Does not include water that is part of **Multiple Modes and Mail**.
4	Air (includes truck-air)	Includes shipments move by air or a combination of truck and air in commercial or private aircraft. Includes air freight and air express. In the case of imports and exports by air, domestic moves by ground to and from the port of entry or exit are categorized with **Truck**.
5	Multiple Modes and Mail	Includes shipments by multiple modes and by parcel delivery services, U.S. Postal Service, or couriers (capped at 150 pounds). This category is not limited to containerized or trailer-on-flatcar shipments.
6	Pipeline	Includes crude petroleum, natural gas, and product pipelines. Note: It also includes pipeline flows from offshore wells to land, which are counted as **Water** moves by the U.S. Army Corps of Engineers. Does not include pipeline that is part of **Multiple Modes and Mail**.
7	Other and Unknown	Includes movements not elsewhere classified such as flyaway aircraft, and shipments for which the mode cannot be determined.
8	No Domestic Mode	Includes shipments that have an international mode, but no domestic mode and is limited to import shipments of crude petroleum transferred directly from inbound ships to a U.S. refinery at the zone of entry. This classification enables a proper accounting of flows that do not utilize any domestic transportation network.