
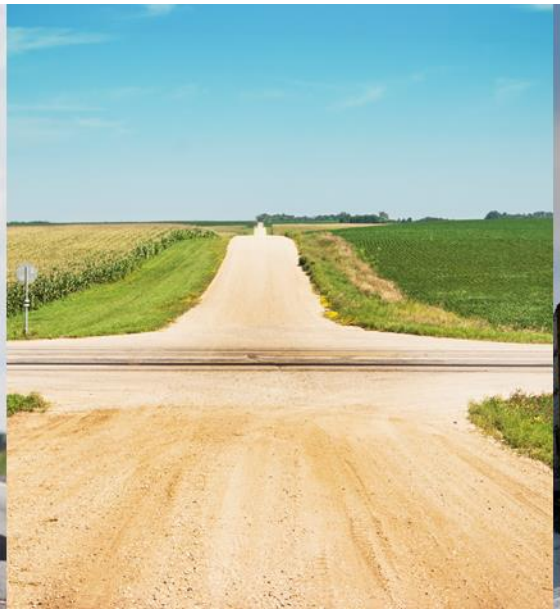


Minnesota Department of Transportation
District 4 Freight Plan
Working Paper 3: Freight System Profile – Economy, Inventory, Demand, and Performance

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Acronyms and Abbreviations

Abbreviation	Definition
AADT	Annual Average Daily Traffic
BEA	Bureau of Economic Analysis
BNSF	Burlington Northern Santa Fe
BTS	Bureau of Transportation Statistics
CFS	Commodity Flow Survey
CP	Canadian Pacific
CRFC	Critical Rural Freight Corridors
CUFC	Critical Urban Freight Corridors
DIV	Digital Inspection Vehicles
FAF	Freight Analysis Framework
FAR	Hector International Airport
FAST	Fixing America's Surface Transportation
FFF	Free Flow Factor
FHWA	Federal Highway Administration
GDP	Gross Domestic Product
HCAADT	Heavy Commercial Annual Average Daily Traffic
HGL	Hydrocarbon Gas Liquid
HOS	Hours of Service
LQ	Location Quotient
MI	Michigan
MN	Minnesota
MnDOT	Minnesota Department of Transportation
MSA	Metropolitan Statistical Areas
MSP	Minneapolis-St. Paul International Airport
MUTCD	Manual on Uniform Traffic Control Devices
NAICS	North American Industry Classification System
NC	Not Calculable
NHFN	National Highway Freight Network
NHS	National Highway System
NTAD	National Transportation Atlas Database
OTVR	Otter Tail Valley Railroad
OSOW	Oversized-Overweight
PHFS	Primary Highway Freight System
QCEW	Quarterly Census of Employment and Wages

RQI	Ride Quality Index
RRVW	Red River Valley & Western
SR	Sufficiency Rating
STRAHNET	Strategic Highway Network
SWOT	strengths, weaknesses, opportunities, and threats
TCWR	Twin Cities & Western
TTI	Travel Time Index
TTTR	Truck Travel Time Reliability
TX	Texas
US	United States
WA	Washington

Executive Summary

Minnesota Department of Transportation (MnDOT) District 4 is made up of 12 counties in West-Central Minnesota: Becker, Big Stone, Clay, Douglas, Grant, Mahnomen, Otter Tail, Pope, Stevens, Swift, Traverse, and Wilkin. The District is home to 4.5% of Minnesota's population but makes up 12.4% of its land area. This District 4 Freight Plan is currently under development to provide MnDOT with a clear understanding of the regional multimodal freight assets, performance, and connection to the District's economy.

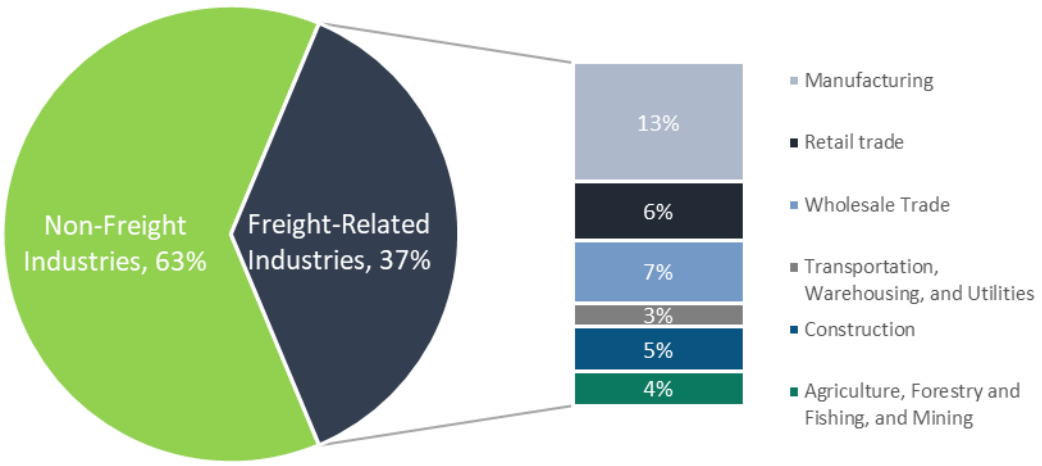
The District 4 Freight Plan is being built upon past research and planning efforts, including the Minnesota Statewide Freight System and Investment Plan and the Manufacturers' Perspectives Study, to inform MnDOT's future policy and programming decisions related to freight and economy.

District 4's Economic Context

Analysis of the District's employment, Gross Domestic Product (GDP), and market competitiveness by industry shows that District 4's economy is heavily reliant on the freight transportation system due to the significance of agriculture and manufacturing industries. These freight-related industries are growing in the District, with a rate higher than the national average, indicating potential growth in the need for workforce and transportation resources in the future.

The District's relatively high level of mid-range educational attainment shows the regional labor market's suitability for filling middle-income jobs that require some prior training or experience, many of which are concentrated in freight-related industries such as agriculture and manufacturing. On the other hand, the District's minimal in-migration and aging of the labor force in the past decade can create significant impacts on the future economy of the District, including workforce shortages, reduction in labor productivity, and increase social costs due to delayed retirements.

Figure ES-1: District 4's Employment in Freight Related Industries



Source: CPCS analysis of Full-Time and Part-Time Employment by NAICS Industry 2017, Bureau of Economic Analysis; 2017 Census of Agriculture.

District 4's Freight Transportation System

Figure ES-2 provides a high-level snapshot of the District's key transportation assets. Much of the District is served by I-94, which is supplemented by the District's network of national and state highways such as US-59, US-10, US-75, MN-210, and MN-29. State highways 7 and 9 are also integral to supporting freight-related businesses in the District.

Rail service in District 4 is provided by the BNSF and Canadian Pacific Class I railroads, as well as short line railroads, including Red River Valley and Western, Otter Tail Valley, and Twin Cities & Western. Several roads, pipeline, and grain elevator facilities across the District have access to rail transload services. However, stakeholders consulted in the previous freight study efforts have expressed concerns regarding the limited number of such facilities in District 4 and impacts on the regional competitiveness of many freight-related businesses.

In addition to road and rail, District 4 is served by two regional commercial airports, 16 intermediate airports, and four landing strips. 646 miles of pipeline network in the District provide high-volume and low-cost shipping options for crude oil, natural gas, and other petroleum products.

District 4's Freight System Safety, Condition, and Performance

Key system condition and performance monitoring areas analyzed in this Working Paper are safety, system condition, and mobility. District 4's truck crashes occurred between 2010 and 2019, were primarily clustered along major highways and in high-population areas such as I-94, US-10, and US-59. A total of 55 incidents occurred at public highway-rail grade crossings in the District between 2010 and 2019. However, fatal incidents were relatively rare and occurred at random locations.

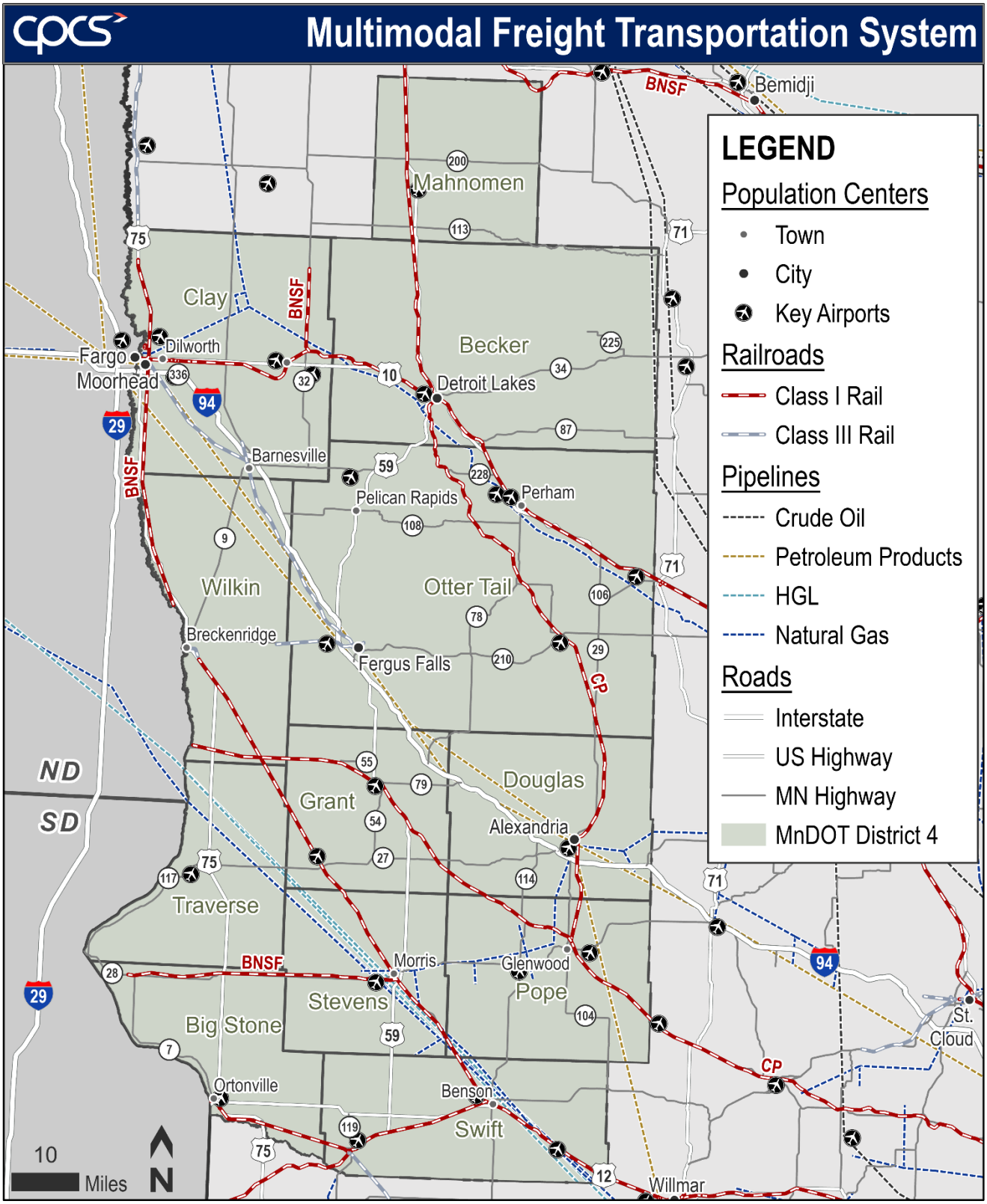
Analysis of truck mobility measures in District 4 showed that the District's highways and corridors generally do not experience significant truck congestion during peak time. However, peak-hour congestion does create issues for trucks and personal vehicles at intersections and interchanges across the District.

In terms of infrastructure condition, pavement surfaces of almost all major highways in the District are in fair or good condition. Bridge infrastructure deficiency is an issue at 68 structures across District 4, with over half of the deficient bridges located on the county road system. Bridge condition on the trunk highway system is relatively better, which is critical to the efficiency and safety of the freight movements in the District.

Next Steps for the District 4 Freight Plan

Working Paper 3 provides context for all future work on the District 4 Freight Plan. The data and analysis presented in this Working Paper will be completed with feedback and insight from stakeholder consultations and committee meetings. Together, this data and feedback will be used to create a comprehensive assessment of District 4's freight-related needs, issues, and potential improvements in Working Paper 4.

Figure ES-2: MnDOT District 4 Multimodal Freight System



Source: CPCS analysis of National Transportation Atlas Database, 2021.

1 District 4 Economic Context

Key Findings:

District 4 is home to 4.5 percent of Minnesota's population and makes up 12.4 percent of its land area. Since 2010, the District's population has increased by about 4 percent. But the majority of this increase has happened in high population urban areas. District 4's unemployment rate has improved significantly since 2010, primarily due to increase in hiring, however, one of the significant economic issues in District 4 is slow population growth rate, minimal in-migration, and aging of the labor force, all of which can threat the District's workforce size and impact industries.

District 4's economy is highly reliant on agriculture and manufacturing industries, both of which depend on freight transportation for continuity and growth. While some freight-related industries, such as construction and wholesale and retail trade, have declined in recent years, agriculture, manufacturing, and mining have increased in regional competitiveness relative to the rest of the country.

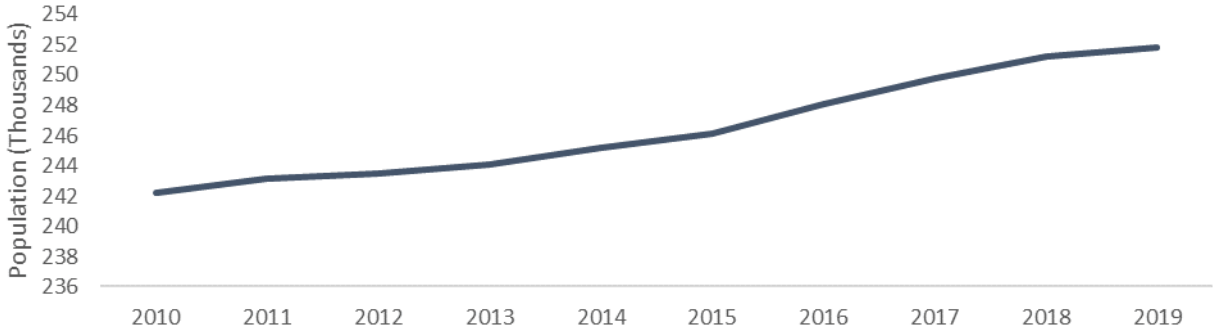
1.1 District 4's Economy

This chapter provides an overview of the economic characteristics of District 4, focusing on social aspects such as education and income. The economic overview is followed by an analysis of employment and income across "freight-related" industries to provide context for understanding the general transportation needs of businesses in District 4 and inform further assessment of freight transportation needs and issues.

Population

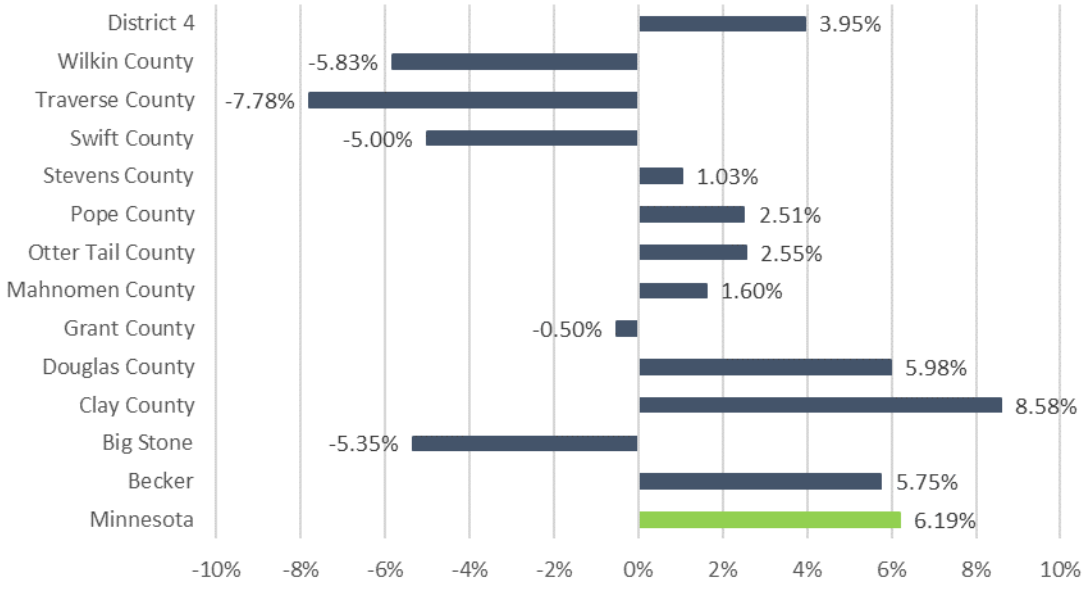
Population trends directly impact the District's economic development, workforce availability, and the current and future demand for transportation services and infrastructure. Since 2010, District 4's population has increased by about 4 percent. The majority of this increase is due to the high population growth in Clay (8.6%), Douglas (6%), and Becker (5.7%) Counties. Meanwhile, Wilkin, Traverse, Swift, Big Stone, and Grant Counties experienced a decline in population. The highest decline has been in Traverse (8%) and Wilkin (6%) Counties, indicating extensive out-migration. By comparison, Minnesota's statewide population has increased by about 6.2 percent between 2010 and 2019. Figure 1 shows District 4's population levels between 2010 and 2019, and Figure 2 shows the county-level trends.

Figure 1: District 4 Population Trend (2010-2019)



Source: CPCS analysis of US Census Bureau Historical Population by County 2010-2019.

Figure 2: Population Trends (2010 to 2019)



Source: CPCS analysis of US Census Bureau Population Estimates for July 1, 2010-2019.

As of 2019, District 4 had a population of 251,808 people. Clay and Otter Trail Counties had the greatest share of the population (25% and 23% respectively), and Traverse County was the least populous (1.3%). Clay County also had the largest population growth between 2010 and 2019. As shown in Figure 1, the District's annual population had a somewhat constant increase between 2010 and 2016. In 2016, the District experienced a rise in annual population growth that continued to the end of 2018. However, annual population growth slowed between 2018 and 2019.

In 2010, an average of 18 percent of the District's population (by county) was age 65 and over, compared to nearly 13 percent for all of Minnesota.[1] By 2019, the share of District 4's population over age 65 increased to 20.3 percent. Meanwhile, according to the US Census's migration flow data, migration to District 4's counties was minimal. Between 2014 and 2018, in-migration from other states and foreign countries to District 4 contributed to 5.6 percent of the total District's population growth, while about 6 percent of the District's population out-migrated to other states or countries.[2]

The minimal in-migration and aging of the labor force can create significant impacts on the future economy of the District, including workforce shortages, reduction in labor productivity, and increase social costs due to delayed retirements. Studies show that a 10 percent increase in the share of the population aged 65 and older can cause an approximately 5.5 percent decrease in the GDP growth rate per capita.[3] Therefore, these factors could affect the District's labor-intensive industries such as agriculture and manufacturing.

Income and Education

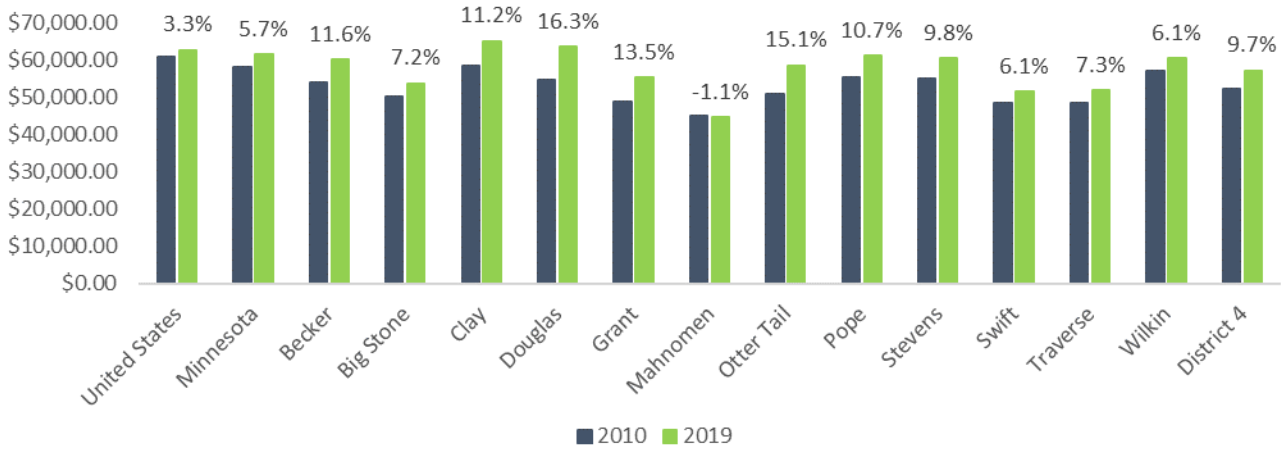
Educational attainment (high school, college, etc.) influences the career opportunities and earning potential of the District's population. Therefore, educational attainment analysis is used to determine the workforce development needed to support different industries and provide a better understanding of the economic well-

[1] US Census County Population by Characteristics, 2010-2019.
[2] US Census County-to-County Migration Flows, 2014-2018.
[3] Maestas et al., (2016) "The Effect of Population Aging on Economic Growth, the Labor Force and Productivity" Rand Corporation.

being and the ability of the District's workforce to support relatively higher-paid medium- and high-skill jobs. A workforce with both medium and high-skilled labor may be necessary to support some freight-related industries like advanced manufacturing.

Figure 3 shows the estimated median household income trends for each county within District 4. In both 2010 and 2019, the average household income of District 4 was below the national and statewide averages. However, the household income in the District increased by 9.7 percent between 2010 and 2019, compared to 3.3 percent nationwide and 5.7 percent statewide growth during the same period. Douglas County saw the highest increase in the average household income ($8,960) between 2010 and 2019, followed by Otter Tail ($7,700), Grant ($6,500), and Clay ($6,500) Counties.

Figure 3: Median Household Income (2010 and 2019 Census Estimates – Presented in 2019 Dollars)



Source: CPCS analysis of 2006-2010 and 2015-2019 American Community Survey Data, US Census Bureau, 2021.

In terms of educational attainment, the District's statistics show a 4.3 percent increase in the number of individuals with bachelor's degree or higher between 2010 and 2019. As Figure 4 shows, the District's share of the population over 25 years old with the educational attainment of a high school degree or and an associate's degree is higher than the state and the country. However, less of the District's population has a bachelor's degree, compared to the statewide and nationwide statistics. Between 2010 and 2019, the percentage of residents 25 and older without a high school degree dropped from 33.6 to 29.3 percent. Meanwhile, the percentage of residents 25 and older with some college or associate degree had a slight increase from 33.9 to 37.8 percent.

The majority of District 4's residents have an education of at least high school or some college degree.

The District's relatively high level of mid-range educational attainment shows that the labor market in District 4 can be suitable for middle-income jobs that require some prior training or experience, many of which are concentrated in freight-related industries such as agriculture and manufacturing.

Figure 4: Education Attainment

Highest Level of Education Attained	D4 2010	D4 2019	Minnesota 2019	US 2019
No high school diploma	10.3%	6.5%	6.9%	12.0%
High school graduate (includes equivalency)	33.6%	29.3%	24.6%	27.0%
Some college, or an Associate's degree	33.9%	37.8%	32.4%	28.9%
Bachelor's degree or higher	22.1%	26.4%	36.1%	32.1%

Source: CPCS analysis of 2006-2010 and 2015-2019 American Community Survey Data, US Census Bureau, 2021.

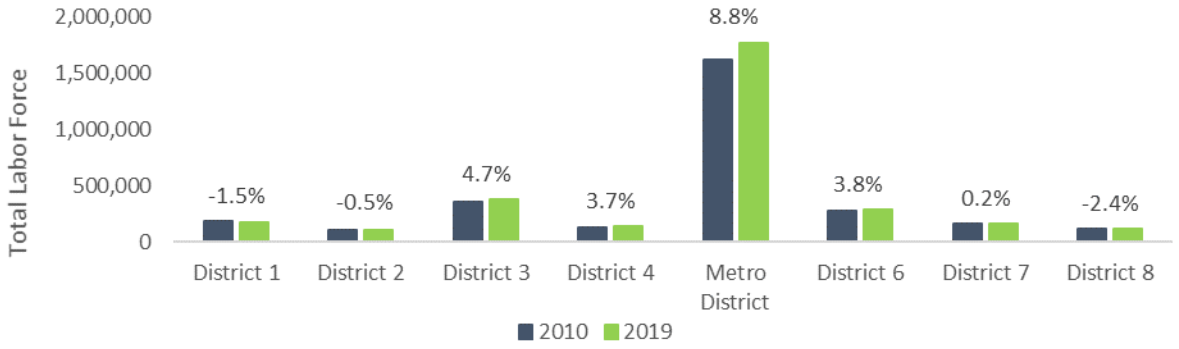
1.2 Employment and Industries

Employment analysis is essential for understanding economic well-being as it provides insights into the strength and impact of the industries that are critical to providing jobs. It can also highlight the relative importance of freight-related industries - industries that rely on the physical movement of goods to support their operations. District 4's unemployment rate was 6.8 percent in 2010, but by 2019, this number decreased to about 3.6 percent. According to the Federal Reserve, the District's current unemployment rate is considered a normal rate in the absence of economic shocks.[4] The significant decrease in District 4's unemployment is primarily associated with an increase in hiring.

Labor Force

Figure 5 shows the changes in the labor force in MnDOT Districts between 2010 and 2019. As the figure shows, over the past decade, the labor force (sum of employed and unemployed people) in District 4 increased by 4,984 people. During the same period, the number of employed residents increased by 17,042 people, and the number of unemployed population decreased by more than 7,480. Since the increase in employed persons is significantly greater than the decrease in unemployed persons, we can conclude that in addition to increased hiring, more than half of the decline in the District's unemployment rate is due to population growth and an increase in the size of the labor force.

Figure 5: Labor Force Changes between 2010 and 2019 in MnDOT Districts



Source: CPCS analysis of Local Area Statistics, Bureau of Labor Statistics, 2021.

Despite the increase in the population and labor force of District 4 counties during the past ten years, the minimal in-migration and aging of the population can impact the District's future workforce availability. A future decrease in the workforce could result in declined demand for the transportation system, however, the District's freight-related industries will continue to rely on the transportation system to remain competitive.

[4] Federal Reserve, June 2018 Projections https://www.federalreserve.gov/faqs/economy_14424.htm

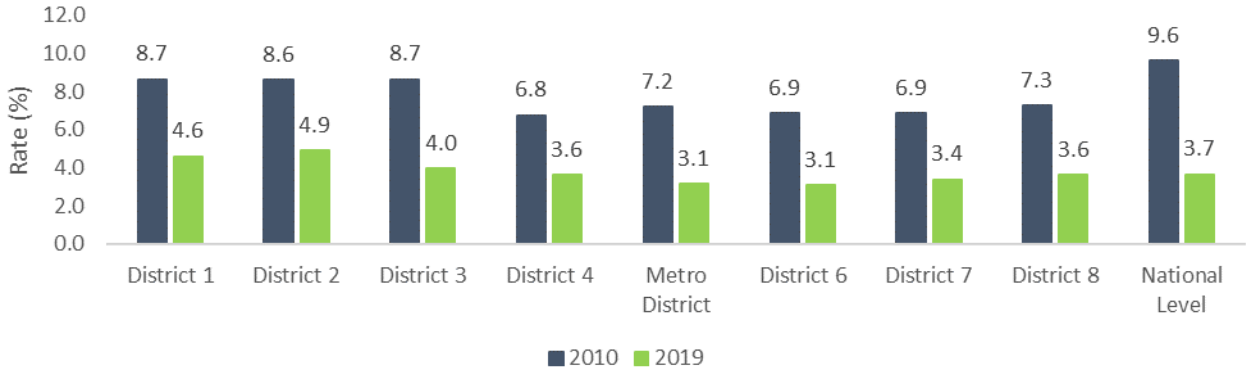
Workforce shortages related to a declining labor force may also aggravate the prevalent truck driver shortage that currently exists across the country and which is present in District 4.

Minimal in-migration and aging of the population are the main threats to the District's future labor force availability.

Unemployment

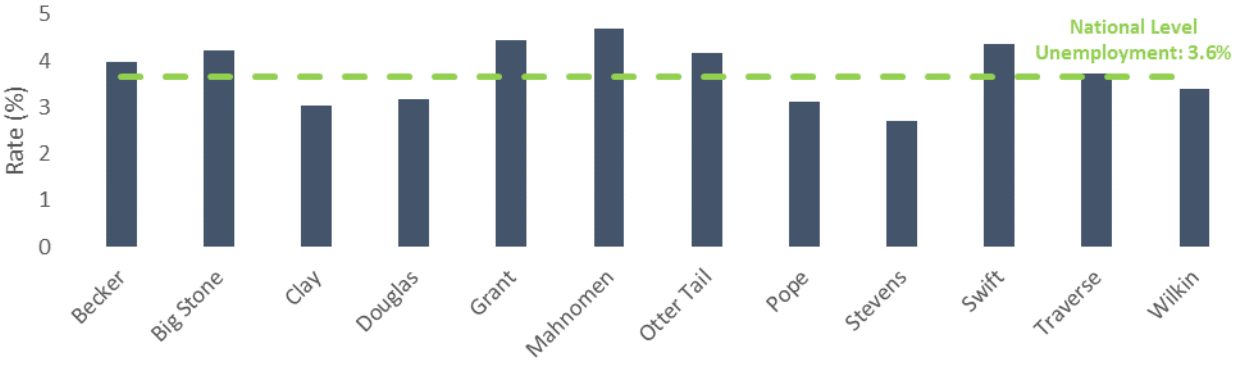
District 4's average unemployment rate in 2019 was 3.6 percent which was equal to the national average, meaning that overall, the District was not economically distressed (Figure 6). However, as Figure 7 shows, six counties in the District had unemployment rates higher than the national average and thus are considered economically distressed. In 2019, Mahnomen County had the highest unemployment rate of 4.7 percent in the District, followed by Grant County (4.4%) and Swift County (3.36%).

Figure 6: Minnesota District Unemployment Rates for 2010 and 2019



Source: CPCS analysis of Local Area Statistics, Bureau of Labor Statistics, 2021.

Figure 7: District 4 County-Level Unemployment Rates 2019



Source: CPCS analysis of Local Area Statistics, Bureau of Labor Statistics, 2021.

1.3 Gross Domestic Product

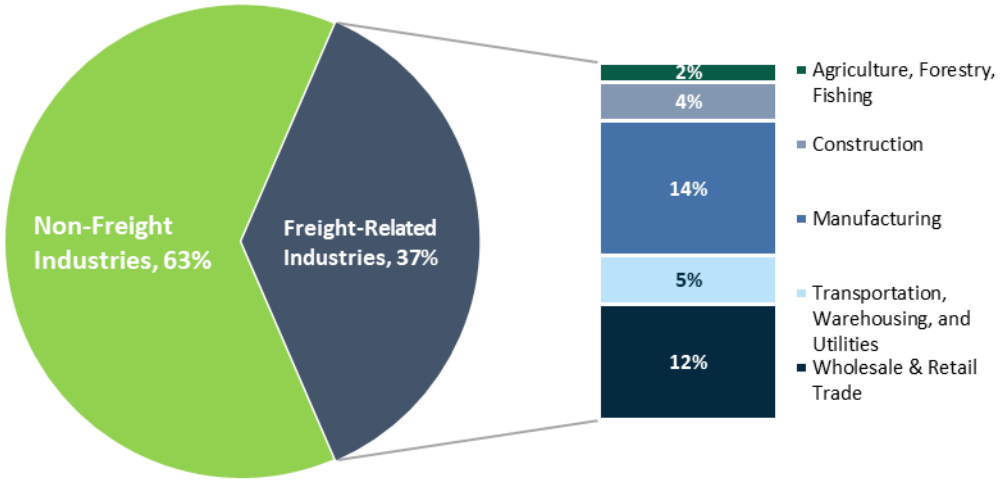
Gross Domestic Product (GDP) is a monetary measure of the value of the services and goods produced in any given geography. Analysis of GDP trends provides insight into the health and growth of an economy and helps

identify the most influential or productive industries. This section provides an overview of the GDP relevant to freight transportation for Minnesota and District 4.

Minnesota's Gross Domestic Product

Figure 8 presents Minnesota's GDP by industry. As shown in the chart, freight-related industries generate about 37 percent of Minnesota's GDP. Within the freight-related industry category, manufacturing has the biggest contribution to the statewide GDP (14%), followed by retail and wholesale trade (12%).

Figure 8: Minnesota GDP Share by Industry, 2019



Source: CPCS analysis of GDP by State in Current Dollars by NAICS Industry 2019, Bureau of Economic Analysis, 2021.

District 4 Gross Domestic Product

The Bureau of Economic Analysis (BEA) provides the GDP by industry data at the county level. As presented in Figure 9, in 2019, the share of freight-related industries from the District's GDP was about 37 percent. Wholesale and retail trade industries had the highest share of District 4's GDP in 2019 (13%), followed by manufacturing (13%) and construction (5%) industries.

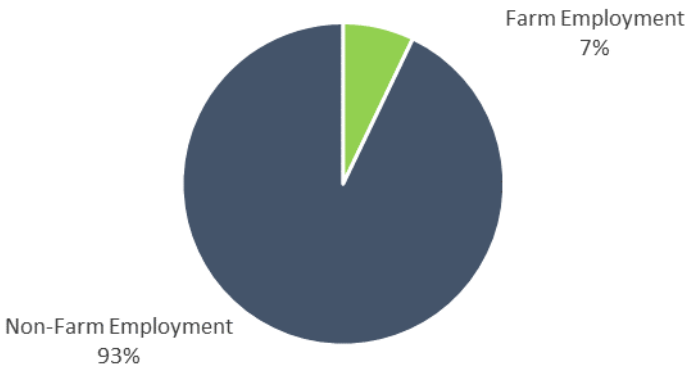
Figure 9: District 4's GDP by Industry, 2019

Source: CPCS analysis of Bureau of Economic Analysis 2019 GDP by Industry Data, Bureau of Economic Analysis, 2021.

Freight-Related Employment

The Quarterly Census of Employment and Wages (QCEW) program provides employment by industry data which enables a comprehensive assessment of the jobs associated with specific industries at the county and state levels. Figure 10 shows the District's employment in the farm and non-farm industries. More than 93 percent of District 4's employment is in the non-farm sector. Manufacturing, retail trade, and healthcare and social assistance are the primary contributors to the District's employment. While the QCEW database provides employment data by 2-digit North American Industry Classification System (NAICS) sectors as well as proprietors of both farm and non-farm businesses, Agricultural Census data is used to supplement farm employment information where employment data coverage is insufficient.

Figure 10: District 4's Farm and Non-Farm Employment, 2019



Source: CPCS analysis of Full-Time and Part-Time Employment by NAICS Industry 2019, Bureau of Economic Analysis for non-farm employment and 2019 Census of Agriculture for farm employment, 2021.

Figure 11 shows the District's non-farm employment by county and industry. The highlighted rows show the freight-related industry employment. These industries are heavily reliant on the transportation network for shipping and receiving goods to support their operations, and include forestry, fishing, and related activities, mining, quarrying, and fossil fuel extraction, manufacturing, retail and wholesale trade, construction,

transportation, and warehousing, and utilities. These industries are generally location-dependent, meaning that their competitiveness is directly linked to the performance of the freight system. In particular, mining, quarrying, agriculture, and transportation are location-dependent, as they cannot be moved like factories.

Over 37% of District 4's workers are employed in freight-related industries.

Figure 11: District 4's Non-Farm Employment by Industry, 2019

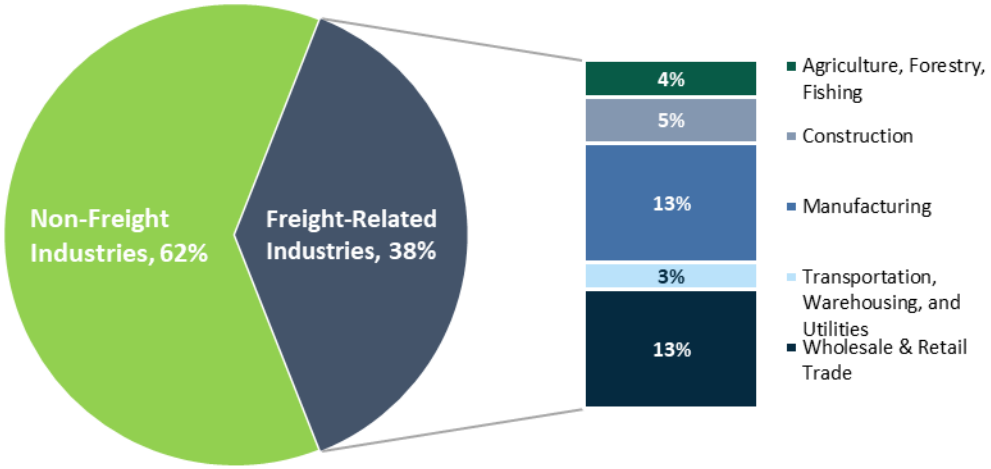
Industry		Total Employment	% of Total
Private Non-Farm	Forestry, fishing, and related activities	269	0.32%
	Mining, quarrying, and oil and gas extraction	118	0.14%
	Utilities	65	0.08%
	Construction	5,377	6.44%
	Manufacturing	7,550	9.05%
	Wholesale trade	2,696	3.23%
	Retail trade	9,887	11.85%
	Transportation and warehousing	1,616	1.94%
	Information	616	0.74%
	Finance and insurance	3,232	3.87%
	Real estate and rental and leasing	3,564	4.27%
	Professional, scientific and technical services	2,966	3.56%
	Management of companies and enterprises	260	0.31%
	Administrative & support & waste management & remediation services	1,532	1.84%
	Educational services	578	0.69%
	Health care and social assistance	5,169	6.20%
	Arts, entertainment, and recreation	1,823	2.19%
	Accommodation and food services	5,809	6.96%
	Other services (except government and government enterprises	5,362	6.43%
Government and government enterprises		14,517	17.40%
Total Non-Farm Employment		83,431	100%

NOTE: BEA data masked for multiple industries to avoid disclosure of confidential information. Estimates of total industry employment are included in higher-level totals.

Source: CPCS analysis of 2019 Full-Time and Part-Time Employment by NAICS Industry, Bureau of Economic Analysis, 2021.

Figure 12 shows the relative employment by industry for District 4, based on freight-related and non-freight jobs.

Figure 12: District 4's Employment in Freight Related Industries, 2019



Note: BEA data masked for multiple industries to avoid disclosure of confidential information. Estimates of total industry employment are included in higher-level totals. Source: CPCS analysis of Full-Time and Part-Time Employment by NAICS Industry 2019, Bureau of Economic Analysis; 2019 Census of Agriculture, 2021.

Freight-Related Industry Specialization

A Location Quotient (LQ) of an industry indicates the proportion of the workforce employed in that industry relative to other geographic areas or industries. Therefore, LQ analysis provides insights into the region's economic base specialization relative to the national norm. Industries that have higher LQ values are typically more export-oriented[5] and, therefore, have a relatively greater contribution to the regional economy. Studies show that an LQ value of greater than 1.3 shows relatively high regional employment compared to national-level employment in a certain industry.[6]

Figure 13 summarizes the District's annual average employment LQs based on 2019 data provided by the QCEW. As the figure shows, District 4 is most-highly specialized in manufacturing, agriculture, and wholesale trade industries. For more information on the LQ methodology and assumptions, refer to Appendix A.

Figure 13: Aggregated Location Quotients for Freight-Related Industries in District 4, 2019

Freight-Related Industry Group (2-Digit NAICS Code)	D4 Location Quotient
Agriculture, Forestry, Fishing and Hunting (11)	1.27
Mining (21)	0.16
Utilities (22)	0.27
Construction (23)	0.93
Manufacturing (31-33)	1.50
Wholesale Trade (42)	1.12
Retail Trade (44-45)	0.81

[5] EMSI Resource Library "Understanding Location Quotient", 2007. https://www.economicmodeling.com/wp-content/uploads/2007/10/emsi_understandinglq.pdf

[6] MnDOT "Transportation Planning to Support Economic Development: An Exploratory Study of Competitive Industry Clusters and Transportation in Minnesota" (2015). http://www.cts.umn.edu/Publications/ResearchReports/reportdetail.html?id=2400

Freight-Related Industry Group (2-Digit NAICS Code)	D4 Location Quotient
Transportation & Warehousing (48-49)	0.62

Source: CPCS analysis of Bureau of Labor Statistics Location Quotients data. Values in the table reflect annual averages based on employment level, 2021.

Among the freight-related industries in District 4, manufacturing and agriculture have the highest degree of specialization compared to the nation. The District is highly specialized in crop and animal production and food processing sectors.

Figure 14 lists some of the most competitive industries for the 12 counties in the District. Cells with "NC" indicate areas where data was not available due to confidentiality restrictions. As shown, Grant and Traverse Counties are highly specialized in the agriculture industry and, in particular, the oilseed and grain farming sector. Meanwhile, Pope, Douglas, and Otter Tail Counties show more specialization in the food processing and machinery manufacturing industries compared to the nation.

Figure 14: Location Quotients of Freight-Related Businesses in the District 4 Counties, 2019

Industry Group (2 to 4 Digit NAICS Code)	Becker	Big Stone	Clay	Douglas	Grant	Mahnomen	Otter Tail	Pope	Stevens	Swift	Traverse	Wilkin
Agriculture, Forestry, Fishing and Hunting (11)	**2.6**	**NC**	**NC**	**0.7**	**7.9**	**NC**	**2.1**	**2.5**	**NC**	**NC**	**10**	**NC**
Crop Production	3.0	1.2	2.7	0.2	8.8	0.5	1.6	2.6	2.3	4.4	8.8	18.3
Animal Production	6.6	4.5	0.8	1.5	3.5	NC	5.3	13.9	65.5	6.9	NC	NC
Oilseed and Grain Farming	9.0	12.0	14.5	0.9	56.9	NC	2.7	10.4	9.4	36.2	25.5	110.2
Other Crop Farming	NC	NC	5.8	0.0	NC	NC	1.0	2.3	NC	9.4	NC	NC
Vegetable & Melon Farming	NC	NC	NC	1.8	NC	NC	4.6	11.6	93.1	NC	NC	NC
Hog and Pig Farming	NC	NC	NC	NC	NC	NC	NC	19.2	52.4	NC	NC	NC
Poultry and Egg Production	15.2	NC	2.3	NC	NC	NC	13.9	NC	NC	NC	NC	NC
Mining (21)	**0.6**	**NC**	**NC**	**0.2**	**NC**	**NC**	**0.2**	**NC**	**NC**	**NC**	**NC**	**NC**
Non-metallic mineral mining and quarrying	2.2	NC	NC	0.8	NC	NC	1.3	NC	NC	NC	NC	NC
Utilities (22)	**NC**	**NC**	**NC**	**0.4**	**NC**	**NC**	**NC**	**NC**	**NC**	**5.6**	**NC**	**NC**
Construction (23)	**0.3**	**1.0**	**1.7**	**0.4**	**1.0**	**0.3**	**1.3**	**0.3**	**0.3**	**0.5**	**0.3**	**0.4**
Manufacturing (31-33)	**1.9**	**0.2**	**0.6**	**2.2**	**0.7**	**NC**	**2.1**	**2.5**	**1.9**	**2**	**0.4**	**0.2**
Food Processing	0.2	NC	1.8	1.0	NC	NC	7.9	NC	NC	1.0	NC	NC
Printing & Support Activities	4.5	NC	0.4	0.3	NC	NC	1.1	NC	NC	NC	NC	NC
Fabricated Metal Product Manufacturing	6.6	NC	0.1	3.2	1.1	NC	1.7	0.7	NC	0.4	NC	NC
Machinery Manufacturing	0.9	NC	0.9	7.9	NC	NC	1.0	17.3	NC	7.1	NC	NC
Wholesale Trade (42)	**NC**	**1.0**	**1.4**	**1.2**	**2.1**	**NC**	**0.7**	**3.5**	**0.8**	**2.1**	**2.9**	**2**
Farm Product Raw Material	1.1	13.9	11.2	3.3	40.9	NC	11.6	NC	20.8	71.3	56.4	86.4

Industry Group (2 to 4 Digit NAICS Code)	Becker	Big Stone	Clay	Douglas	Grant	Mahnomen	Otter Tail	Pope	Stevens	Swift	Traverse	Wilkin
Petroleum and Petroleum Products	3.1	NC	NC	0.4	NC	NC	NC	NC	NC	NC	NC	NC
Miscellaneous Nondurable Goods	NC	NC	3.0	0.8	8.4	NC	3.0	0.8	5.6	3.0	NC	NC
Direct Selling Establishment	5.1	NC	NC	NC	1.1	NC	1.7	1.0	NC	NC	NC	10.1
Retail Trade (44-45)	**0.6**	**1**	**1.3**	**0.7**	**0.9**	**0.7**	**0.6**	**0.9**	**0.8**	**0.8**	**1.4**	**0.4**
Transportation & Warehousing (48-49)	**1**	**1.5**	**0.4**	**0.4**	**1.3**	**1.0**	**0.6**	**0.6**	**0.3**	**1**	**1.6**	**0.6**
Truck Transportation	2.5	NC	1.0	0.8	0.8	0.8	1.0	1.2	0.7	0.6	1.5	0.5
Transit and Ground Passenger Transportation	2.4	NC	0.9	0.1	NC	0.3	1.8	NC	NC	1.1	NC	NC
General Freight Trucking	3.4	0.7	0.7	0.6	NC	1.8	1.2	NC	NC	NC	NC	0.4
School and Employee Bus Transportation	3.4	NC	1.7	NC	NC	0.8	3.6	NC	NC	NC	NC	NC

(NC) Not Calculable, the data does not exist, or it is zero.
Source: CPCS analysis of Bureau of Labor Statistics, 2021.

Freight-Related Industry Competitiveness

The county-level LQ analysis provides insights into the competitiveness of regional industries compared to the national averages. A more dynamic economic indication of the changes in a region's industrial competitiveness over time compared to the national norm can be achieved through Shift-Share analysis. The shift-share analysis estimates regional job growth based on the following three factors:

- **Industrial mix effect:** the growth of a specific industry at the national level. This effect is calculated through the analysis of industry-level employment data for the desired time frame.
- **National growth effect:** the regional industry growth impacted by the national level growth rates for the desired time frame.
- **Regional competitive effect:** the growth (or any change) in regional industry employment due to the unique characteristics of that region.

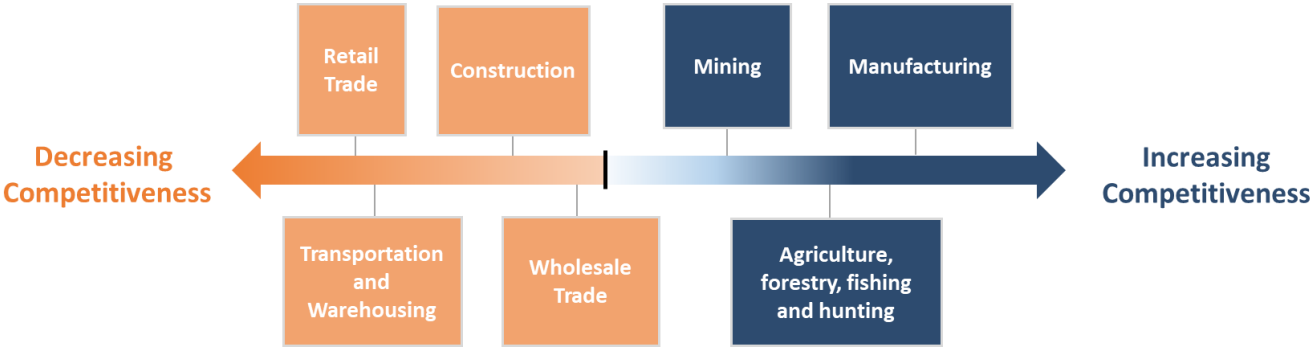
The resulting shift-share analysis is based on the following formula:

Actual Employment Change = National Share + Industrial Mix + Regional Shift

While the LQ analysis in the previous section proved that agriculture and manufacturing are important to the District's economy, the shift-share analysis adds another layer to this by highlighting the significant advantages for the manufacturing and mining industries in District 4.

Figure 15 shows the change in employment due to regional competitive effects in the District. Shift-share analysis of the freight-related industries in District 4 shows that forestry, fishing, and related activities, manufacturing, and mining are the leading industries. This means that these industries are growing in the District, with a rate higher than the national average.

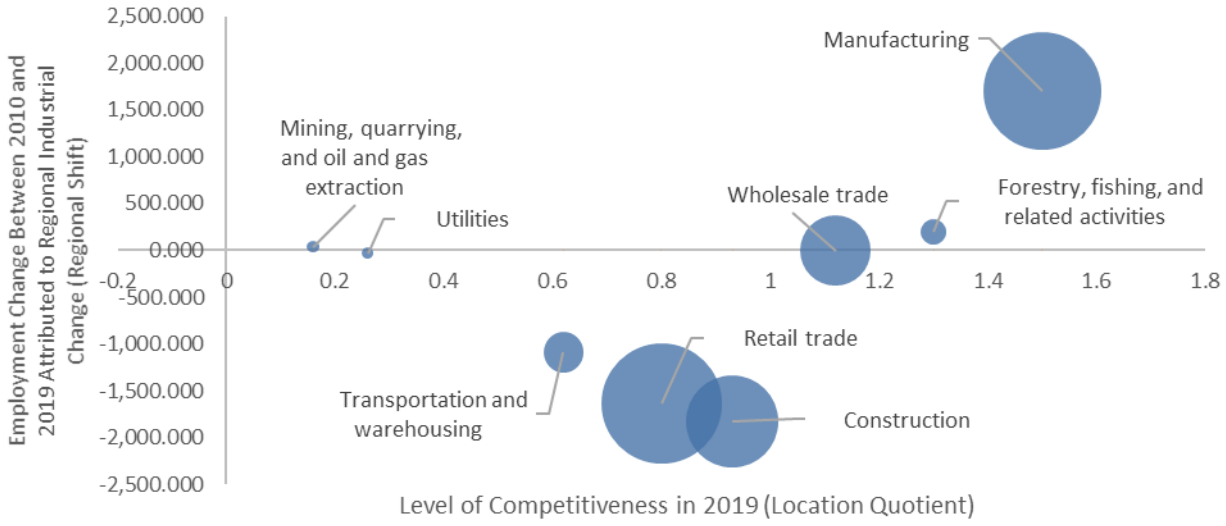
Figure 15: Freight-related Industry Regional Shift, 2010-2019



Source: CPCS analysis of county-level industry employment data provided by the Bureau of Economic Analysis, 2021.

Figure 16 presents the District's freight-related industry competitiveness (X-axis) against the increase or decline in employment due to regional effects (Y-axis). Industries with an LQ greater than 1.0 on the X-axis are relatively more competitive than the US average in 2019, while industries lower than 1.0 on the X-axis were less competitive. On the Y-axis, positive values indicate that the industry has improved in competitiveness between 2010 and 2019, while the employment size of each industry in the District is indicated by the size of the circle for each industry. Appendix A provides additional detailed results of District 4's shift-share analysis.

Figure 16: Regional Competitiveness in Freight-Related Industries, 2010-2019



Source: CPCS analysis of county-level industry employment data provided by the Bureau of Economic Analysis, 2021.

Despite the declining effects of the national trends on the District's manufacturing employment between 2010 and 2019, there has been significant growth in manufacturing jobs in District 4 due to positive regional effects.

1.4 District 4 Industrial Profile

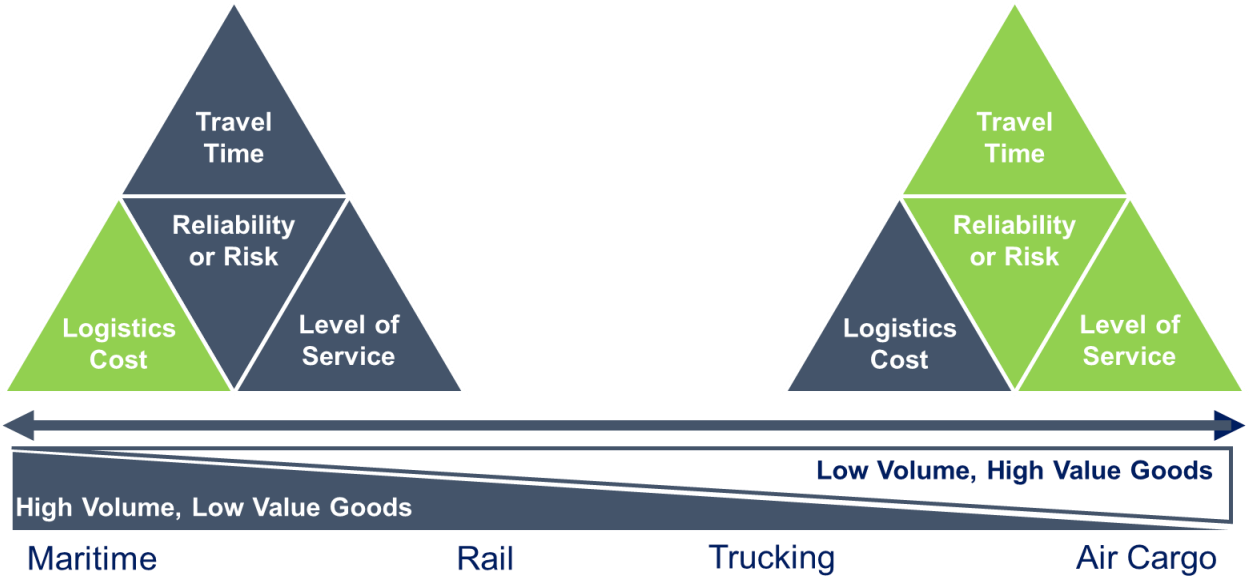
District 4 Freight-Related Industry Locations

Figure 18 shows the locations of freight-related business establishments with more than 20 employees in District 4. As shown, the majority of these businesses are clustered along the major highway corridors, especially I-94 between Alexandria and Fergus Falls, US-59 between Fergus Falls and Detroit Lakes, US-12, US-10, SR-9 in Morris, and SR 28 between Morris and Alexandria.

Freight-Related Industry Transportation Requirements

Shippers have a range of modal options to consider when moving freight, such as trucks, railroads, air freight, and barge or ship service. However, the true range of choices is limited by the availability of each of these modes, characteristics of the cargo being moved, and shippers' access to the available options. In addition to availability, when selecting freight modes and routes, shippers must balance a set of trade-offs between shipping cost, and shipping speed, level of service, and reliability. Each mode of transportation has its own set of characteristics, and together, modes make up a "spectrum" of trade-offs, as presented in Figure 17.

Figure 17: The Modal "Spectrum" of Trade-Offs

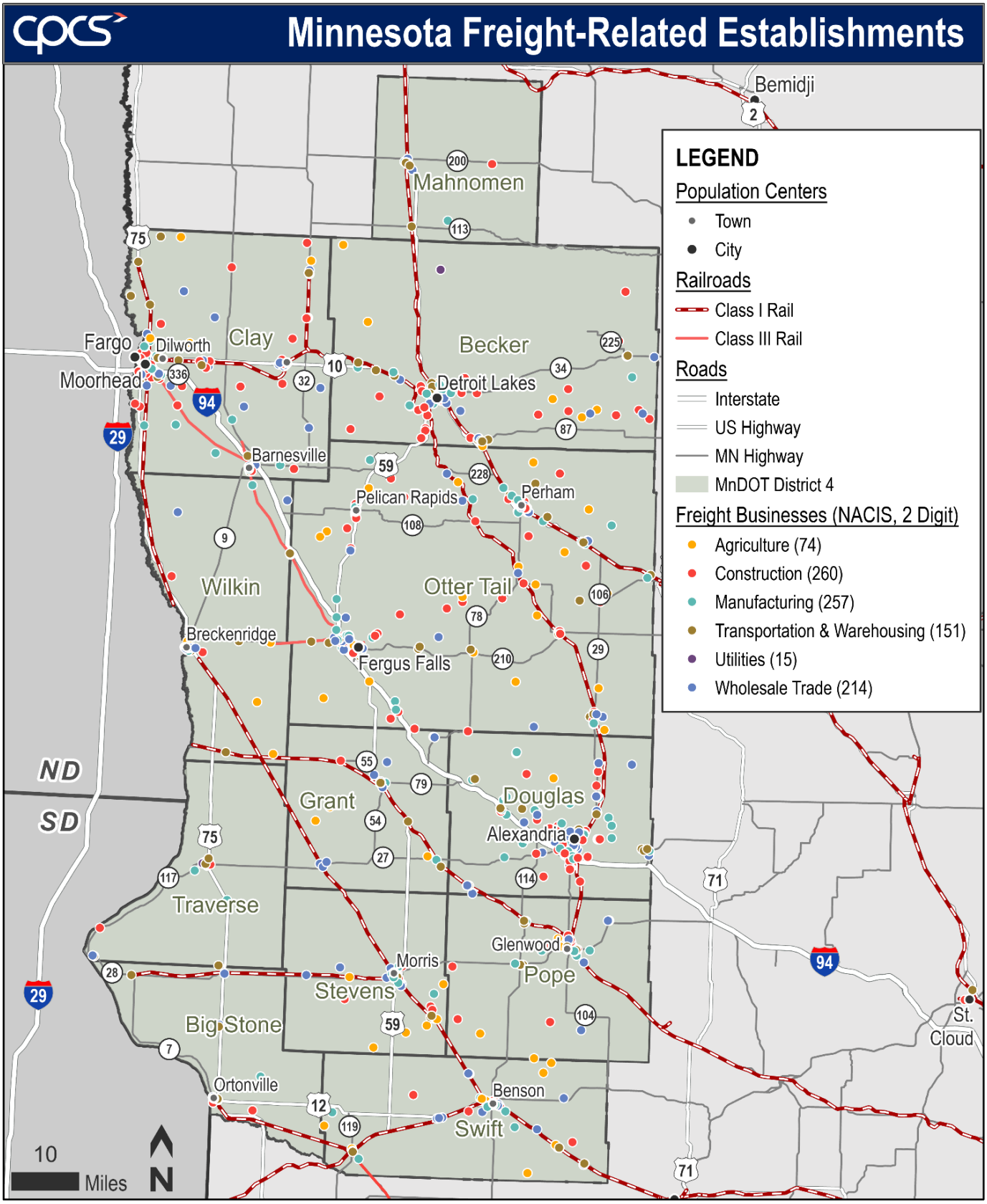


Source: CPCS.

As shown in the spectrum, for higher-value goods such as pharmaceuticals and electronics, the cost of shipping often makes up a relatively small portion of the good's cost, increasing the shippers' willingness to pay for a faster and more reliable freight option such as air cargo or truck. On the other hand, for goods with relatively low per-ton values (such as oil, grain, and aggregate), high logistics costs can significantly affect the market prices, therefore forcing the shippers to prioritize low shipping costs over fast and reliable delivery. Goods like these are often moved by rail, barge, or ship, which have the capacity to carry much higher volumes of heavier goods at relatively lower prices.

Freight shippers must balance shipping costs against faster or more reliable service.

Figure 18: Freight-Related Establishments in District 4



Source: CPCS analysis of Reference USA data, 2021.

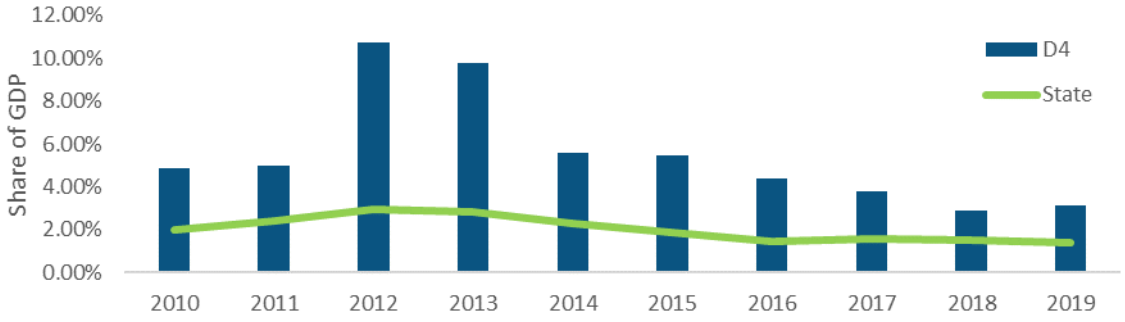
An example of modal considerations can be seen in District 4's agriculture and manufacturing industries. While moving agricultural products by rail provides the District's businesses with a cost-effective shipping option, access to intermodal facilities to transfer containerized cargo between truck and rail modes is limited. This affects the cost competitiveness of manufacturing businesses within the District.

Agriculture

Minnesota is the fifth highest state among all US states in terms of total agricultural production ($16.7 B in 2019). About 26 percent of the cash receipts in the state's agricultural market are associated with corn, 19 percent with soybeans production, and 16 percent with hog farm activities.[7] The majority of the corn and soybean farms in the state are congregated in central, southern, and western counties, which overlaps with District 4.

As Figure 19 shows, the agricultural industry's contribution to District 4's GDP is greater than the industry's share of the state-level GDP. The agricultural industry became increasingly important for the state's and District's economy between 2012 and 2013. Minnesota is ranked first in sugarbeet, second in corn, and third in soybean production across the nation.[8] However, the industry has seen a steady decline in contribution to GDP and is expected to continue this trend.[9] The majority of this decline can be linked to the decline in the average corn yields both in Minnesota and across the country. Minnesota's cornfields in the south and the west (including District 4 Counties) have seen a significant drop in yields primarily due to severe rain.

Figure 19: Agriculture Industry Share of GDP, 2010-2019

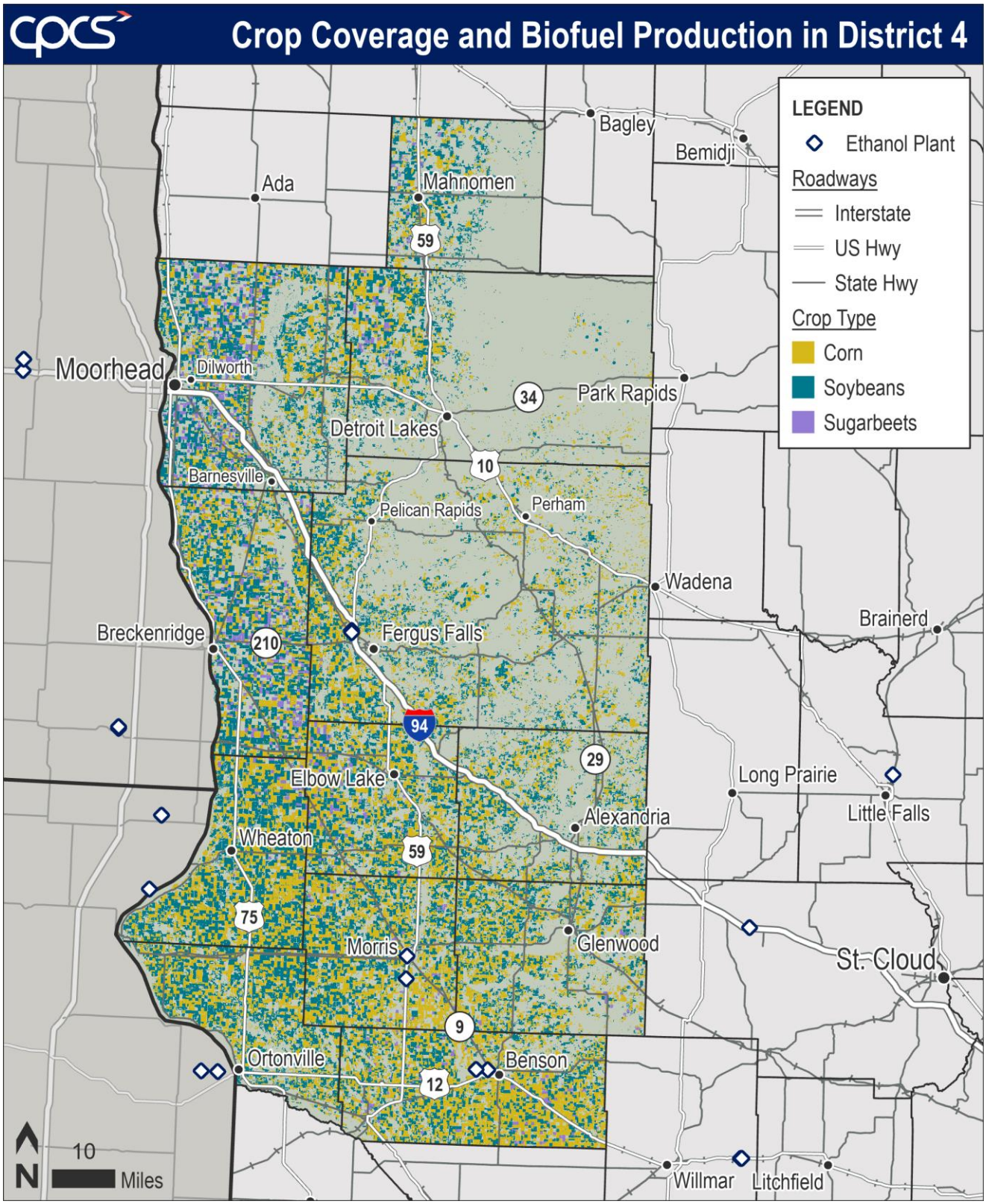


Source: BEA GDP Data, 2021.

Agriculture is a major industry in District 4, with corn, soybeans, dry beans, and sugarbeets as the top produced and processed crops. Figure 20 shows the concentration of farmlands across District 4. As shown, corn and soybean production and processing businesses are distributed among the western counties in District 4, with the highest concentration in Wilkin, Traverse, Swift, Big Stone, and Clay Counties. Sugarbeet production is mostly concentrated in Wilkin and Clay Counties, while dry beans are mostly produced in Becker, Otter Tail, Stevens, and Pope Counties.

[7] The state's soybean production share has declined by 2% since 2017. Source: Minnesota Agricultural Profile, Minnesota Department of Agriculture, 2019: https://minnesota.agclassroom.org/educator/materials/profile.pdf
[8] USDA Crop Production Report 2018-19. https://www.usda.gov/topics/farming/crop-production
[9] USDA Crop Production Report 2019-20.
https://www.nass.usda.gov/Publications/Todays_Reports/reports/cropan20.pdf

Figure 20: Crop Production Locations and Biofuel Production Plants in District 4



Source: USDA Cropscape, 2019; Enegry.gov, 2021.

Corn

In 2019, nearly 16 percent of the corn cropland in Minnesota was located in District 4, with over 15 percent of the state's harvested area producing more than 188 million bushels of corn and 230,400 tons of silage corn on an annual basis.[10]

Acres Planted in District 4	Acres Harvested in District 4	Production, Measured in Bushels in District 4
1,203,900	1,112,100	188,732,000

Source: CPCS analysis of 2019 USDA National Agricultural Statistics Service, 2021.

An average of 85 percent of corn crops is processed for food, animal feed, and industrial manufacturing. Also, a wide variety of food products use corn as a base ingredient, such as cereals, corn oil, and corn flour products, to chewing gums and peanut butter.

Corn ethanol is produced from the fermentation of corn stover.[11] Figure 20 shows the ethanol production plants in Minnesota. As the figure shows, three ethanol production plants are located in District 4: Green Plains Inc. in Fergus Falls, DENCO II LLC in Morris, and Chippewa Valley Ethanol Co. in Benson. All of these plants use corn as feedstock and have an aggregate capacity of 130 million gallons per year.[12] The byproduct of corn processed for food or biofuel production is animal feed. Silage is another corn byproduct that is used for animal feed.

Soybeans

Soybeans are important for Minnesota's economy as they are a top agricultural export commodity. The majority of Minnesota's soybean fields are located in central, southern, and western Minnesota. Over 50 percent of the state's soybean harvest is exported, mainly to China, Mexico, Indonesia, Japan, and Taiwan. The rest is processed to produce livestock feed or used for food and biofuel production.[13] Over 14 percent of the soybean production fields in Minnesota are located in District 4, with about 14 percent of the state's harvested area producing more than 39 million bushels of soybeans on an annual basis.[14]

Acres Planted in District 4	Acres Harvested in District 4	Production, Measured in Bushels in District 4
975,200	966,600	39,326,000

Source: CPCS analysis of 2019 USDA National Agricultural Statistics Service, 2021.

Processing soybean results in biodiesel and glycerin. The closest biodiesel plant to the District is the Minnesota Soybean Processors plant in Nobles County, which is connected to farms in District 4 via US-59.

[10] Source: USDA National Agricultural Statistics Service, 2017.
[11] USDA, National Corn Growers Association, 2010.
[12] NREL, Biofuel Atlas, accessed May 2021.
[13] Minnesota Soybean Research and Promotion Council, accessed 2019. https://mnsoybean.org/msrpc/about-soy/
[14] USDA National Agricultural Statistics Service, 2017.

Sugarbeets

Minnesota's sugarbeets farms are primarily clustered in central, southern, and western Minnesota. Within the District, sugarbeet farms are mostly located in Clay, Wilkin, Grant, and Swift Counties. More than 46 percent of Minnesota's sugarbeet cropland is in District 4, with about 28 percent of the state's harvested area producing more than 3.2 million tons of sugarbeets annually.[15]

Acres Planted in District 4	Acres Harvested in District 4	Production, Measured in Tons in District 4
188,000	118,900	3,264,600

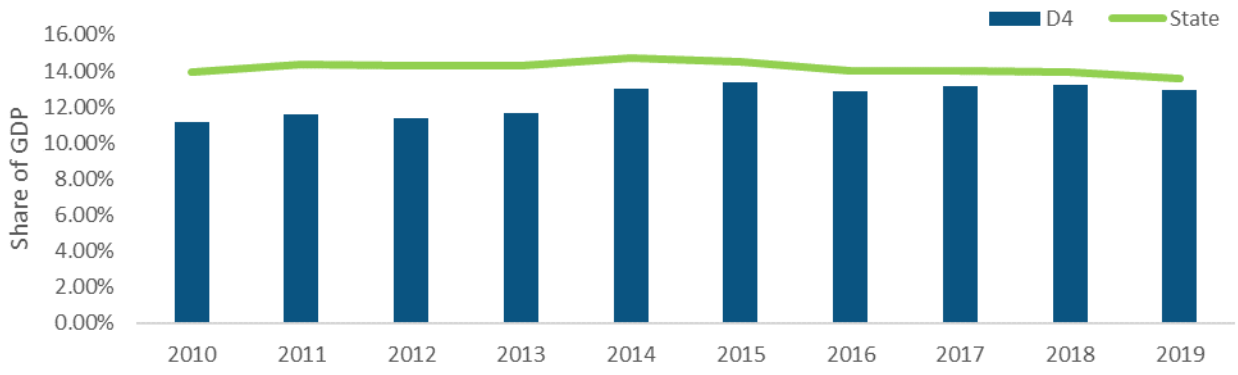
Source: CPCS analysis of 2018 USDA National Agricultural Statistics Service, 2021.

Sugarbeets are used to produce common sugar, while the pulp byproduct of sugar production is used for animal feed along with the sugarbeets' leaves. Molasses is another byproduct and is used for alcohol and pharmaceutical manufacturing.

Manufacturing

Manufacturing is the most competitive freight-related industry in District 4. Figure 21 shows the trends in the share of manufacturing in the total GDP for Minnesota and District 4. While shift-share analysis showed that Minnesota's GDP is more reliant on the manufacturing industry compared to the national average, analysis of county-level industry GDP trends shows that manufacturing has maintained its share of total GDP over the past decade. Minnesota's manufacturing share of GDP has remained relatively steady, around 14 percent between 2010 and 2019. In 2019, the Manufacturing sector's share of GDP from the state's economy was about 14 percent, while this number was about 13 percent for the District.

Figure 21: Manufacturing Share of GDP in Minnesota and District 4, 2010-2019

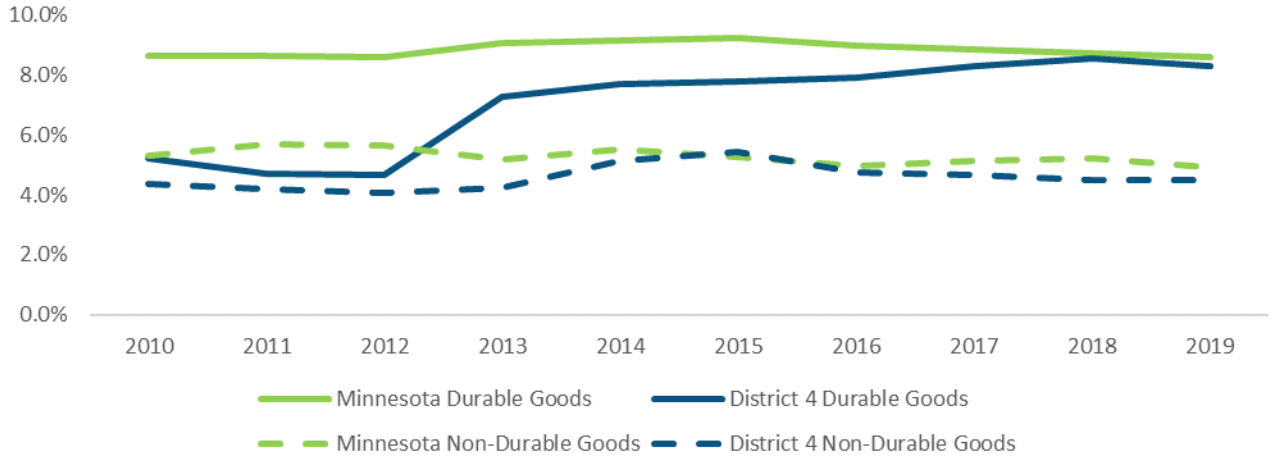


Source: CPCS analysis of BEA GDP Data, 2021.

Figure 22 shows that in both Minnesota and District 4, the manufacturing industry is more represented by durable goods than non-durable goods. The durable goods manufacturing sector has seen a sudden increase in the share of total District-level GDP in 2013 and has stayed relatively steady since.

[15] USDA National Agricultural Statistics Service, 2017.

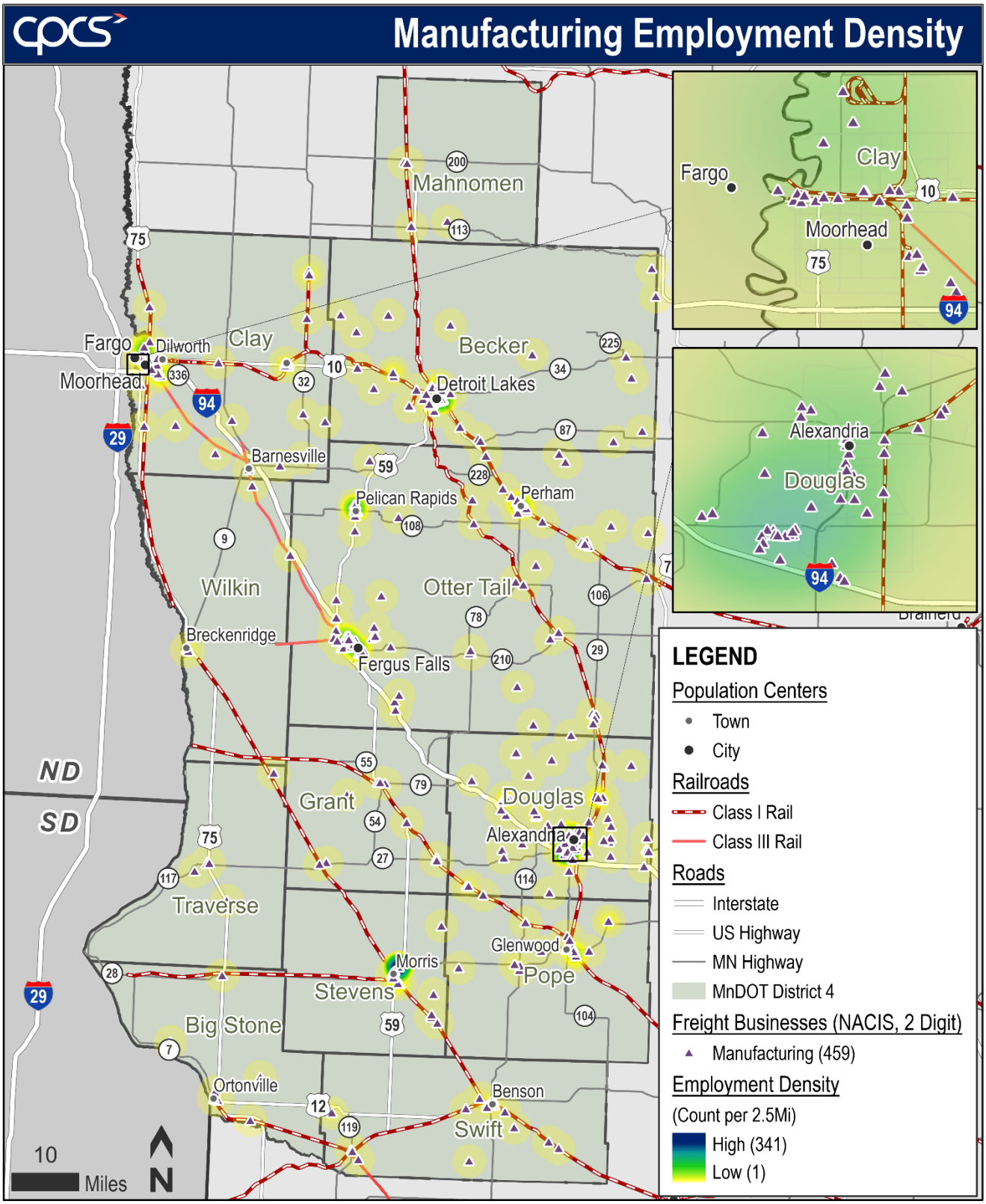
Figure 22: Manufacturing Share of GDP by Type of Goods, 2010-2019



Source: CPCS analysis of BEA GDP Data, 2021.

As Figure 23 shows, Otter Tail, Swift, Pope, Stevens, Clay, and Becker Counties stand out as particularly important centers for manufacturing employment, with cities such as Morris, Moorhead, Detroit Lakes, Alexandria, and Fergus Falls hosting the greatest concentrations of manufacturing jobs. District 4's manufacturing businesses are clustered in close proximity to major highways such as US-10, US-59, BNSF's Staples subdivision, and Canadian Pacific's rail line.

Figure 23: Manufacturing Industry Business Concentration in District 4, 2019



Source: CPCS Analysis of ReferenceUSA Data, 2021.

2 District 4 Multimodal Freight System

Key Findings:

A multimodal transportation system serves District 4's economy by enabling movement of goods to, from, and through the region. The agricultural, manufacturing, and other freight-dependent businesses in the District are served by a network of interstate, national, and state highways such as I-94, US-59, US-10, US-75, MN-210, and MN-29. Rail freight activities on Class I and short line tracks in the District are also integral to supporting freight-related businesses. In addition, two regional commercial airports provide air cargo services in the District, supported by 16 intermediate airports, and 4 landing strips. Also, 646 miles of pipeline network operate in the District, primarily moving crude oil, natural gas, and other petroleum products.

2.1 District 4 Freight System Overview

District 4 consists of 12 counties in west-central Minnesota, accounting for 12. percent of the state's land area and 4.5 percent of the state's total population. Major cities in the District include Detroit Lakes, Morris, Alexandria, Fergus Falls, and Moorhead, which is part of the Fargo-Moorhead metropolitan statistical area at the District's border with North Dakota.

Much of the District is served by I-94, which is supplemented by the District's network of national, and state highways such as US-59, US-10, US-75, MN-210, and MN-29. State Highways 7 and 9 are also integral to supporting freight-related businesses in the District.

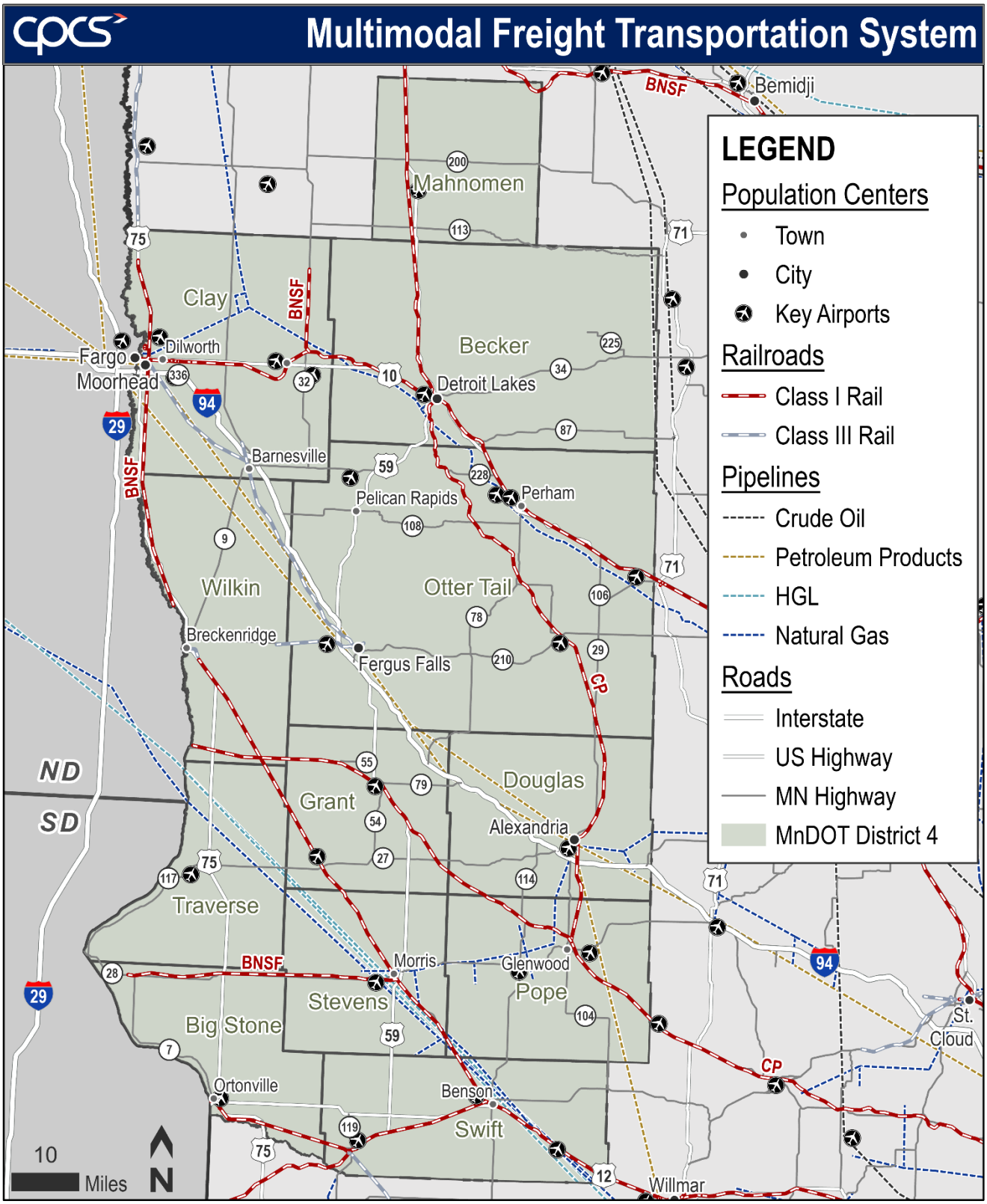
Rail service in District 4 is provided by the Burlington Northern Santa Fe and Canadian Pacific Class I railroads, as well as short line railroads, including Red River Valley and Western, Otter Tail Valley, and Twin Cities & Western. Several roads, pipelines, and grain elevator facilities across the District have access to rail transload and intermodal services. However, stakeholders consulted as part of previous freight studies have expressed concerns regarding the limited number of such facilities in District 4 and how this impacts the competitiveness of many freight-related businesses in the region.

In addition to road and rail, District 4 is served by two key airports, 16 intermediate airports, and four landing strips. Also, 646 miles of pipeline network in the District provide high-volume and low-cost shipping options for crude oil, natural gas, and other petroleum products.

Figure 24 provides a high-level snapshot of the District's key transportation assets. In order for District 4 to remain economically prosperous, it is important for these transportation systems to be well-aligned and work in conjunction with one another to continue to provide key freight services to the District.

115	1,557	668	2,484	18	646
Miles of Interstate	Miles of US and State Highways	Miles of Rail	Bridges	Public Airports	Miles of Pipelines

Figure 24: MnDOT District 4 Multimodal Freight System



Source: CPCS analysis of National Transportation Atlas Database, 2021.

Statewide Freight System Trends

The fifth generation of Freight Analysis Framework (FAF5) is used to provide an overview of statewide freight flow characteristics and trends. FAF, created by the Bureau of Transportation Statistics (BTS), integrates several data sources, including Commodity Flow Survey (CFS) data and Census Bureau's international trade statistics, to present a comprehensive view of multimodal freight movements among states and Metropolitan Statistical Areas (MSA). The current version of FAF5 released in early 2021 is benchmarked to the most recent version of the CFS data (2017) and only provides base year regional and state-level flows. Future releases of FAF5 will include base year and forecasted tonnages, values, commodity types, and mode shares.[16]

In 2017, Minnesota's freight system moved 1.16 billion tons of freight with an estimated value of $694.4 billion, which grew 7.9 percent from 2012. Trucking was Minnesota's dominant mode by tonnage in 2017, handling about 66.3 percent of the total share of freight tonnage and 72.4 percent of the total share of freight value carried in Minnesota. Even though rail still had the second-highest share of tonnage (11.8%), the rail share of tonnage decreased by about 5 percent, with a 2 percent drop in the share of value between 2012 and 2017. The volumes of freight moved by water remained stable, whereas the values decreased 0.3% between 2012 and 2017. Meanwhile, the value of air cargo carried grew significantly (3.17%). Noticeably, the share of freight tonnage transported by pipeline experienced an increase of 0.8 percent between 2012 and 2017, while the share of values shrank by about 2.6 percent. Figure 25 summarizes the 2012 and the 2017 freight modal split in Minnesota.

Figure 25: Freight Modal Split in Minnesota, 2012 and 2017 Comparison

Freight Mode	2012 Tonnage	2017 Tonnage	2012 Value	2017 Value
Truck	64.0%	66.3%	68.7%	72.4%
Rail	16.7%	11.8%	6.2%	4.2%
Water	2.1%	2.1%	0.5%	0.2%
Pipeline	14.2%	15.0%	7.9%	5.3%
Multiple Modes and Mail	2.9%	4.3%	14.3%	14.5%
Air	0.01%	0.02%	0.03%	3.2%

Source: Freight Analysis Framework 4.5 and Freight Analysis Framework 5, 2021.

The FAF 4.5 projects that by 2045, total freight volumes in Minnesota will have risen by 45.5 percent to 1.3 billion tons. The value of freight will increase 88.1% ($0.57 trillion) over the next two decades. Despite these tonnage and value changes, the modal split of freight moved in Minnesota is expected to remain relatively constant during this timeframe.

Minnesota's freight tonnage is expected to increase by 80% between 2012 and 2040. Freight value is expected to increase by 16%.

In 2017, the top five commodities by volume remained the same as in 2012. Cereal grains continued to be the top commodity by volume, accounting for 18.5 percent of the total freight tonnage, even though the grain tonnage decreased by about 0.2 percent between 2012 and 2017. Coal and petroleum products and gravel maintained stable growth, increasing by 3.7 percent and 1.8 percent. The increasing shares of coal and petroleum products reflect the oil boom in North Dakota. Other agriculture products, such as sugar beets, peas,

[16] BTS, About Freight Analysis Framework, March 2021. Note: 2012 freight flow data has been extracted from FAF4.5.

potatoes, and sweet corn, contributed an 8.1 percent share of the total freight tonnage in Minnesota (Figure 26).

Figure 26: Top Five Current Commodity Shares by Tonnage, 2012 vs. 2017

2012 Top Commodities by Tonnage	Share %	2017 Top Commodities by Tonnage	Share %
Cereal Grains	18.7	Cereal Grains	18.5
Coal-n.e.c.[17]	10.4	Coal-n.e.c.	14.1
Gravel	8.3	Gravel	10.1
Other Agriculture Products	8.0	Other Agriculture Products	8.1
Metallic Ores	7.6	Metallic Ores	5.0

Source: Freight Analysis Framework 4.5 and Freight Analysis Framework 5

In 2017, top commodities by value were mixed freight, electronics, machinery, motorized vehicles, and precision instruments. The ranking slightly changed with growth in mixed freight (1.9%), becoming the top commodity by value in Minnesota. Noticeably, the cereal grains and other prepared food products fell out of the top commodity list in 2017, replaced by motorized vehicles and precision instruments. The changes in the top five commodities by value demonstrate that manufacturing and high technology products are growing in the State of Minnesota (Figure 27).

Figure 27: Top Five Current Commodity Shares by Value, 2012 vs. 2017

2012 Top Commodities by Value	Share %	2017 Top Commodities by Value	Share %
Electronics	7.4	Mixed Freight	8.7
Mixed Freight	6.8	Electronics	7.2
Machinery	5.8	Machinery	6.3
Cereal Grains	5.4	Motorized Vehicles	5.1
Other Prepared Foodstuffs	5.3	Precision Instrument	5.0

Source: Freight Analysis Framework 4.5 and Freight Analysis Framework 5, 2021.

2.2 Road Network

District 4's road network consists of one interstate highway (I-94), four US national highways (US-10, US-12, US-59, and US-75), state highways, and numerous county and local roads. This road network plays an important role in the District's economic competitiveness, as it provides direct connections among all businesses as well as to other modal systems located within or beyond the District boundaries. Figure 28 lists the mileages of the major elements of the District's road network, and Figure 30 provides a visual overview of the routes within the system.

Figure 28: District 4 Road System Mileages

	District 4	Minnesota
Interstate	115	913
US Highway	541	3,294
State Highway	1,016	7,080

Source: CPCS analysis of FHWA Data, 2021.

[17] Coal-n.e.c. refers to coal and petroleum products not elsewhere classified, including natural gas.

Tonnage information by commodity specific to District 4 is not available, but statewide tonnage figures can provide insight into potential trends for freight moving on District's road network. In 2017, trucks carried 66.6 percent of the total freight tonnage and 72.5 percent of the value in Minnesota. Due to the flexibility of trucking operations, trucks can handle a wide range of commodities in short- and long-haul operations and are the sole provider of "last mile" services for most businesses. In 2017, cereal grains, gravel, agricultural products, non-metal mineral products, gasoline, and animal feed were the top commodities carried via trucks in terms of tonnage. Figure 29 summarizes Minnesota's top commodities carried by truck in 2017.

Figure 29: Major Commodities Carried by Trucks, 2017

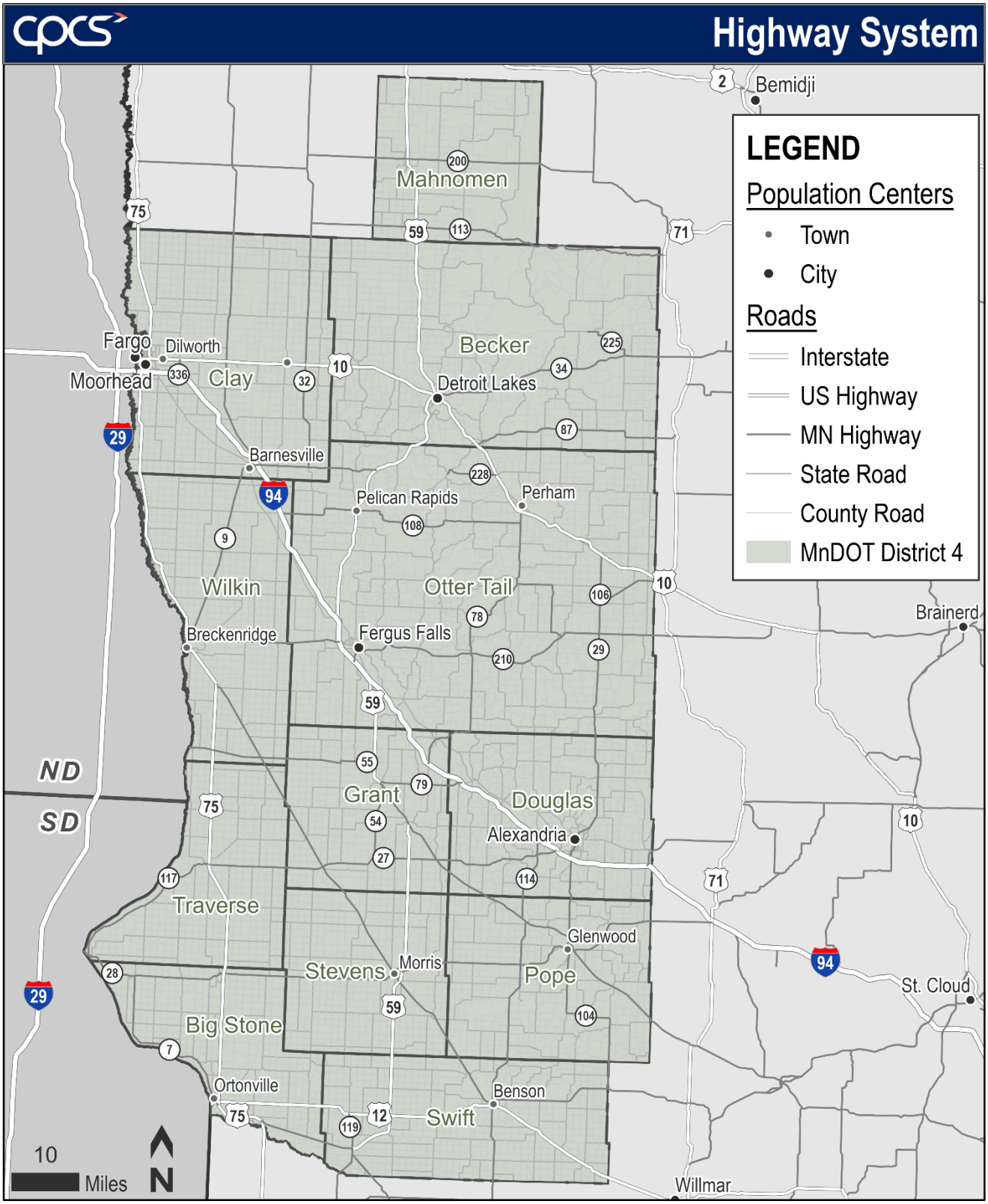
Top Commodities	Tonnage	Percent of Total
Cereal Grains	172,681,700	22.5%
Gravel	110,912,500	14.4%
Other Agriculture Products	86,033,180	11.2%
Nonmetal Mineral Products	54,815,570	7.1%
Gasoline	50,116,900	6.5%
Animal Feed	34,977,770	4.6%
Other Foodstuff	32,385,590	4.2%
Coal	24,604,210	3.2%
Waste/Scrap	19,572,380	2.6%
Nonmetallic Minerals	19,544,310	2.5%
Mixed Freight	18,268,740	2.4%
Fuel Oils	17,737,510	2.3%
Logs	17,178,830	2.2%
Natural Sands	13,146,370	1.7%
All Other	96,889,483	12.6%
Total	**768,865,043**	**100%**

Source: Freight Analysis Framework 5, 2021.

Comparing statewide and District 4-specific commodities provides insight into the unique qualities of the District's transportation system. Specific differences between District 4 and Statewide commodities include:

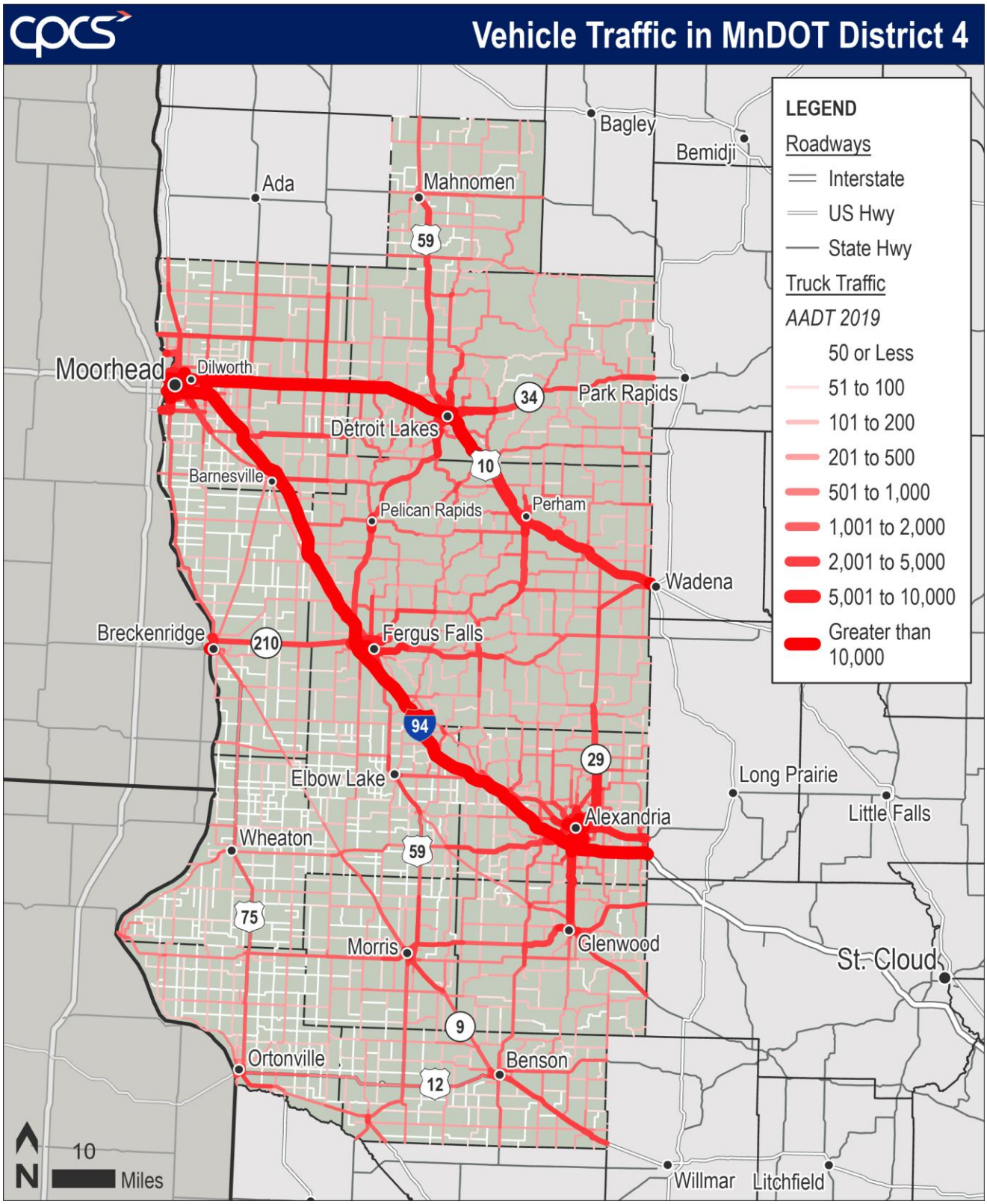
- **Cereal Grains** made up 48 percent of District 4's truck tonnage, which is larger than the statewide share (22.5%). The high percentage of cereal grains truck tonnage is likely due to agriculture being District 4's dominant industry.
- **Animal Feed** contributed 13 percent of the total truck tonnage in District 4, but only 4.5 percent of Minnesota's truck tonnage. This is likely due to the high concentration of agricultural activities in the District.
- **Gravel** made up 5 percent of District 4's truck tonnage, which is lower than the 14.4 percent of statewide truck tonnage. The minimal aggregate activity occurring by truck within the District is likely due to the expense attached to trucking gravel great distances in combination with the remoteness and minimal population growth of the District.
- **Nonmetal Mineral Products** contributed 7 percent to Minnesota's truck tonnage, but only 4 percent of District 4's truck tonnage. Nonmetal mineral products include sand, gravel, limestone, clay, and marble. The decrease of nonmetal mineral products might reflect the low construction activities in District 4 as a byproduct of low population growth.
- **Live Animals/Fish** made up 1 percent of District 4's truck tonnage, whereas it contributed less than 1 percent to Minnesota's truck tonnage.

Figure 30: MnDOT District 4 Highway System



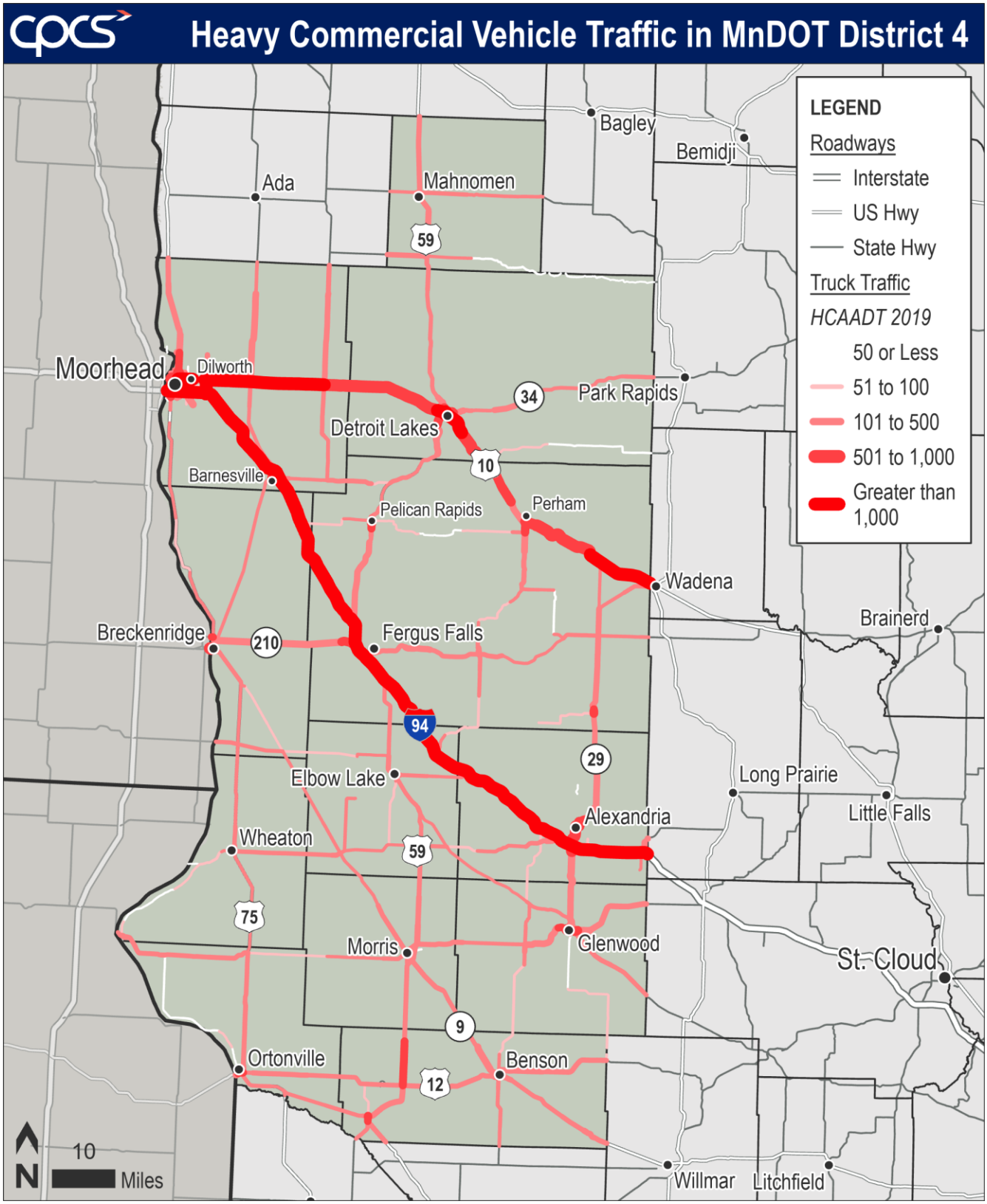
Source: CPCS analysis of FHWA Data, 2021.

Figure 31: District 4 Average Annual Daily Traffic Volumes (All Vehicles)



Source: CPCS analysis of MnDOT and NTAD data, 2021.

Figure 32: District 4 Average Annual Daily Traffic Volumes (Trucks, Only)



Source: CPCS analysis of MnDOT and NTAD data, 2021.

Key Corridors

Trucking activities in District 4 are served by one interstate as well as a network of US Highways and State Routes, primarily I-94, US-10, US-12, and US-59. These corridors carry relatively high truck volumes between densely populated areas both inside and outside the District. Figure 31 and Figure 32 provide an overview of all vehicle and truck-specific traffic volumes in District 4 and illustrate which routes are most important based on vehicle volume.

I-94

Interstate 94 is the only interstate highway in District 4. I-94 is a major east-west corridor running across six northern US states from the Canadian border in Port Huron, Michigan, to Billings, Montana. In Minnesota, I-94 connects Minneapolis with St. Cloud, Alexandria, Fergus Falls, and the Fargo-Moorhead region at Minnesota-North Dakota border. In 2019, I-94 served an Annual Average Daily Traffic (AADT) of 23,000 vehicles in District 4. About 3,950 of these vehicles were trucks, meaning that trucks made up about 17 percent of traffic. I-94 connects to several south-north corridors in Minnesota and District 4, including US-59, which is a border-to-border corridor from Laredo, TX to Lancaster, MN, US-75, that runs from Dallas, TX to the Canadian border point of entry at Noyes, MN, and I-35, which is a key central US corridor stretching from Laredo, TX, to Duluth, MN.

US-10

US Highway 10 is a primarily east-west corridor running in the Midwest and Great Lakes regions. US-10 starts at an interchange with I-75 near Bay City, MI, running west to Ludington at Lake Michigan. Across the lake, US-10 starts again in Manitowoc, WI, and traverses Stevens Point, Minneapolis, and St. Cloud. Then, the highway heads northwest towards Detroit Lakes and ends in Fargo. For the majority of its length in Minnesota, US-10 is a 4-lane divided highway. US-10 connects to US-59 in Detroit Lakes and to US-75 in Moorhead. On average, about 12,150 vehicles use US-10 in District 4 on a daily basis, about 1,040 of which (8.5%) are trucks.

US-59

US Highway 59 is a major north-south corridor starting at the Lancaster–Tolstoi Border Crossing in Minnesota, crossing Iowa, Missouri, Kansas, Oklahoma, Arkansas, and Texas to end at the US border with Mexico in Laredo, TX. In Minnesota, US-59 is mostly a 2-lane, undivided highway. Within District 4, the highway crosses Mahnomen, Detroit Lakes, Fergus Falls, and Morris. Several freight-related business establishments are located along US-59 in District 4, which connects with major east-west corridors such as US-10 in Detroit Lakes, I-94 in Fergus Falls, and US-12 west of Benson. US-59 ‘s general traffic volume across the District is about 4,250 vehicles per day, of which about 9 percent (377) are trucks.

US-12

US Highway 12 runs east-west across the southern portion of the District in Swift and Big Stone Counties. US-12 starts in Aberdeen, WA, passes through ten states and terminates in Detroit, MI. In Minnesota, US-12 starts in Ortonville and passes through Benson and Wayzata, just west of Minneapolis. For most of its length in Minnesota, it remains a 2-lane highway. Beyond Wayzata to I-394, US-12 becomes a 6-lane freeway and runs simultaneously with I-394 and I-94, passing through the Twin Cities and on to the Wisconsin state line at Hudson. Within District 4, US-12 has an AADT of 3,380 and a Heavy Commercial Annual Average Daily Traffic (HCAADT) of 380 (11%). Several manufacturing and agricultural

businesses in District 4 rely on US-12 to connect to the Twin Cities and other destinations. Also, US-12 provides access to other major highways in Minnesota, including US-71, US-59, and US-75.

Secondary Routes

In addition to the key corridors, there are other important routes that support freight movements within District 4.

US-75

US Highway 75 is a major highway that runs north-south and stretches 1,239 miles from Noyes, MN to I-30 and I-45 in Dallas, TX. US-75 currently does not cross through the US-Canada border due to the closure of the Noyes-Emerson East Border Crossing in 2006. The connection with I-30 and I-45 allows US-75 to access the Gulf of Mexico in Galveston, TX. US-75 traverses through District 4 close to the Minnesota-Wisconsin state line and passes through Moorhead and Breckenridge. In Moorhead, US-75 connects with I-94. Within District 4, US-75 has an average AADT of 5,461 and an HCAADT of 341 (6.2%).

MN-9

Minnesota Route 9 is a 225-mile-long state highway that runs from MN-23 in New London to US-2 in Fairfax Township near Crookston. MN-9 connects with US-75 in Wahpeton, ND, just west of District 4 at the North Dakota-Minnesota state line. Within District 4, MN-9 has an average AADT of 2,241 and an HCAADT of 274 (12.2%)

MN-29

Minnesota Route 29 stretches 126 miles from US-59 and US-212 in Montevideo to US-71 in Wadena. MN-29 traverses through Swift County, Pope County, Douglas County, and Otter Tail County in District 4. It connects with I-94 and US-52 in St. Cloud and overlaps with US-12 in Ortonville and Willmar. Within District 4, MN-29 has an AADT of 6,891 and an HCAADT of 428 (6.2%).

MN-336

Minnesota Route 336 is a 2.3-mile-long highway located in northwest Minnesota. The short highway runs from I-94/US-52 near Moorhead to the interchange US -10 near Dilworth and Glyndon in the north. The connection between two key corridors made by MN-336 makes this short highway a crucial thoroughfare for truck traffic. MN-336 is also a MnDOT-designated Critical Urban Freight Corridor and had an AADT of 12,600 in 2019.[18]

Key Origins and Destinations

Analysis of the common origins and destinations of heavy-duty truck trips in District 4 was derived from vehicle tracking data provided by MnDOT's StreetLight subscription. StreetLight allows the users to easily analyze and visualize road traffic conditions and performance and is collected through a variety of sources, including INRIX's truck GPS database derived from mobile phone applications such as Google Maps and Waze, onboard navigation systems, and truck Electronic Logging Devices (ELDs). The data utilized by StreetLight is aggregated and generalized to preserve individuals' confidentiality and anonymity.

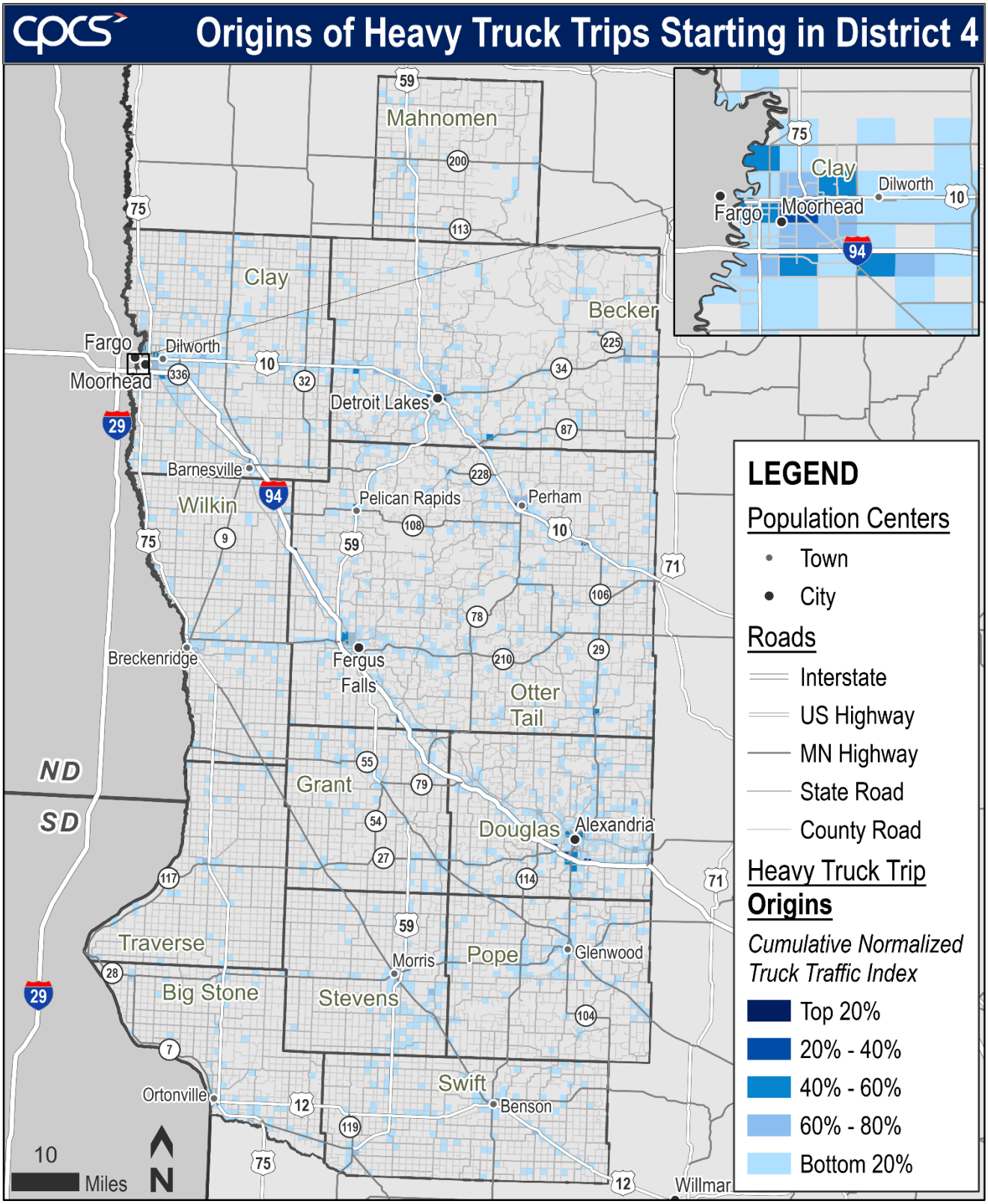
StreetLight's analytical tools allow users to query the origin and destination of truck trips in specific areas. In order to preserve confidentiality, origins and destinations have been aggregated into Transportation Analysis

[18] MnDOT, Statewide Freight Plan, 2018.

Zones (TAZs) and Township Sections, which provide more generalized information on areas of origin and destination. Figure 33**Error! Reference source not found.** shows the origin of truck trips starting in District 4, and Figure 34 shows the destination of truck trips that started in District 4. Figure 35 and Figure 36 show the opposite, with destinations of trips ending in the District and the general areas where those inbound trips originated. Based on analysis of the figures, some key points emerge:

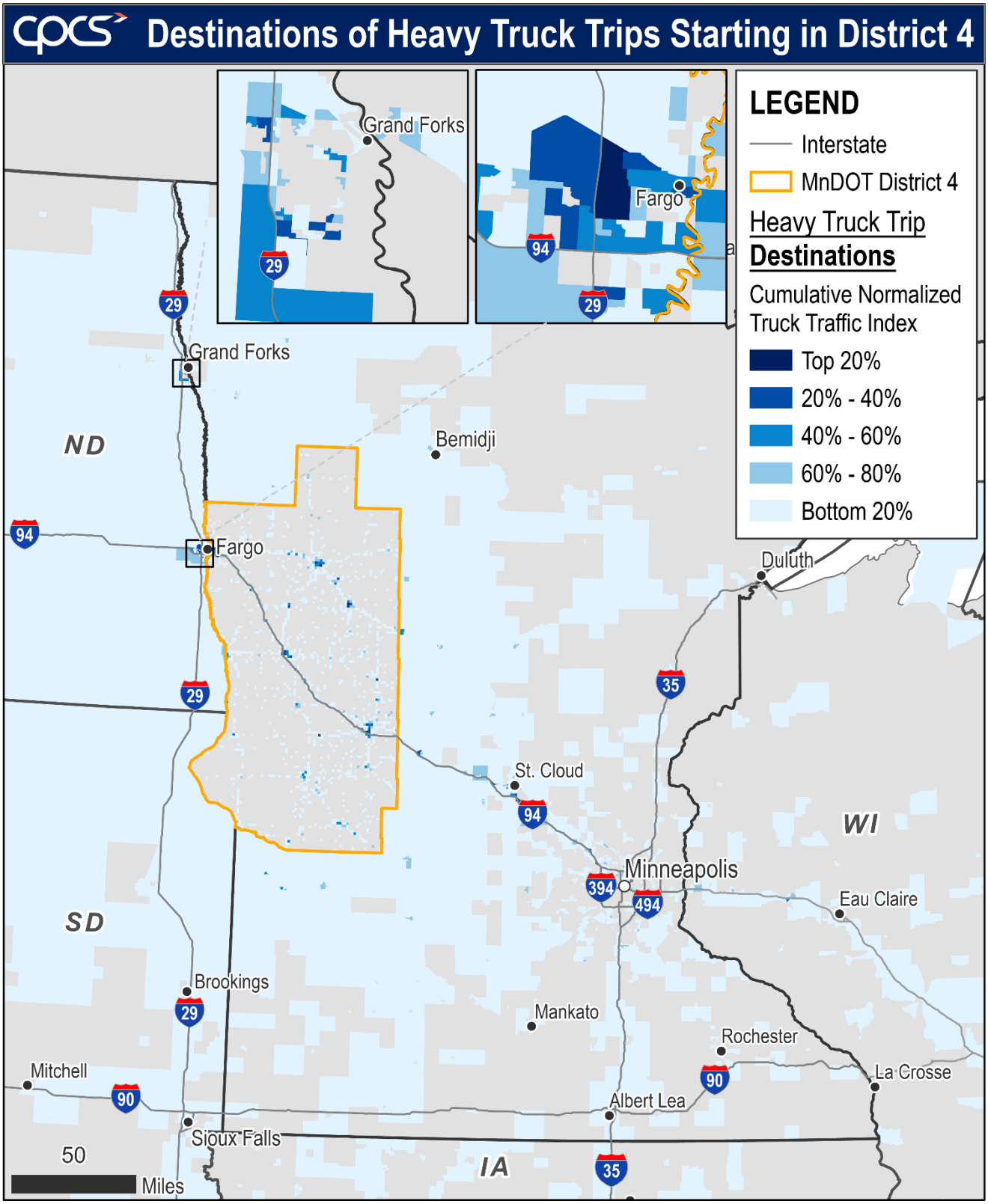
- Over one-quarter of the tracked truck trips originating in District 4 begin in four areas:
    - I-94/US-59 interchange southeast of Fergus Falls: this area has a high concentration of agricultural and construction businesses.
    - Rothsay truck stop on I-94: this area is used by many trucks for overnight parking to comply with Hours of Service (HOS) regulation. Since Streetlight's underlying data confidentiality protections generate new vehicle tracking IDs each day, this protection only allows the system to "see" trips of 24 hours or less before the ID number is discarded. Therefore, StreetLight interprets this truck stop as a major "origin" as it is where many truckers' start their day, and their vehicles are assigned a new ID for the day. Similar patterns highlighting truck stops can be seen in StreetLight data elsewhere in Minnesota and the US.
    - US-10 between Perham and Wadena: truck trip start points are concentrated at New York Mills industrial area.
    - I-94 in western Alexandria: several construction, retail and wholesale, and manufacturing businesses are clustered in this area.
- Truck trips originating in the District primarily end within District 4 or Minnesota. Major destinations for these trips are the Fargo-Moorhead area, Fergus Falls, Detroit Lakes, and Alexandria.
- Truck trips destined to District 4 are primarily originated from the Fargo-Moorhead metro area.
- Major destinations within the District for truck trips originating outside of the District are:
    - I-94/US-59 interchange southeast of Fergus Falls: the area has a high concentration of agricultural and construction businesses.
    - I-94/US-59 interchange northwest of Fergus Falls: some industrial facilities are in this area.
    - I-94/US-52/MN-11 interchange north of Rothsay: this area is used by trucks for overnight parking.
    - US-10 near Perham: truck trip end points are concentrated near the intersection with MN-80, where agricultural and mining businesses such as Northern Irrigation, Perham Stockyards, and Perham Sand & Gravel are located.
    - US-10 between Perham and Wadena: truck trip end points are concentrated at New York Mills industrial area.
    - I-94 east and west of Alexandria: several construction, retail and wholesale, and manufacturing businesses are clustered in this area.

Figure 33: Origins of Heavy-Duty Truck Trips Starting in District 4, 2019



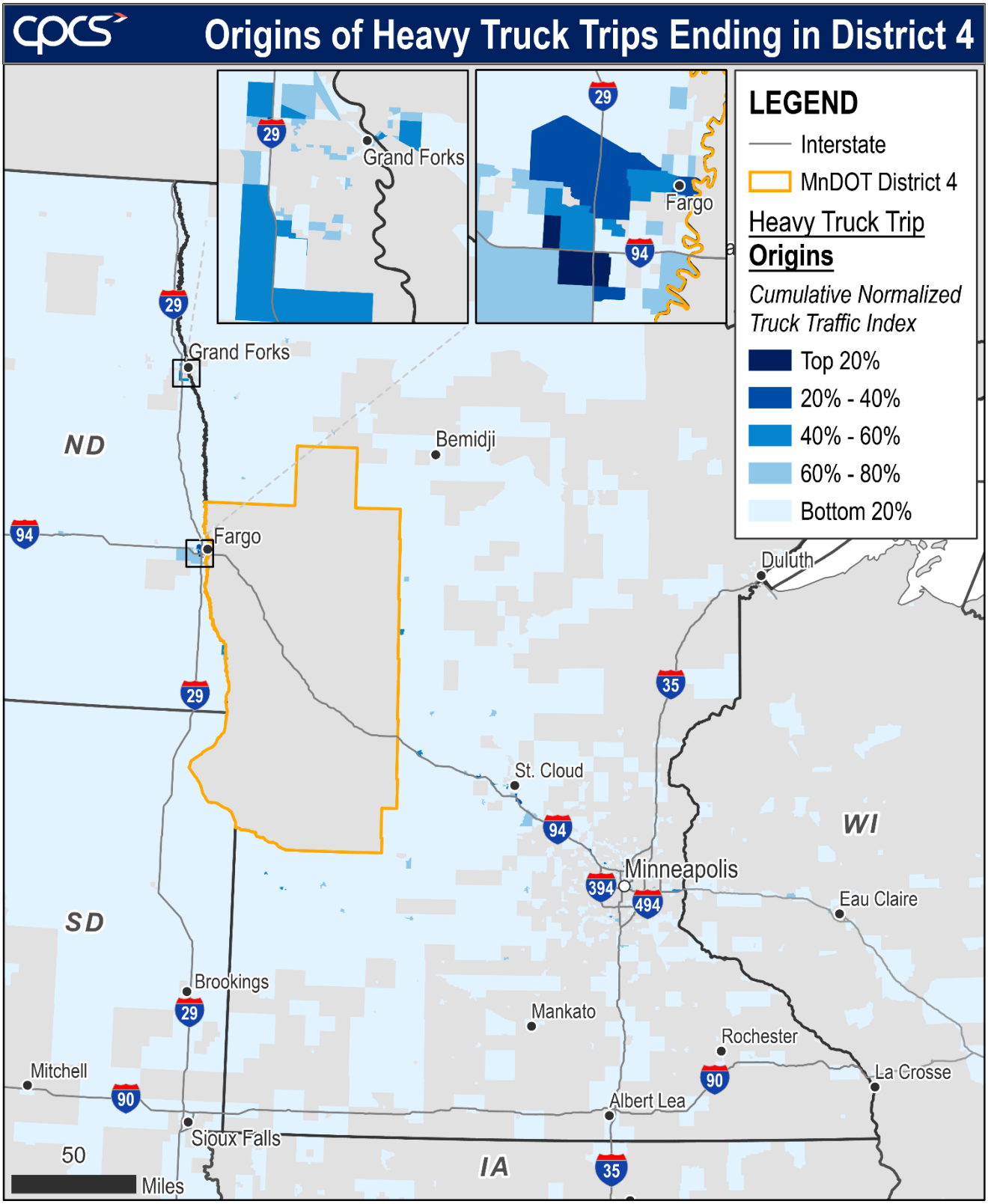
Source: CPCS Analysis of StreetLight Data, 2021.

Figure 34: Destinations of Heavy-Duty Truck Trips Starting in District 4, 2019



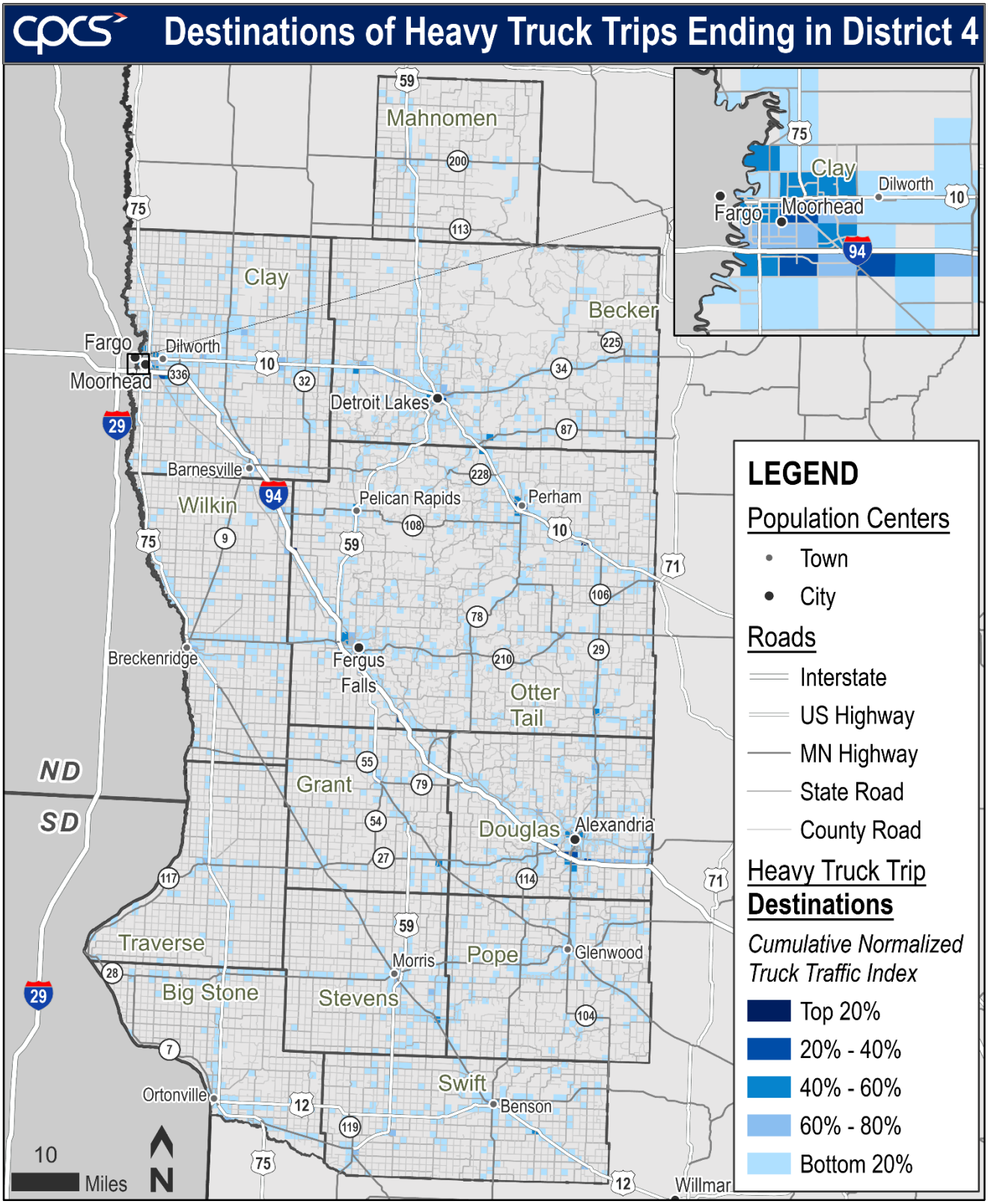
Source: CPCS Analysis of StreetLight Data, 2021.

Figure 35: Origins of Heavy-Duty Truck Trip Ending in District 4, 2019



Source: CPCS Analysis of StreetLight Data, 2021.

Figure 36: Destinations of Heavy-Duty Truck Trips Ending in District 4, 2019



Source: CPCS Analysis of StreetLight Data, 2021.

National Highway System and Critical Freight Corridors

The National Highway System (NHS) consists of federally-designated highways and major arterials that are critical components of the national and statewide transportation systems and important to the economic vitality of states, regions, and local communities. NHS includes the interstate highways, principal arterials that connect origins and destinations with the interstate system, the Strategic Highway Network (STRAHNET), which is key to the US's defense policy and emergency response capability, Strategic Highway Network Connectors, which provide access to the STRAHNET highways, and Intermodal Connectors.

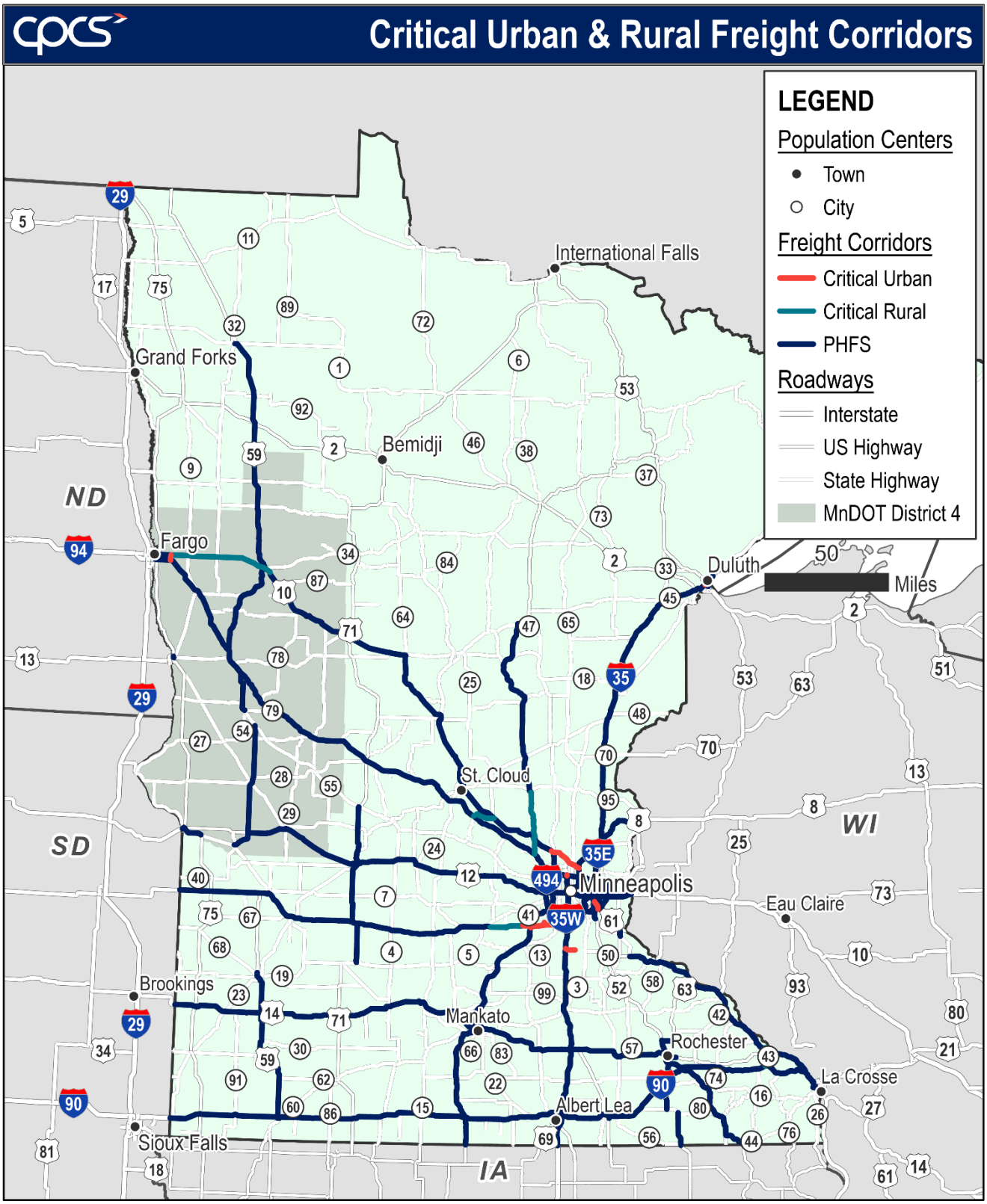
In line with Fixing America's Surface Transportation Act (FAST Act) requirements, the Federal Highway Administration (FHWA) has established the National Highway Freight Network (NHFN). The NHFN consists of interstate and primary highway freight system (PHFS) that are critical to the movement of goods. The NHFN also includes Critical Urban and Critical Rural Freight Corridors (CUFCs/CRFCs), which are key public routes connecting freight facilities to PHFS routes and interstates. A CUFC is an urban arterial that fosters connections between intermodal freight facilities to the interstate system, while a CRFC is a rural arterial where more than 25 percent of the AADT is truck traffic.[19] CRFC/CUFC designation provides access to Federal resources for investment in freight performance improvements.

Based on FHWA's requirements, a maximum of 150 centerline miles is allowed for CRFC designation in Minnesota. Meanwhile, FHWA allows a maximum of 75 centerline miles for CUFC designation in Minnesota.[20] Within District 4, MnDOT has designated I-94 as a PHFS route. Also, a 2-mile segment of Minnesota Highway 336 (MN-336) between US-10 and I-94 near Moorhead is designated as CUFC, while a 40-mile segment of US-10 from MN-336 to Randolph Road in Detroit Lakes is identified as a CRFC (Figure 34).[21]

District 4 has one listed PHFS, a CUFC, and a CRFC route. These routes are vital to the region as they provide access and critical connections for oversize-overweight truck movements to points outside the District.

[19] USDOT, FAST Act, Section 1116 National Highway Freight Program (NHFP) Guidance: Designating and Certifying Critical Rural Freight Corridors and Critical Urban Freight Corridors, 2016.
[20] PHFS is designated by FASC Act as the network of the most critical freight highways in the U.S. transportation system. FHWA designates the PHFS highways and updates the list every five years. For more information: https://ops.fhwa.dot.gov/freight/infrastructure/ismt/nhfn_states_list.htm
[21] MnDOT Statewide Freight System and Investment Plan, 2018.

Figure 37: Intermodal Connectors and Critical Freight Corridors in Minnesota



Source: CPCS analysis of MnDOT data, 2021.

Key Structures and Facilities

Bridges

There are 1,710 road bridges in District 4 (10 feet or greater), accounting for 6.9 percent of Minnesota's total number of bridges.[22]

In addition to the road bridges, 219 rail bridges are in the District. While railroad bridges enable the movement of trains without disruptions to other modes or creating safety issues at grade crossings, rail bridges with low vertical clearance can create route restrictions for trucks and, in particular, hinder oversize-overweight (OSOW) movements. More information on bridge conditions and clearances is provided in Chapter 3.

Truck Stations and DOT Headquarters

MnDOT's District 4 Headquarters are located in Detroit Lakes and Morris, with support offices in Alexandria, Fergus Falls, and Moorhead. District 4 also operates 13 truck maintenance stations. District 4's truck stations are primarily located in rural areas where highways serve high traffic volumes. The District's truck stations are located along major state highway corridors, including I-94, US-10, US-59, and US-75 (Figure 38).

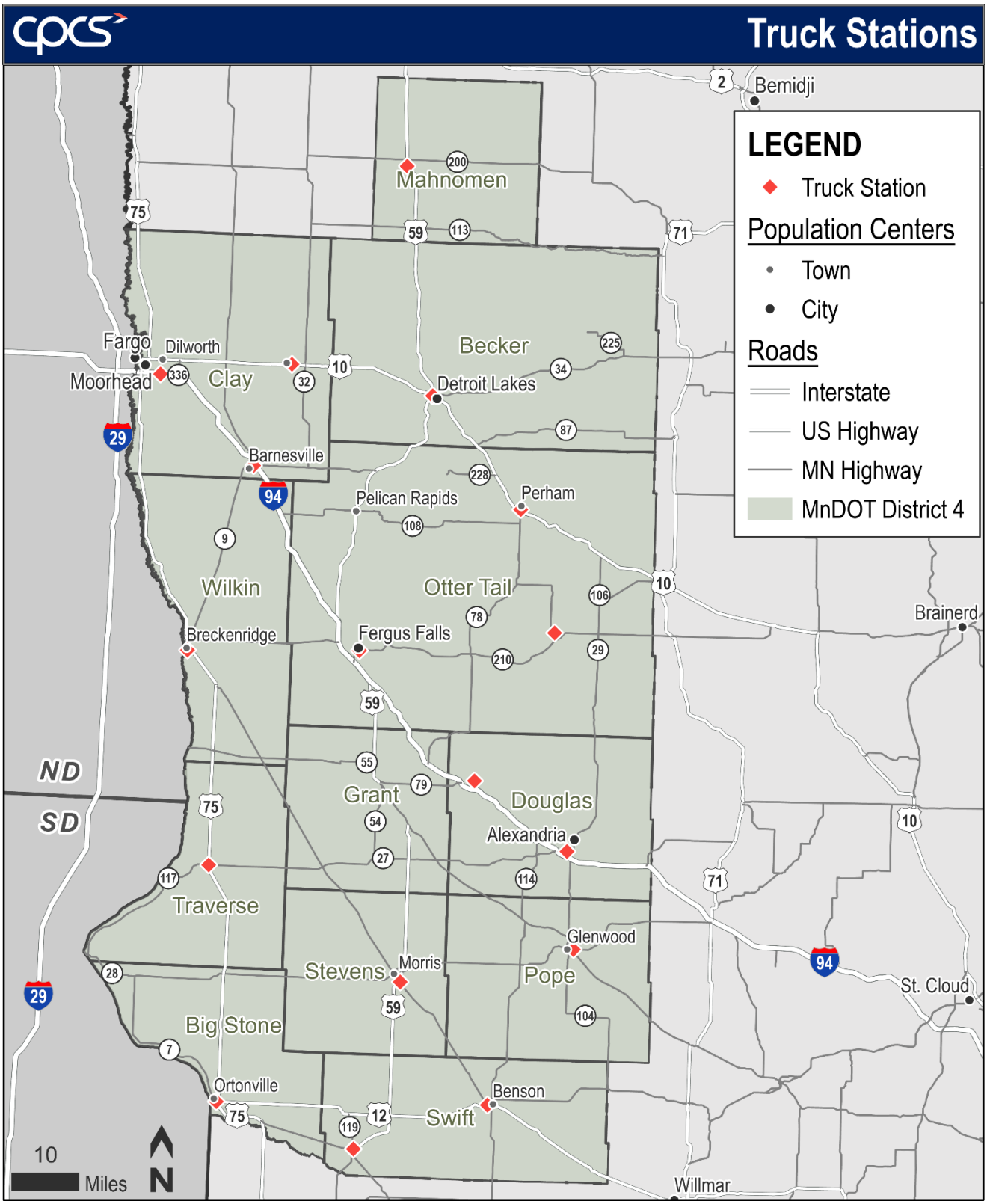
The sizes of truck stations vary based on the number of snowplows assigned to them. MnDOT District 4 allocates snowplows to truck stations at the beginning of the winter season, and they park where they are assigned unless in the event of a weather emergency. The District has 61 snowplow routes. Other equipment assigned to District 4 truck stations include three motor graders, four truck-mounted snow blowers, and several tractor-mounted snow blowers.

In 2020, District 4 plowed over 3,590 lane miles of snow and ice, accounting for 12 percent of the state's total snow and ice lane miles removed. Blown snow also creates snowdrifts of up to 10 feet high on some roads. District 4 has 33 miles of temporary and permanent snow fences to mitigate snowdrifts at critical locations.[23]

In addition to MnDOT District 4's work, local counties, municipalities, and private companies operate their own maintenance and plowing programs for their respective transportation assets.

[22] MnDOT, Minnesota Bridges, 2019: https://www.dot.state.mn.us/bridge/pdf/minnesotabridges-2019-report.pdf
[23] MnDOT District 4 Fact Sheet, 2020.

Figure 38: Truck Stations in District 4



Source: CPCS analysis on MnDOT Data, 2021.

2.3 Railroad Network

Minnesota has the eighth-highest number of rail miles in the US, and rail freight accounts for nearly 25 percent of all freight tonnage moved in the state.[24] Rail freight in District 4 primarily serves agricultural and manufacturing industry businesses that rely on relatively lower costs of carrying bulk products by trains. Two Class I railroads and three Class III (short line) railroads operate over 668 miles of track in District 4. There are 619 highway-rail grade crossings in the District, of which only 33 percent are signalized.[25]

668	14.5%	206	413	2	3
Miles of Track	of the State's Total Track Miles	Actively-Protected Public Crossings	Passively-Protected Public Crossings	Class I Rail Operators	Short Line Railroad

Burlington Northern Santa Fe (BNSF) and Canadian Pacific (CP) are the two Class I railroads that own trackage and operate in District 4. Otter Tail Valley Railroad (OTVR) is a short line operating in the District, connecting agricultural and mining industry businesses between Fergus Falls and Moorhead to the BNSF's Staples and Moorhead subdivisions. Twin Cities & Western (TCWR) and Red River Valley & Western (RRVW) railroads also operate on short segments within the District.

Figure 39 summarizes information on railroad trackage and the number of public at-grade crossings in District 4. Figure 40 shows the location of rail lines by operator, and Figure 41 displays the train volumes and speed limits on each line. RRVW's trackage is limited to 2 miles on the extreme edge of the district, and thus not visible. BNSF railroad ranks first in the District both in terms of the total number of miles operated and the number of public at-grade crossings, followed by CP and Otter Tail Valley railroads.

Figure 39: Freight Railroad System of the District

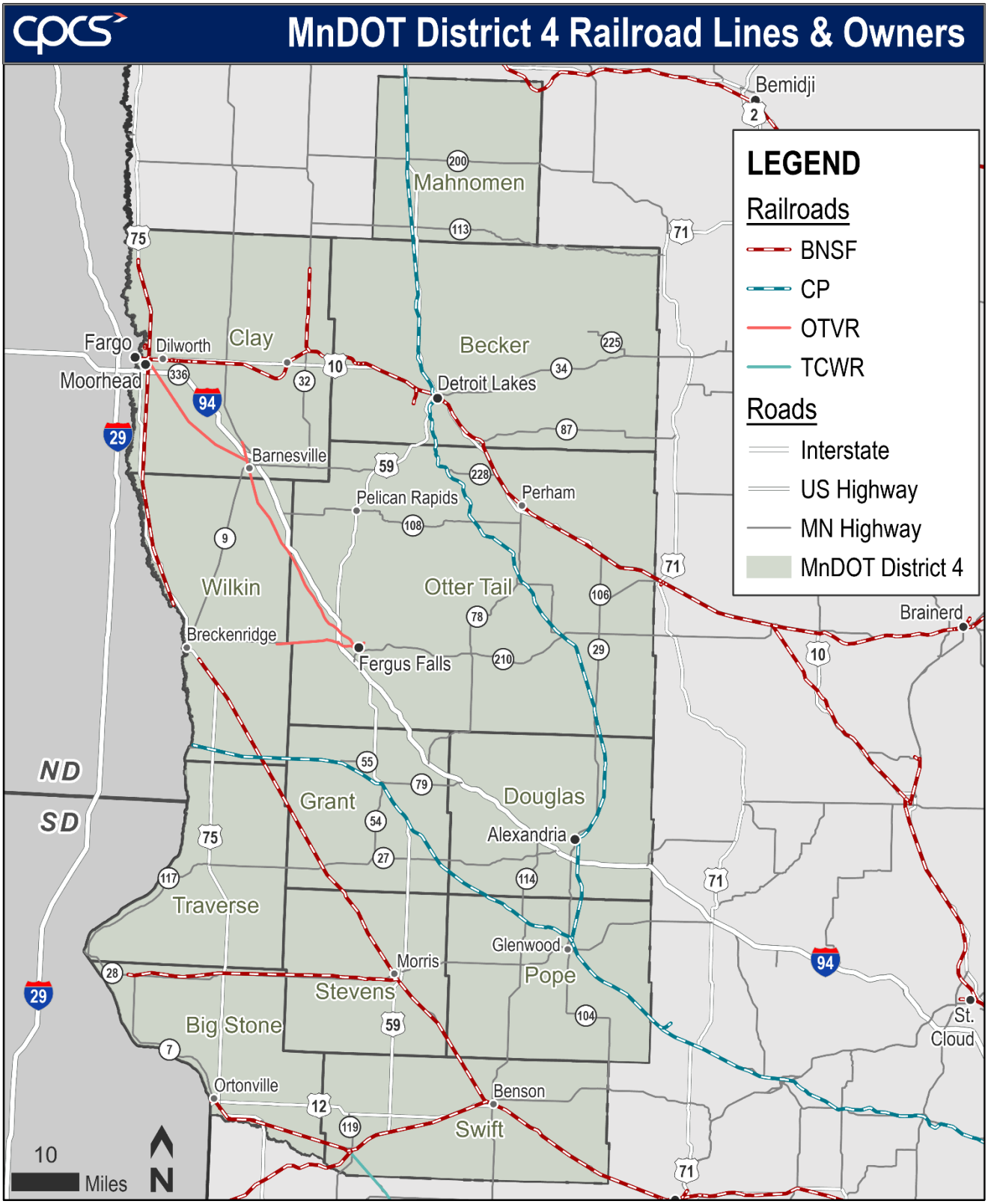
Railroad	System Miles in District 4	Public At-Grade Crossings
BNSF	359	358
CP	223	216
Otter Tail Valley Railroad	71	93
Twin Cities & Western Railroad	4.8	7
Red River Valley & Western	2.3	4

Source: Minnesota State Rail Plan, 2015; FRA Grade Crossing Safety Data, 2021; National Transportation Atlas Database, 2021.

According to FAF 5, more than 137 million tons of cargo were carried by rail to or from the state in 2017. The statewide rail freight tonnage is anticipated to grow by 83 percent to more than 460 million tons by 2040, with 90 percent of the cargo carried in carloads, and 10 percent carried in intermodal containers.[26]

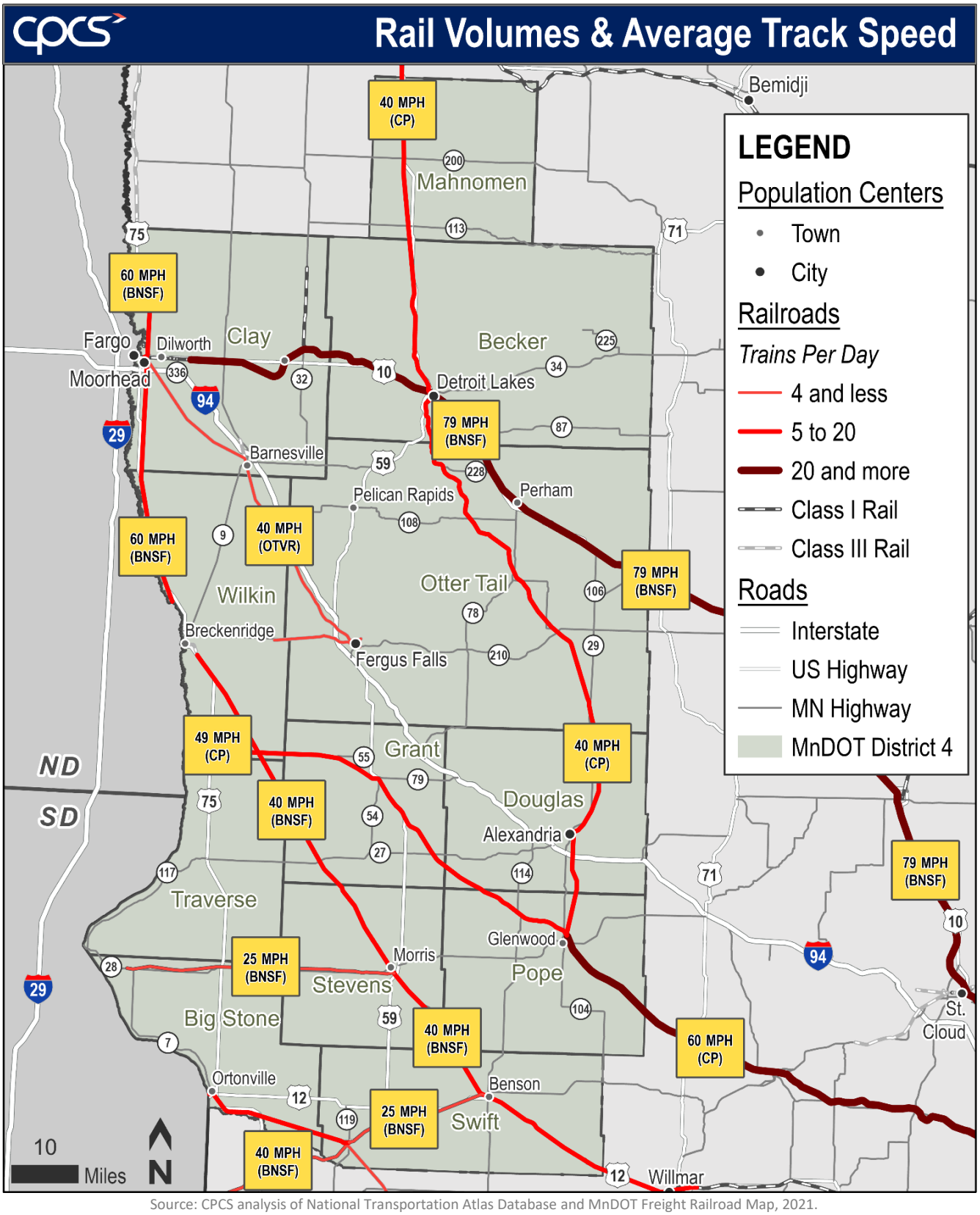
[24] MnDOT, State Rail Plan, 2015.
[25] MnDOT District 4 Fact Sheet, 2020.
[26] MnDOT "Minnesota State Rail Plan" (2015). http://www.dot.state.mn.us/planning/railplan/resources.html

Figure 40: MnDOT District 4 Railroad Lines and Owners



Source: CPCS analysis of National Transportation Atlas Database, 2021.

Figure 41: District 4 Rail Volumes and Average Track Speeds



Source: CPCS analysis of National Transportation Atlas Database and MnDOT Freight Railroad Map, 2021.

The use of Minnesota's freight rail system has changed over time and is expected to continue changing in the future. Figure 42 lists the major commodities carried by rail in Minnesota. In 2017, cereal grains, metallic ores, and natural sands held the highest shares of the total tonnage carried by rail in the state. Compared to the top commodities carried by rail in 2012, the top three commodities transported by rail remain the same. Natural sand production share of tonnage increased and became one of the top four commodities by volume in Minnesota.

Figure 42: Major Commodities Carried by Rail in Minnesota, 2017

Top Commodities	Tonnage	Percent
Cereal Grains	34,267,550	25.0%
Metallic Ores	27,657,970	20.2%
Coal	13,116,550	9.6%
Natural Sands	12,683,130	9.3%
Other Agriculture Products	5,981,669	4.4%
Fertilizers	5,816,964	4.2%
Fuel Oils	5,544,231	4.0%
Wood Products	5,511,333	4.0%
Animal Feed	4,048,598	3.0%
Crude Petroleum	3,851,534	2.8%
Other Foodstuffs	3,163,464	2.3%
Nonmetallic Minerals	3,106,955	2.3%
Newsprint/paper	2,303,553	1.7%
Basic Chemicals	2,041,154	1.5%
All Other	7,933,299	5.8%
Total	102,760,404	100%

Source: Freight Analysis Framework 5, 2021.

Key Corridors, Structures, and Facilities

BNSF Railway

The BNSF railway operates on 1,584 miles of track in Minnesota and 359 miles of track within the District. BNSF has the highest number of track miles owned and operated in the state and primarily carries agricultural commodities, coal, ore, and intermodal cargo. Figure 43 shows the number of trains per day and average speed of trains on BNSF tracks in the District.

As shown, BNSF trains operate on several segments within the District, with the highest speed and volume running on the lines between Wadena and Dilworth and lowest speed and daily volume along the Benson to Appleton and Morris to Beardsley segments.

Figure 43: BNSF Railway Operations in District 4

Railway Segment	Trains Per Day	Maximum Speed (MPH)
From Wilmar to Breckenridge	2 to 20	40
From Benson to Appleton	4 or less	25
From Appleton to Ortonville	5 to 20	40
From Morris to Beardsley	4 or less	25
From Breckenridge to Moorhead	5 to 20	60
From Wadena to Dilworth	20 or more	79

Source: CPCS analysis of Minnesota Freight Railroad Map developed by Office of Freight and Commercial Vehicle Operations, 2021.

MnDOT is currently working with the City of Moorhead and BNSF to construct an underpass to remove US-10/MN-75's grade crossing from the BNSF rail line. The project is currently in the environmental impact assessment phase and is expected to improve safety and mobility by separating heavy road and rail traffic. The City also has another grade separation project on SE Main Ave/20 St/21 St crossing with BNSF and OTVR lines. The project realigns the SE Main Ave/20 St/21 St intersection to pass under new rail bridges that will carry the BNSF and OTVR rail tracks and is expected to address safety and congestion concerns at this location, especially due to trains blocking emergency responders. Additionally, a new track will be constructed as part of this project that will enable direct train movements, eliminating the currently existing delays due to trains backing to change direction.[27]

CP Railway

The CP Railway operates on 1,179 miles of track in Minnesota and 223 miles of track in District 4. CP's line runs on an east-west segment parallel with US-55, from Brooten in Pope County to the North Dakota border west of Tenney. A south-north segment of the CP line runs from Glenwood in Pope County towards the US-Canada border crossing in Noyes. Figure 44 shows the CP rail segments, number of trains, and maximum train speeds.

Figure 44: CP Railway Operations in District 4

Railway Segment	Trains Per Day	Maximum Speed (MPH)
From Brooten to Glenwood	20 or more	60
From Glenwood to west of Tenney	5 to 20	49
From Glenwood to Noyes	5 to 20	40

Source: CPCS analysis of Minnesota Freight Railroad Map developed by Office of Freight and Commercial Vehicle Operations, 2021.

CP trains in Minnesota carry a variety of commodity groups, including intermodal containers (47%), grain (27%), fuels, chemicals, and plastic (16%), metals and minerals (8.6%), fertilizer, sulfur, and other products (<2%).[28]

Short Lines

Short lines are railroads that serve the local or regional freight demands. Three short lines operate on over 78 miles of track (10% of the State's total short line mileage[29]) in District 4, and Figure 45 provides an overview of their operations.

[27] City of Moorhead Website, Current & Future Projects, accessed May 2021: http://www.cityofmoorhead.com/departments/engineering/current-projects
[28] CP Railway, State Profile: Minnesota, 2018.
[29] Excluding trackage rights.

Figure 45: Short Lines Operating in District 4

Short Line Railroads	Mileage	Area Served	Class I Rail Connection	Commodities
Otter Tail Valley (OTVR)	71	Between Fergus Falls and Moorhead	BNSF	Agricultural products, chemicals and plastics, coal and coke, and minerals and stone mining
Twin Cities & Western Railroad (TCWR)	4.8	Appleton in Swift County	BNSF	Grains, sugar, sugarbeet pulp, lumber, canned & frozen vegetables, clay, fertilizers, coal, crushed rock, agricultural machinery
Red River Valley & Western (RRVW)	2.3	Breckenridge in Wilkin County	BNSF	Grain, sugar, corn syrup, fertilizer, coal, gravel, animal feed products, lumber, steel, other agricultural and food manufacturing products

Source: CPCS analysis of information provided on short line websites, accessed May 2021.

OTVR is owned by Genesee & Wyoming and operates on tracks in District 4 between Fergus Falls, Barnesville, and Moorhead. For almost its entire length, the OTVR line runs parallel to I-94 and serves the area's businesses in agricultural, chemicals and plastics, coal and coke, and mineral and stone mining sectors. OTVR connects with BNSF's Moorhead and Staples subdivisions at the Dilworth terminal.

TCWR owns and operates on tracks between Hopkins west of Minneapolis and Appleton in Swift County, at which point connects to BNSF's Appleton subdivision. TCWR has trackage rights to operate on BNSF's line between Appleton and Milbank, South Dakota. TCWR trains primarily carry grains, sugar, sugarbeet pulp, lumber, canned and frozen vegetables, clay, fertilizers, coal, crushed rock, and agricultural machinery.[30]

RRVW is an independently-owned railroad operating in Minnesota, North Dakota, and South Dakota. RRVW trains carry grain, sugar, corn syrup, fertilizer, coal, gravel, animal feed products, lumber, steel, and other agricultural and food manufacturing products.

A review of previous rail-related studies shows that in District 4 and even across Minnesota, short lines continue to face challenges associated with infrastructure conditions. Compared to Class I railroads, short line tracks are often less robust, with lower-grade tie and ballast conditions. These conditions may restrict their operations to lighter-weight trains.[31] Being unable to accommodate modern rolling stock or heavier rail cars (such as increasingly-common 286,000-pound capacity cars) means that the short lines would not be able to carry certain commodities that require transportation in specific rail cars. The competitive position of some carriers, therefore, becomes significantly undermined.

Such rail track-related issues are even considered in the existing trackage rights agreements within the District. As a result, smaller railroads, such as TCWR, sometimes have to rely on connecting carriers to serve the market needs of their own customers, which could sometimes create service delays and reliability issues.

At-Grade Rail Crossings

Road-rail grade crossings are conflict points between rail and automobile, pedestrian, or cyclist traffic that can create safety issues and delays for all transportation system users. Figure 46 lists the types and number of crossings in District 4 by county. Over 66 percent of the grade crossings in the District are on public roads. These

[30] UP Website, Twin Cities & Western Railroad Company TCWR #768, accessed May 2021. https://www.up.com/customers/shortline/profiles_t-z/tcw/index.htm

[31] MnDOT, Minnesota State Rail Plan, 2015.

crossings should be equipped with safety devices as standardized in the USDOT's Manual on Uniform Traffic Control Devices (MUTCD).

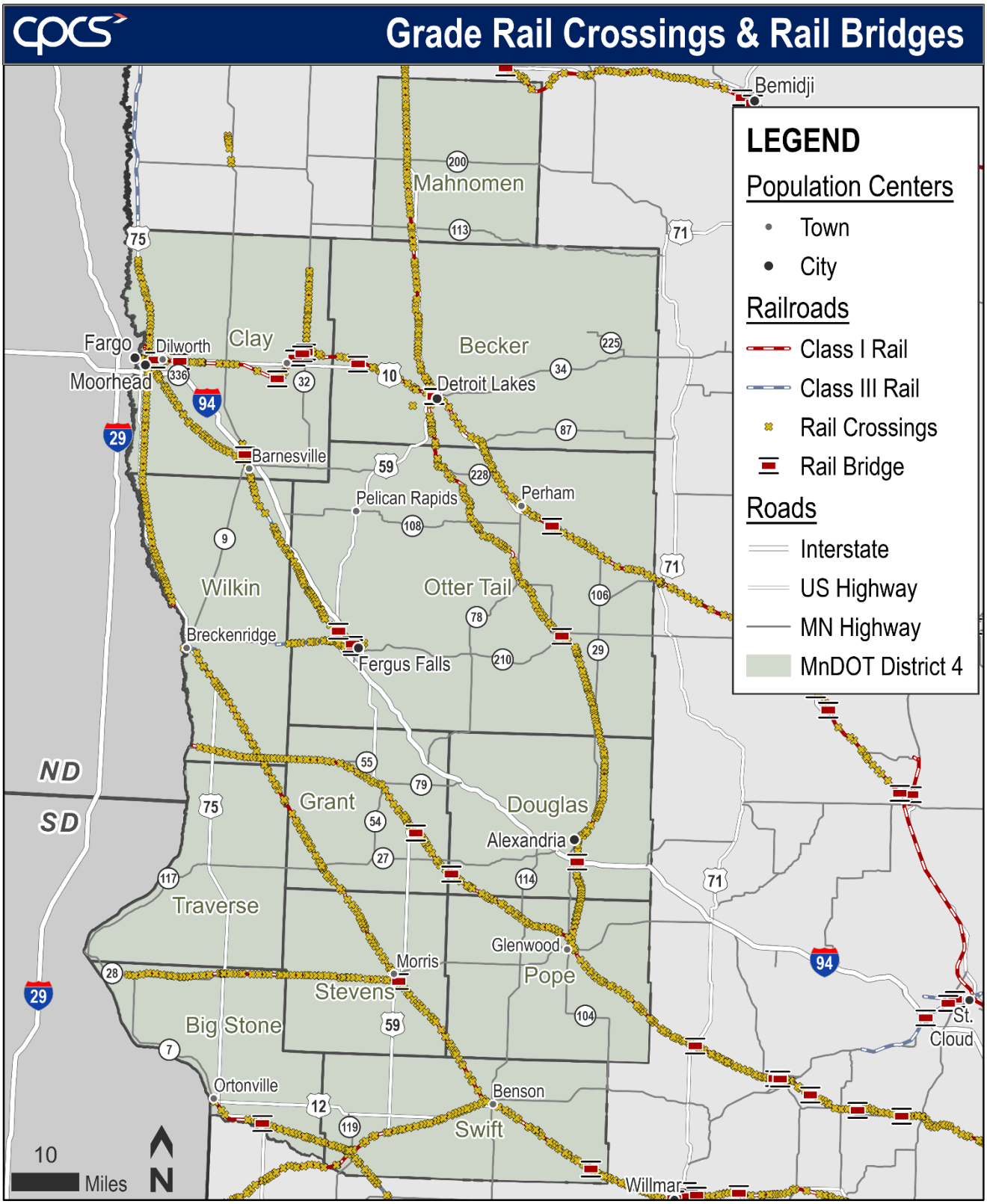
Actively-controlled crossings are equipped with active safety devices such as gates, flashing lights, or bells, while passively-controlled crossings are only protected by passive safety devices such as stop signs, pavement markings, or crossbucks. Actively-controlled crossings are often also equipped with passive devices such as signs and pavement markings to enhance the effectiveness of active devices. Nearly all (99%) of the public grade crossings in District 4 have some type of passive safety device. However, only about 30 percent of public crossings are actively controlled. Figure 47 shows the locations of grade crossings in District 4.

Figure 46: Public Grade Crossings in District 4

County	Public Crossing with Active Devices	Public Crossing with Passive Devices	Total Public Crossings	Private Crossings
Becker	21	53	54	33
Big Stone	1	45	45	13
Clay	31	139	141	38
Douglas	20	36	36	24
Grant	16	47	47	21
Mahnomen	6	21	21	6
Otter Tail	42	120	121	94
Pope	12	35	35	34
Stevens	11	39	39	24
Swift	16	61	61	32
Traverse	1	9	9	1
Wilkin	14	69	69	22
Total	**191**	**674**	**678**	**342**

Source: Federal Railroad Administration Crossing Inventory, 2021.

Figure 47: District 4 Rail Crossings and Bridges



Source: CPCS analysis of Federal Railroad Administration Data, 2021.

Rail Transload Facilities

Rail-served intermodal terminals in Minnesota are primarily clustered in or near the Twin Cities. However, District 4 has several rail transloading terminals and yards as well as rail-served grain shuttles, as listed in Figure 48. These facilities connect rail with other modes (road and grain elevator) and are primarily located along the BNSF Staples corridor from Wadena to Dilworth and CP's line between Glenwood and Mahnomen. Figure 49 displays these locations throughout the District.

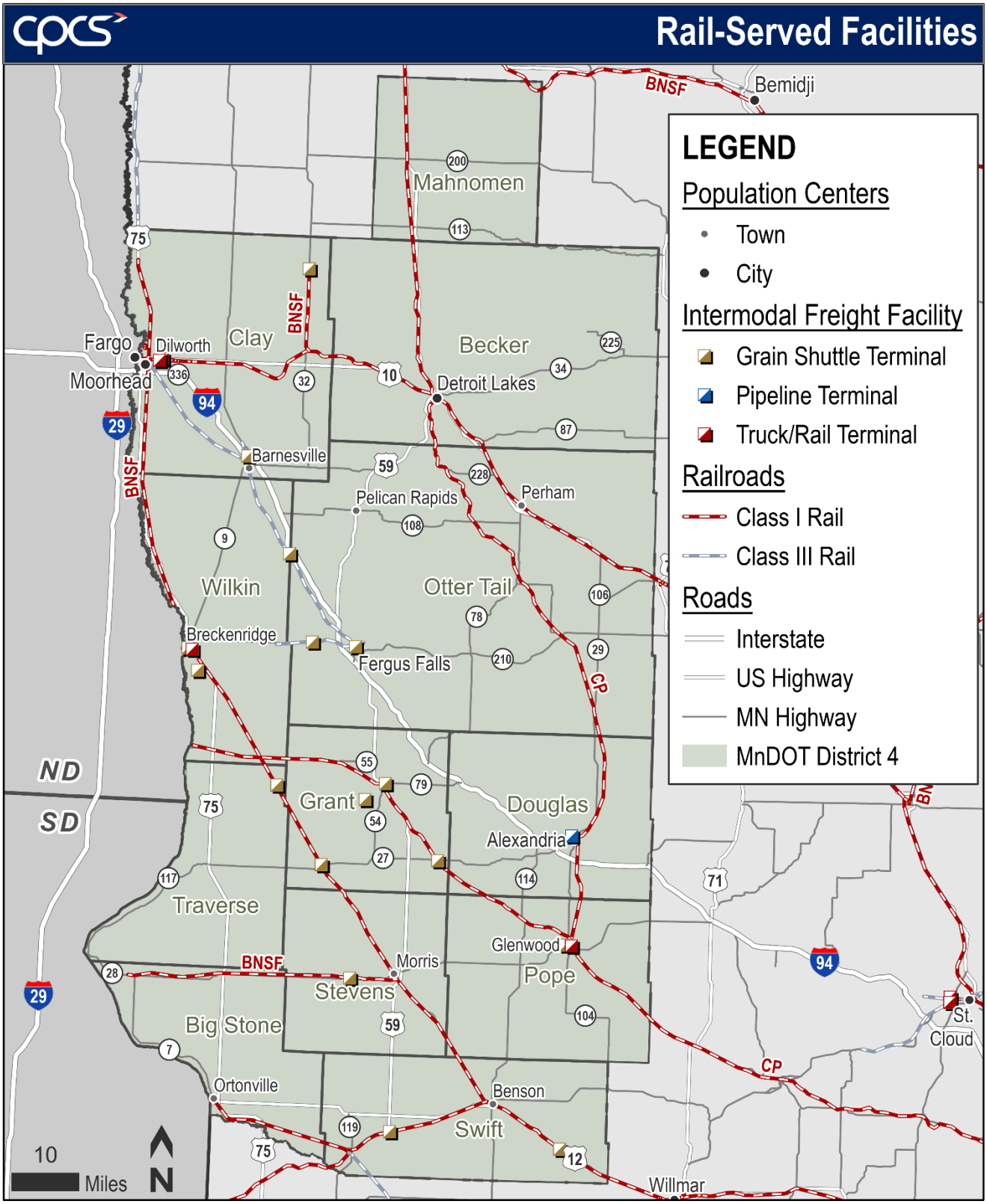
Figure 48: District 4's Rail Terminals and Yards

Facility Name	City	Facility Type	Commodity	Railway
Agassiz Valley Grain, LLC	Barnesville	Grain Shuttle Terminal	Wheat, soybeans, corn	OTVR
BNSF Dilworth Auto Reload - Arnies Unloading	Dilworth	Truck/Rail Terminal	Auto Reload (GM, Chrysler)	BNSF
Cargill, Inc.	Alberta	Grain Shuttle Terminal	Corn, soybeans, wheat	BNSF
Elbow Lake Co-op Grain	Elbow Lake	Grain Shuttle Terminal	Corn, wheat, soybeans	CP
Erskine Grain Terminal LLC	Erskine	Grain Shuttle Terminal	Soybeans, wheat	BNSF
Farmers Elevator	Fergus Falls	Grain Shuttle Terminal	Corn, soybeans, wheat	OTVR
Glacial Plains Cooperative	Murdock	Grain Shuttle Terminal	Corn, soybeans, oats	BNSF
Hoffman Co-op Grain Assn.	Hoffman	Grain Shuttle Terminal	Corn, soybeans, wheat	CP
Magellan Pipeline	Alexandria	Pipeline Terminal	Oil Products	None
Minn-Kota Ag Products	Breckenridge	Grain Shuttle Terminal	Soybeans, Corn, Wheat	RRVW
New Horizons Ag Service	Herman	Grain Shuttle Terminal	Corn, soybeans, wheat	BNSF
New Horizons Ag Service	Fergus Falls	Grain Shuttle Terminal	Corn, soybeans, wheat	OTVR
Prairie Lakes Co-op	Glenwood	Grain Shuttle Terminal	Corn, soybeans, wheat, oats	CP
Red River Grain Company	Breckenridge	Grain Shuttle Terminal	Wheat, soybeans, corn	RRVW
Rothsay Farmers Co-op	Rothsay	Grain Shuttle Terminal	Wheat, oats, corn	OTVR
West Central Ag Services	Ulen	Grain Shuttle Terminal	Corn, soybeans, wheat	BNSF
Western Consolidated Co-op	Holloway	Grain Shuttle Terminal	Corn, oats, soybeans	BNSF
Wheaton-Dumont Co-op	Tenney	Grain Shuttle Terminal	Wheat, corn, soybeans	CP
Breckenridge	Breckenridge	Rail Yard	Intermodal	RRVW
Dilworth	Dilworth	Rail Yard	Intermodal	BNSF
Glenwood	Glenwood	Rail Yard	Intermodal	CP

Source: CPCS analysis of Minnesota Intermodal Freight Facility Dataset and Minnesota State Rail Plan, 2021.

*Note: Facilities classified as "Grain Elevators" instead of "Grain Shuttle Terminals" were identified by scans of Google Earth and Google Maps imagery, and information about their classification as shuttle facilities was unavailable.

Figure 49: District 4 Rail-Served Facilities



Source: CPCS analysis of National Transportation Atlas Database, 2021.

2.4 Air Cargo Network

Freight shipping by air accounts for a small portion of the freight carried by other modes. However, air freight is still important to the economy as the cargo carried by air is typical of high value. Also, air cargo usually has a relatively lower weight and is highly time-sensitive. As Figure 50 shows, precision instruments, plastics/rubber, electronics, and valuable machinery are the top air-carried commodities in Minnesota.

Figure 50: Top Air Commodities in Minnesota, 2017

Top Commodities	Tonnage	Percent
Precision Instruments	85,782	32.6%
Plastics/rubber	29,166	11.1%
Electronics	26,329	10.0%
Machinery	19,119	7.3%
Nonmetal Mineral Products	17,674	6.7%
Textiles/leather	16,112	6.1%
Chemical Products	11,310	4.3%
Mixed Freight	6,543	2.5%
Articles-base Metal	5,833	2.2%
Basic Chemicals	5,629	2.1%
All Other	39,976	15.2%
Total	263,473	100%

Source: Freight Analysis Framework 5, 2021.

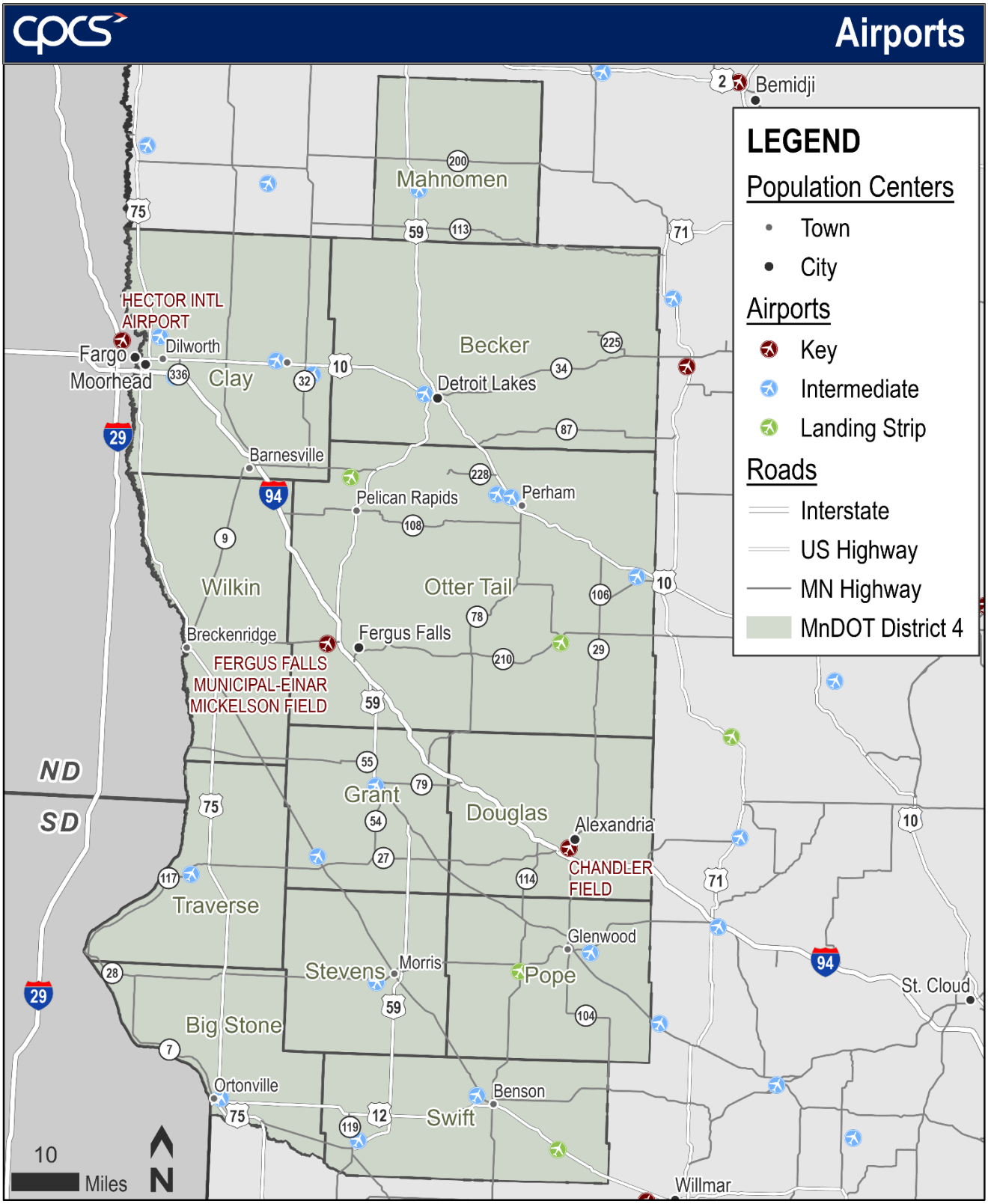
Figure 51 shows the District's commercial airports. The two key regional airports providing commercial service in District 4 are Muni-Einar Mickelson Field in Fergus Falls and Chandler Field in Alexandria. In addition to these facilities, 16 intermediate airports[32] and four landing strips are scattered across the District. Minneapolis-St. Paul International Airport (MSP) is the closest major international airport to the District and is among the busiest commercial airports in the US.

Additionally, the Hector International Airport (FAR) in Fargo, ND, is adjacent to the District just across the North Dakota border. FedEx initiated air cargo hub service in 2016, while UPS started their service in FAR in 2018. As a result, the air cargo traffic increased by 3.67 million pounds or 87.4 percent between 2016 and 2020.[33]

[32] According to MnDOT's State Aviation System Plan 2012, intermediate airports serves "as landing facilities for flight training, aircraft maintenance, and general aviation aircraft up to the smaller business jet size."

[33] Hector International Airport December 2020 & Year-End Statistics. https://fargoairport.com/december-year-end-2020-monthly-statistics/ Accessed on 5/20/2021.

Figure 51: MnDOT District 4 Airports



Source: National Transportation Atlas Database, 2021.

2.5 Pipeline Network

Pipelines offer a high-volume, low-cost option for transporting large amounts of liquids and gases, making pipelines a key element of the transportation network for liquid fuels. Figure 52 summarizes major commodities that are transported via pipelines in Minnesota.

Figure 52: Major Commodities Carried through Minnesota's Pipeline, 2017

Commodity	Tonnage	Percent
Coal-n.e.c.	138,074,600	79.3%
Crude Petroleum	33,462,770	19.2%
Gasoline	1,662,230	1.0%
Fuel Oils	372,610	0.4%
Others	181,493	0.1%
Total	173,572,210	100%

Source: FAF 5

Minnesota has no petroleum or natural gas resources and primarily imports crude oil, natural gas, and other petroleum products. Minnesota has two oil refineries that process crude coming from Canada and North Dakota via pipeline and rail. Both of these refineries are located near the Twin Cities metro area.

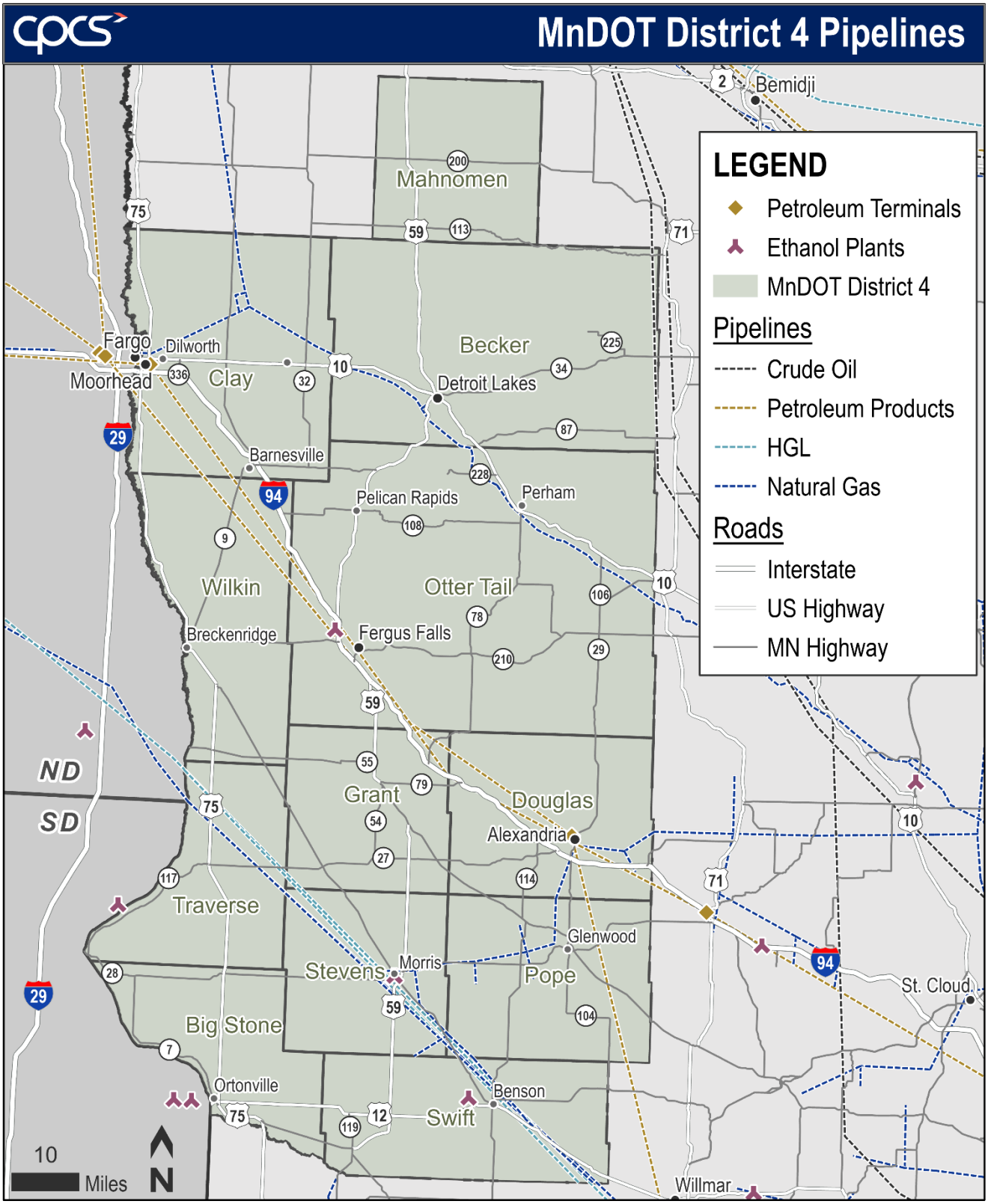
In District 4, there are 646 miles of active pipeline, most of which are dedicated to carrying natural gas and petroleum products. Figure 53 summarizes the pipeline coverage, by type, within the District and Figure 54 illustrates the pipeline network in District 4.

Figure 53: District 4 Pipeline Coverage

Commodity	Length (Miles)	Percent of Total
Crude Oil	25	3.9%
Hydrocarbon Gas Liquids (HGL)	84	13.0%
Natural Gas	298	46.1%
Petroleum Products	239	36.9%

Source: US EIA, 2020.

Figure 54: MnDOT District 4 Pipelines



Source: CPCS analysis of EIA data, 2021.

3 District 4 Freight System Condition and Performance

Key Findings:

This chapter provides analysis of key system condition and performance monitoring areas identified in the Statewide Freight Plan, which are safety, system condition, and mobility. In terms of freight safety performance, review of District 4 roadway crashes between 2010 and 2019 reveals that truck crashes are primarily clustered along major highways and in high-population areas such as such as I-94, US-10, and US-59. During the same period, a total of 55 incidents occurred at public highway-rail grade crossings in the District.

District 4's highways and corridors do not experience significant truck mobility issues such as peak-time congestion. However, peak-hour congestion does create issues for trucks and personal vehicles at intersections and interchanges across the District.

In terms of infrastructure condition, pavement surfaces of almost all major highways in the District are in fair or good condition, meaning that majority of road users experience a smooth drive. Bridge infrastructure deficiency is an issue at 68 structures across District 4, with over half of the deficient bridges located on the county road system. Bridge condition on the trunk highways is relatively better, which is critical to the efficiency and safety of the freight movements in the District.

3.1 Linking System Evaluation to Statewide Goals

The Minnesota Statewide Freight System and Investment Plan establishes goals for investments in the multimodal freight system. To support these goals, key system condition and performance monitoring areas are identified in the statewide plan as follows:

- **Safety.** To assess and ensure the safety, security, and resilience of the freight system.
- **Infrastructure Condition.** To assess and ensure the suitability of the transportation system for handling freight.
- **Mobility.** To assess and minimize transportation system delay, congestion and improve reliability for freight users.

These areas served as the starting point for the data analysis presented in this chapter. This chapter uses data that is readily available at the state and federal levels and, where available, builds on other relevant studies that have been conducted by MnDOT.

Minnesota Statewide Freight Goals

The Minnesota Statewide Freight System and Investment Plan identified five goals to reflect those aspects of the multimodal freight system viewed as most important to the public and private sector freight stakeholders in the state:

- Support Minnesota's Economy;
- Improve Minnesota's Mobility;
- Preserve Minnesota's Infrastructure;
- Safeguard Minnesotans; and
- Protect Minnesota's Environment and Communities.

3.2 Safety

Ensuring the safe performance of the transportation system is one of MnDOT's most critical missions. The 2020-2024 Strategic Highway Safety Plan also sets road safety improvement targets to guide statewide as well as county and local government-level system planning and investment. Transportation safety incidents and crashes result in physical harm (injuries and fatalities), property damage costs (damaged vehicles and cargo), social impacts (loss of productivity), and negative impacts on the performance of the transportation system

(delays, congestion). Minnesota's long-term traffic safety goal is to eliminate road crash-related deaths and injuries, but the state's 2025 target is less than 225 traffic-related deaths and 980 injuries.[34]

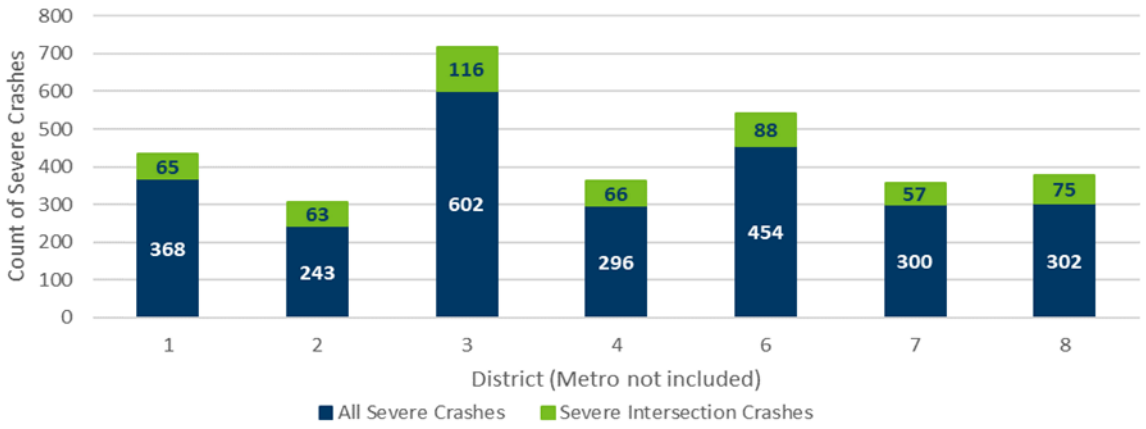
The assessment of District 4's freight network safety presented in this section focuses on the following four topics:

- **Previous roadway crashes:** analysis of the statewide road crash risk factors based on MnDOT's Investment Plan's "sustained crash location" measure;
- **Roadway crash risk factors:** analysis of the District-level road crash risk factors according to MnDOT's District Safety Plans for the state, which involves an assessment of crash risk factors;
- **Previous road-rail grade crossing incidents:** similar to roadway crashes, grade crossing safety assessment reflects MnDOT's Investment Plan "sustained crash location" measure; and
- **Road-rail grade crossing risk factors:** analysis of grade crossing safety risks based on MnDOT's assessment of the relative safety of public grade crossings in the state.

Road Safety

This section compares District 4's crash rates with other areas in Minnesota to understand road safety in the District and determine whether safety-related performance is relatively better or worse than other Districts. Figure 55 compares the number of crashes leading to injuries and fatalities across MnDOT Districts. As shown, between 2009 and 2013, District 4 ranks 6th in terms of the total injury and fatality (severe) crashes and 4th in terms of severe crashes occurring at roadway intersections.

Figure 55: Severe Crashes in Minnesota, 2009-2013

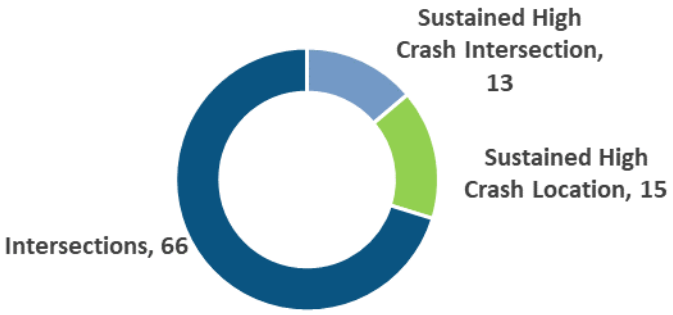


Source: District Safety Plans Update, 2016.
Metro District is not included due to its significantly higher traffic volumes and disproportionately higher number of crashes.

Figure 56 shows the distribution of severe crashes in District 4. As the figure shows, 13 intersections and 15 locations along the District's roadway network were identified as sustained high crash locations due to significantly higher number of crashes resulting in deaths or serious injuries. 10 of the high-crash intersections were in rural areas (775). Between 2009 and 2013, a total of 66 severe crashes occurred at intersections in District 4, the majority of which were right-angle (73%) and rear-end (20%) collisions.[35]

[34] MnDOT, 2020-2024 Strategic Highway Safety Plan, 2020. https://www.dot.state.mn.us/trafficeng/safety/shsp/mn-shsp-2020-24.pdf
[35] MnDOT, District Safety Plans Update, 2016.

Figure 56: District 4's Severe Crashes, 2009-2013



Source: District Safety Plans Update, 2016.

About 6% of severe intersection crashes, 6% of severe high-crash location crashes, and 12% of severe high-crash intersection crashes in the State have occurred in District 4.

For freight-specific safety analysis, crashes involving trucks have been isolated to determine if there are specific "hot spots" or high-density locations in terms of truck crashes. Figure 57 summarizes the number of crashes that involved trucks greater than 10,000 lbs. in District 4. Between 2010 and 2019, more than 2,600 truck-involved crashes happened in District 4, about 4 percent of which led to fatalities and serious injuries.

Figure 57: Number of Truck-Involved Crashes by Crash Severity, 2010-2019

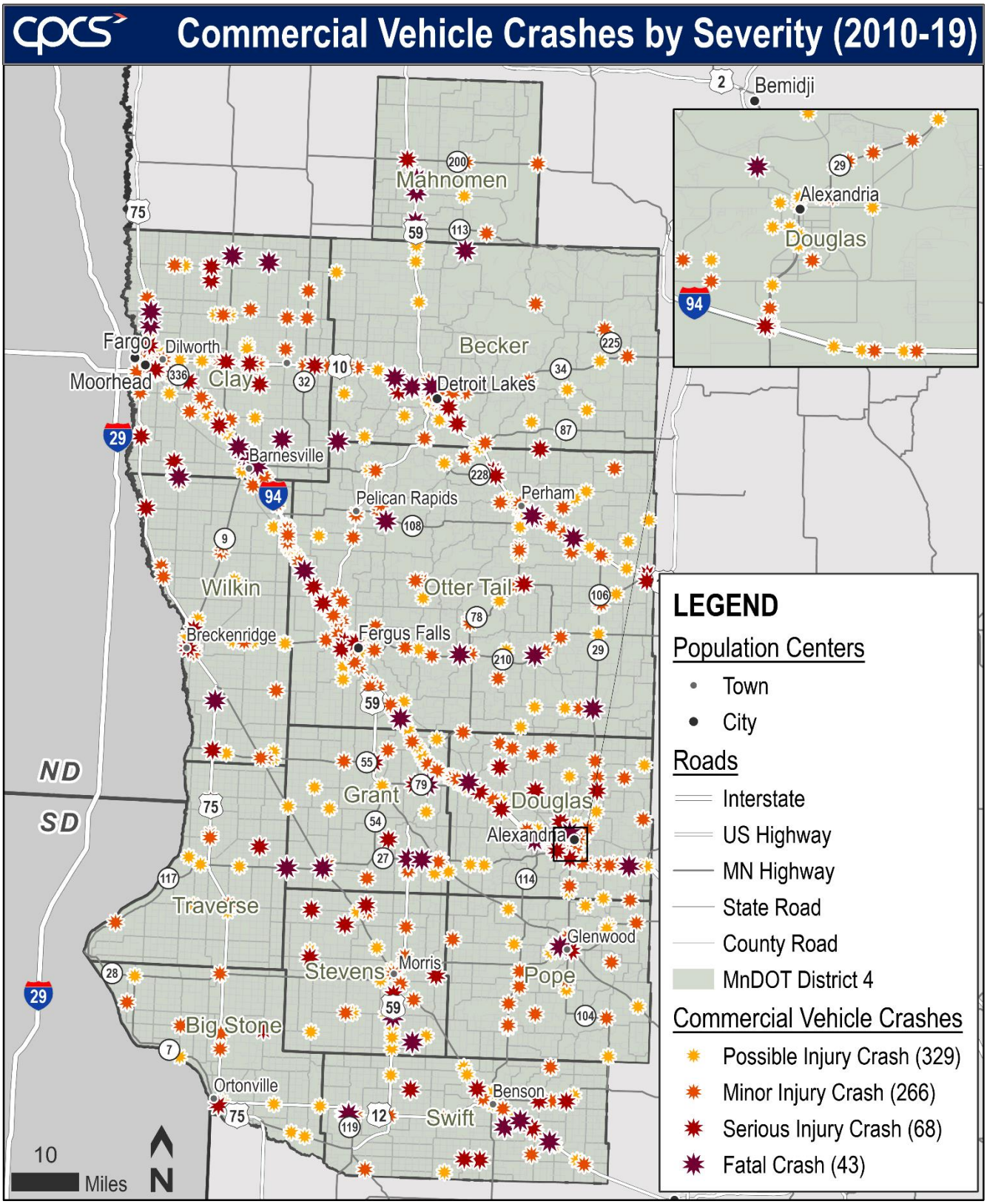
Crash Severity	Crash Count
Fatal	44
Serious Injury	69
Minor/Possible Injury	600
Property Damage Only	1,919
Unknown	2

Source: CPCS analysis of MnDOT crash data, 2021.

Figure 58 shows the distribution and severity of truck crashes in District 4 from 2010 to 2019. Commercial vehicle crashes are concentrated around high-volume traffic corridors and urban areas, such as I-94, US-10, and US-59. The high number of truck crashes along major highways in or near densely populated centers can be associated with the relatively higher overall traffic volumes and truck traffic volumes.

District 4 truck crashes are primarily clustered along major highways and in high-population areas.

Figure 58: Truck Crashes by Severity



Source: CPCS Analysis of MnDOT Truck Crash Data, 2021.

Fatal and serious injury crashes are primarily clustered along US-10 in Detroit Lakes, MN-29 in Alexandria, and MN-9 in Benson and Morris. The remainder of severe crashes are distributed across the District's major highways. This phenomenon is noted in MnDOT's District Safety Plans, as a statewide analysis found that approximately only 10 percent of severe crashes occur at high-crash locations while the rest happen at seemingly "random" locations.[36]

Crashes can be caused by a wide range of factors, including weather and visibility, pavement condition, time of day, driver behavior, vehicle maintenance, and geometric roadway design. While the majority of these factors are outside of the DOT's control, the design factor is strongly influenced by the DOT's planning and investment decisions. For instance, MnDOT uses crashes occurring at random locations as an indicator of infrastructure design issues and has adopted a risk factor-based approach to examining and investing in safety improvements at such locations.

MnDOT's risk-based approach supplements the traditional historic high-crash analysis method of identifying needed safety investments. A variety of risk factors inform the evaluation of crash risk for different types of roads and intersections, including 2-lane, 4-lane, and freeway segments and intersections for both rural and urban areas. Examples of the risk factors evaluated for road segments are shoulder width, median width, curve density, access point density, vehicle volume on mainline and intersecting roads. Meanwhile, factors such as speed limit, traffic control, skew and curvatures, and land use are used to evaluate intersection crash risk. Specific risk thresholds for each safety factor are created, and if a segment exceeded a threshold in a specific factor, it is awarded a star. Figure 59 provides an example of stars assigned to some of the high-risk urban intersections in District 4.

Figure 59: Example Risk Factor Tabulation

Route System	Route No.	Description	Speed Limit	Cross Product	Traffic Control	Major Corridor Speed	Skew	On/Near Curve	Primary Land Use	Severe RA Crash Density	Total Stars	Crash Cost
MN	29	CR46/ALEXANDRIA	45	★	★	★	★	★	★		★★★★★★	$2,034,600
MN	29	50TH AV M111/ALEXANDRIA	45	★	★	★	★	★	★		★★★★★★	$1,692,200
MN	29	22ND AV CSAH 23 MSAS 121/ALEX	45	★	★	★	★	★	★		★★★★★★	$1,427,200
US	10	21ST ST SRT 1ST AVN/MOORHEAD	45	★	★	★	★	★	★		★★★★★★	$1,114,800
US	10	30TH ST/MOORHEAD	45	★		★	★	★	★	★	★★★★★★	$1,098,600
US	10	E JCT TH 75/MOORHEAD	45	★	★	★	★	★	★		★★★★★★	$885,400
US	59	MAIN ST/DETROIT LAKES	40	★		★	★	★	★	★	★★★★★★	$631,000
MN	29	30TH AV MSAS 119/ALEXANDRIA	45	★	★	★	★	★	★		★★★★★★	$560,800
US	10	14TH ST MSAS 122/MOORHEAD	45	★	★	★	★	★	★		★★★★★★	$88,400
US	75	24TH AVE S/MOORHEAD	40	★	★	★			★	★	★★★★★	$11,749,800

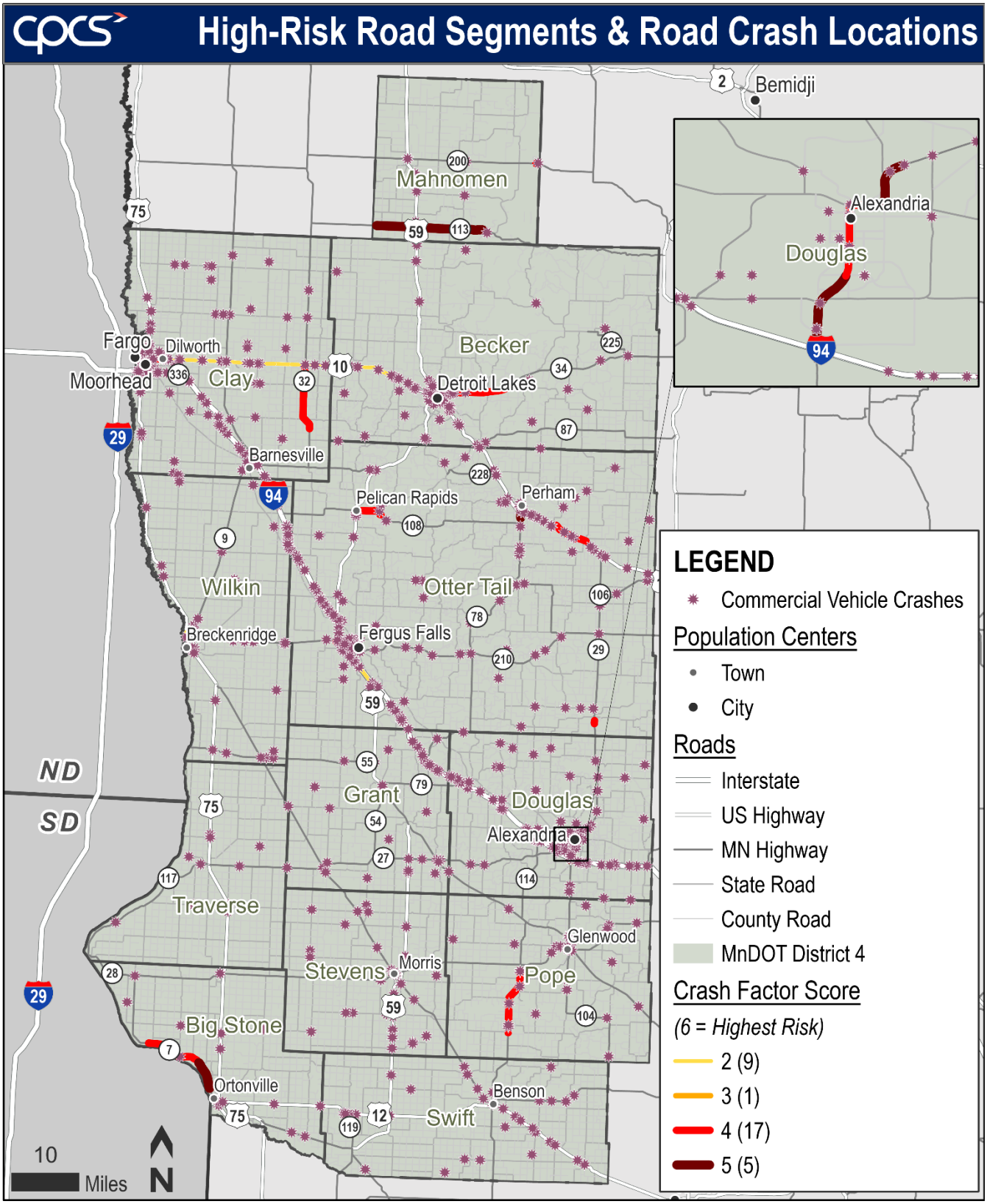
Source: MnDOT District Safety Plans, 2016.

Figure 60Figure 59 provides an illustration of the District 4 highways identified as high-risk, along with the locations of truck crashes. Key areas with a higher risk in the District are:

- MN-29 south and north of its interchange with I-94 in Alexandria
- MN-29 intersections with County Road 82 (3rd Ave.) in north Alexandria
- MN-7 between Ortonville and the route's intersection with MN-38
- MN-113 west of the intersection with County Road 37 in Round Lake Town
- MN-78 between Otter Tail and Perham

[36] MnDOT, District Safety Plans Update, 2016.

Figure 60: High-Risk Road Segments



Source: CPCS analysis of MnDOT District Safety Plan data, 2021.

A brief summary of the count of higher-risk network elements in District 4 and Minnesota as a whole is provided in Figure 61. As shown in the figure, the majority of District 4's severe crashes at roadway curves occurred at locations where potential projects were identified. However, only 45 percent of intersection severe crashes and 38 percent of road segment severe crashes in the District occurred at locations that were identified as high-risk.

Figure 61: Systemic High-Risk Locations in District 4 and Minnesota as a Whole (Metro District excluded)

	Intersections		Road Segments		Curves	
	Qualified Projects	% Severe Crashes at Qualified Locations	Qualified Projects	% Severe Crashes at Qualified Locations	Qualified Projects	% Severe Crashes at Qualified Locations
District 4	240	45%	65	38%	227	64%
Remainder of MN Total	1,208	57%	564	49%	1,357	64%
District 4 Share of MN Total	18%	-	10%	-	14%	-

Source: CPCS analysis of MnDOT District Safety Plan Update, 2021.

In order to better inform freight-related safety improvements, the District may wish to do a freight-specific risk factor analysis tailored to target truck-specific concerns, such as the need for shoulders, acceleration, deceleration, and turning lanes.

Grade Crossing Safety

Analysis of incidents at road-rail grade crossings provides insight into safety issues related to rail freight activity. Between 2010 and 2019, District 4 had a total of 55 incidents at public grade crossings, 11 of which were fatal, and 15 of which led to injuries. Figure 62 provides a breakdown between types of crossings and the severity of incidents. Passively-controlled crossings are crossings with signage such as stop signs, whereas actively-controlled crossing protection includes equipment such as gates, lights, and bells.

Figure 62: District 4 Public Grade Crossing Crashes, 2010-2019

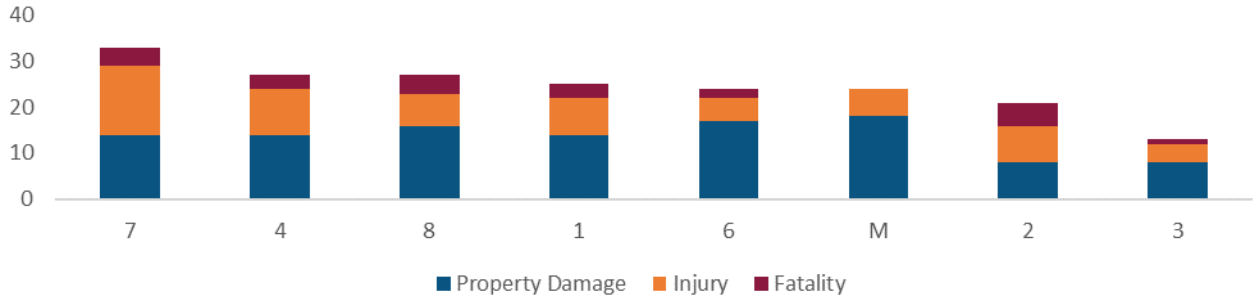
Crossing Type	Property Damage Only Crashes	Injury Crashes	Fatal Crashes	Total Crashes
Passively-controlled	14	10	3	27
Actively-controlled	15	5	8	28
Total	29	15	11	55

Source: CPCS analysis of MnDOT Rail Grade Crossing Safety Data, 2021.

Figure 63 and Figure 64 compare the grade crossing incidents across MnDOT districts. As shown, District 4 had an average crash rate compared to other MnDOT districts at both passively-controlled and actively-controlled public grade crossings. However, the number of fatal incidents at actively-controlled grade crossings was higher than all other MnDOT districts.

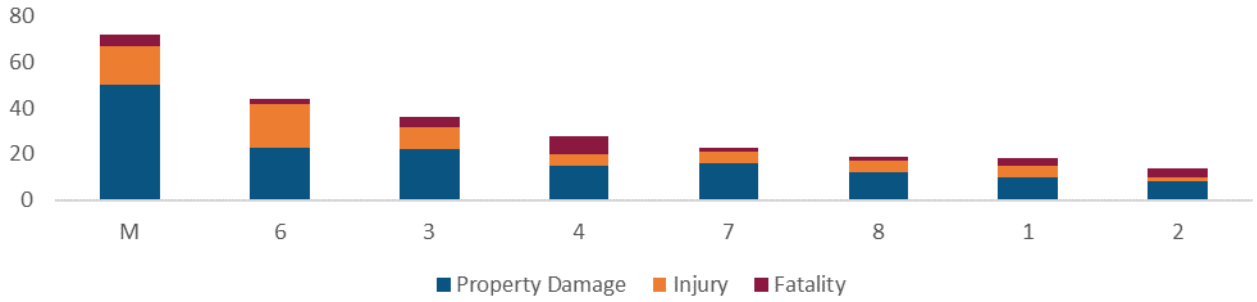
District 4's grade crossing crash rate was average compared to other Districts in Minnesota.

Figure 63: Crashes at Passively-Controlled Public Grade Crossings, 2004-2013



Source: CPCS analysis of MnDOT Rail Grade Crossing Safety Data, 2021.

Figure 64: Crashes at Actively-Controlled Public Grade Crossings, 2004-2013



Source: CPCS analysis of MnDOT Rail Grade Crossing Safety Data, 2021.

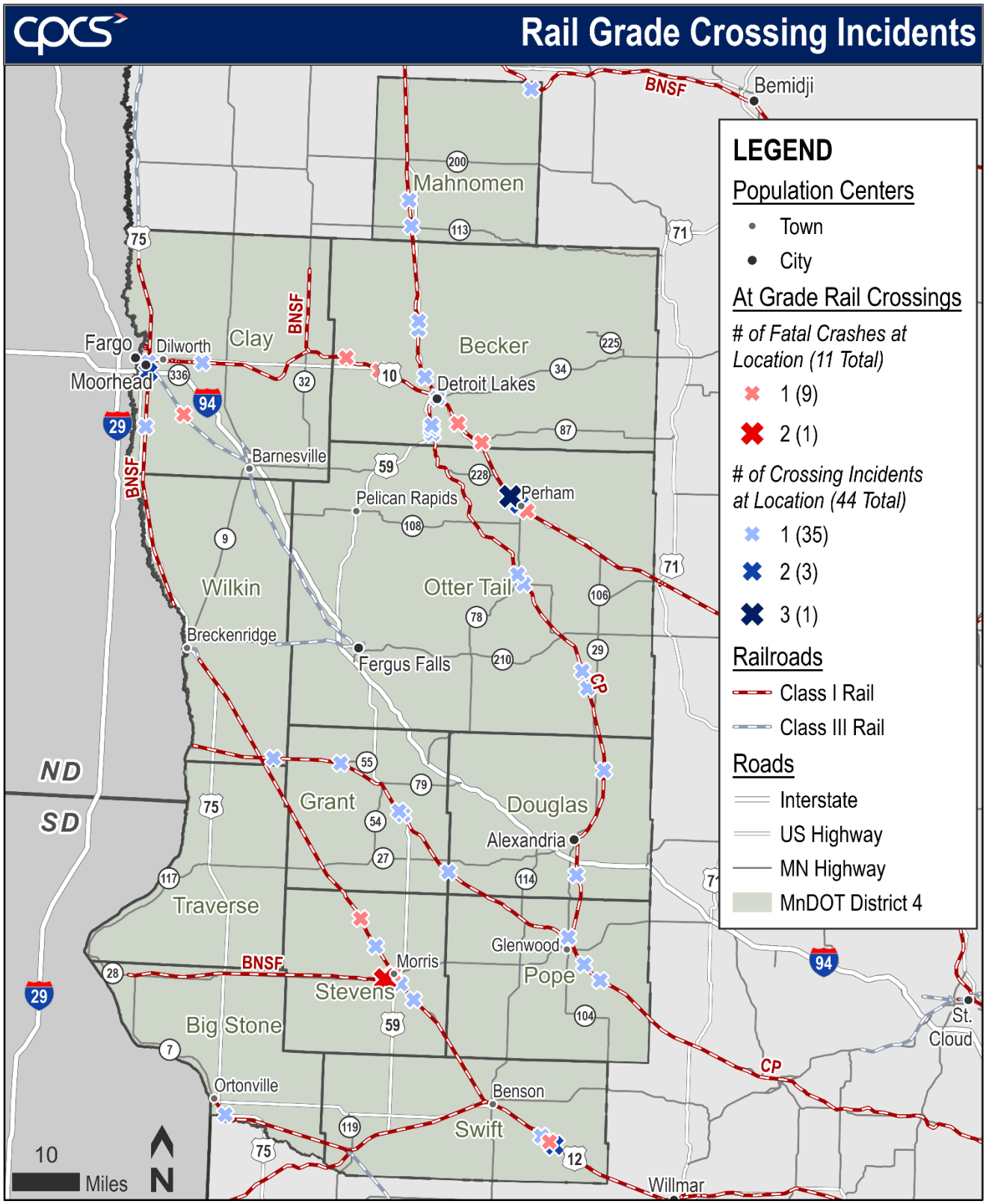
Figure 65 provides a map of public grade crossing incidents in District 4 between 2004 and 2013. The map was developed using rail crossing risk analysis data provided by MnDOT and previously used for their Rail Grade Crossing Safety Project Selection report (2016). Risk factors at passively-controlled and actively-controlled grade crossings are presented in Figure 66 and Figure 67. As the figures show, fatal and injury rail crossing incidents occurred at random locations in District 4. Due to this randomness, no specific rail safety pattern can be observed, but in general, crossing incidents appear to be concentrated on higher-volume rail lines, particularly BNSF's Morris subdivision between Wilmar and Moorhead.

MnDOT uses several factors to calculate rail crossing risk, including road and rail traffic at the crossing, speed limits, number of tracks, angle of crossing (or skew), sight distances, and distance to other rail crossings or road intersections. Based on each of these factors, a numbered risk rating between 0 and 9 is assigned to each crossing, with a risk rate of 8 or 9 indicating the highest level of safety hazard. According to MnDOT, safety issues at the rail crossings with ratings of 8 and 9 identified in the 2016 Safety Report have already been studied further and addressed if needed. Also, MnDOT has studied crossings with a rating of 7 and has partially worked through the ones rated 6 to improve rail safety.[37]

As the risk rating map shows, the majority of the District's actively-controlled crossings have moderate (4-6) levels of risk. While the passively-controlled crossings in the District show relatively higher levels of risk, they are still within the moderate risk levels. For both actively and passively-controlled crossings in the District, the BNSF line in Otter Tail County and the CP line in Pope, Douglas, and Grant Counties have relatively higher levels of risk. This is expected as these lines have higher operational speeds and higher traffic volumes compared to other rail lines in District 4.

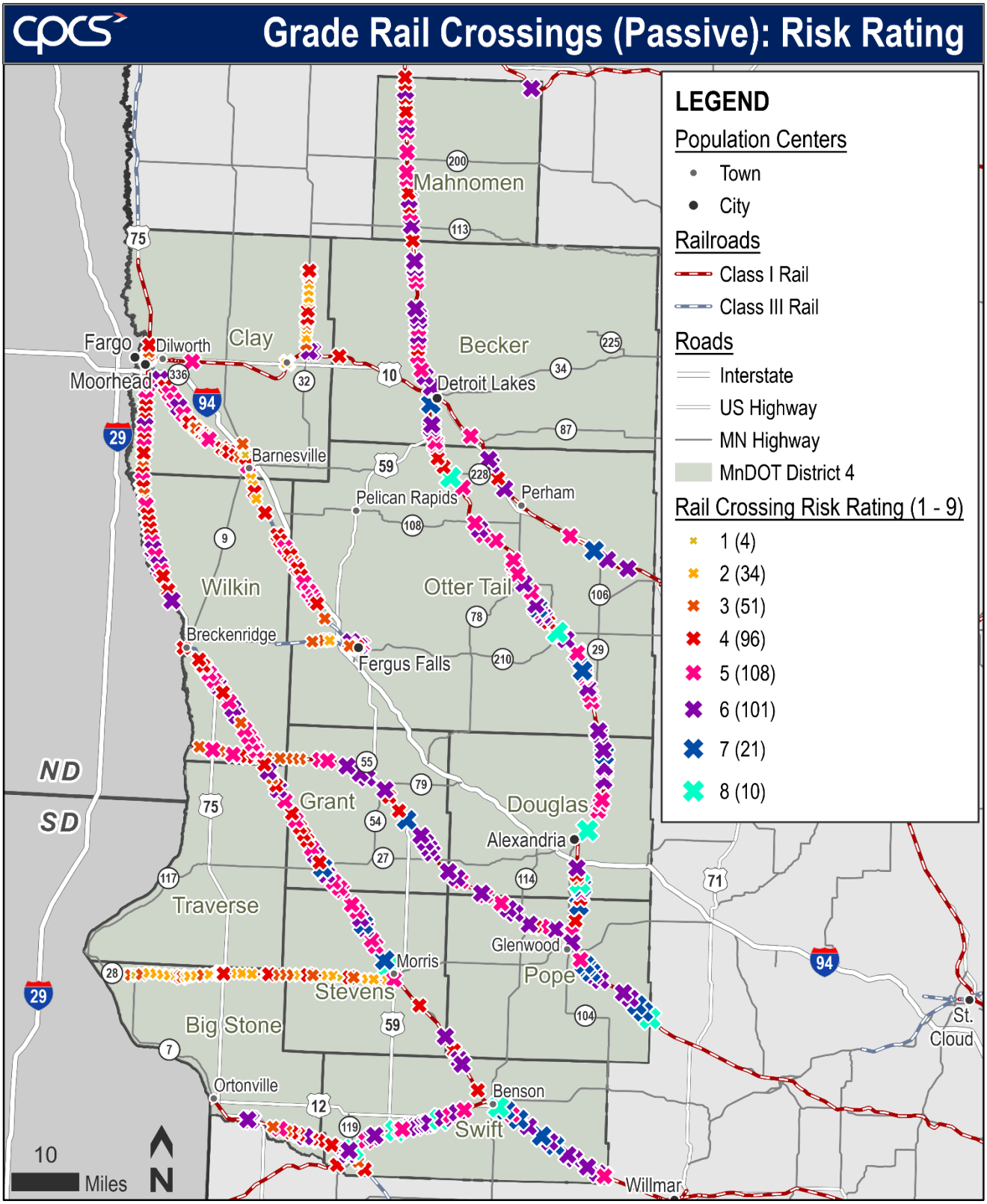
[37] MnDOT, Rail Safety and Education, accessed 2021. https://www.dot.state.mn.us/ofrw/railroad/safety.html

Figure 65: Rail Crossing Incidents in District 4



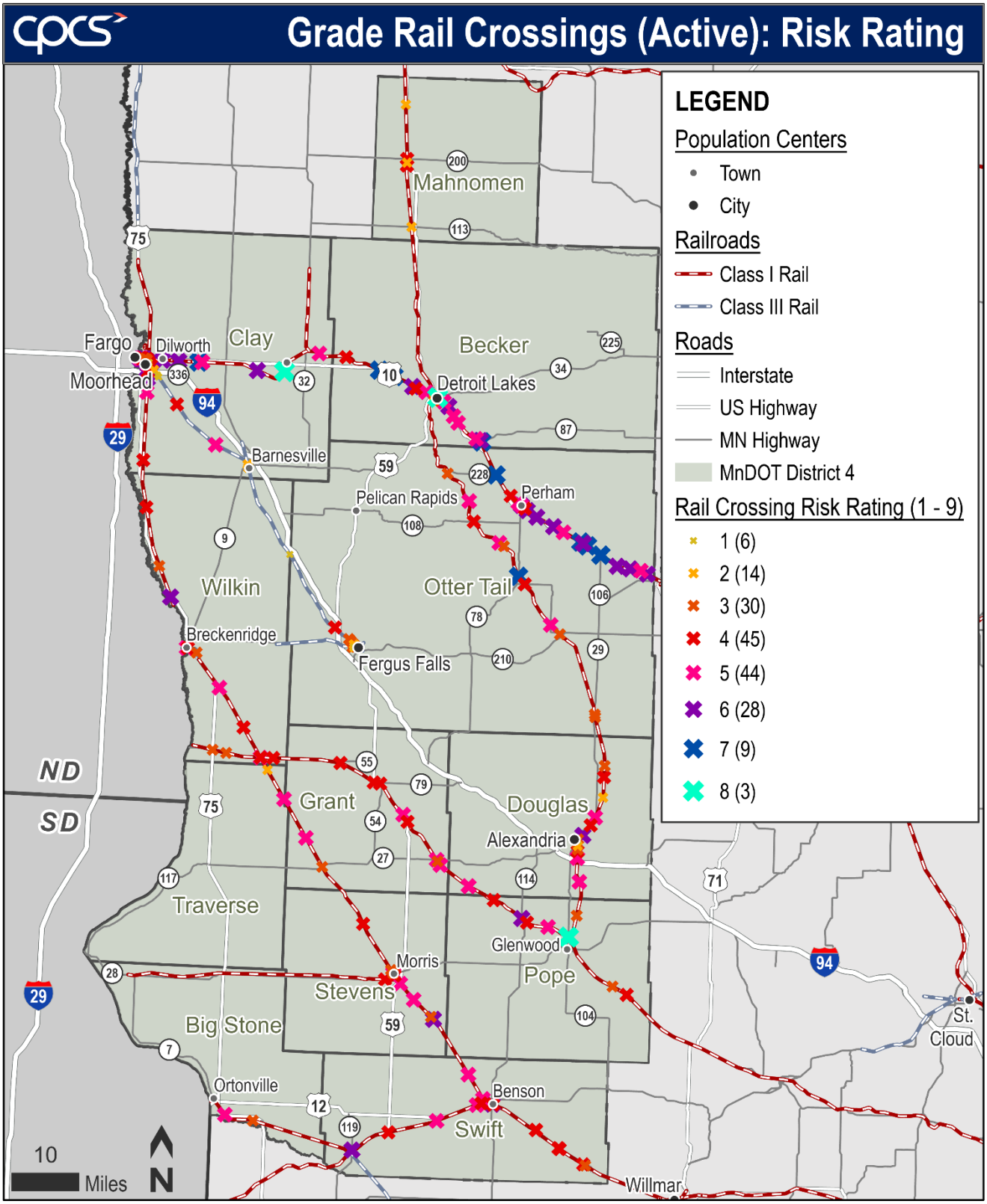
Source: CPCS analysis of MnDOT Rail Grade Crossing Safety Data.

Figure 66: Passively-Controlled Crossing Risk Ratings



Source: CPCS analysis of MnDOT Rail Grade Crossing Safety Data.

Figure 67: Actively-Controlled Crossing Risk Ratings



Source: CPCS analysis of MnDOT Rail Grade Crossing Safety Data, 2021.

3.3 Mobility

Mobility refers to the ease or efficiency of movement, meaning that limited level of effort and cost are associated with moving under high-mobility conditions. Mobility declines as the complexity and cost of a movement increases. Moving freight in a transportation system with low mobility is unreliable, expensive, and inefficient, all of which can affect a region's economic well-being. The following four measures have been evaluated to understand freight mobility in District 4:

- Truck travel speed, a measure of overall mobility;
- Truck Free Flow Factor, a measure of roadway congestion;
- Truck Travel Time Reliability, a measure of the variability of truck travel speeds; and
- Bridge vertical clearances and OSOW load restrictions, measures of the system's ability to accommodate oversize-overweight loads.

These measures were evaluated using one year's worth of truck GPS probe data from 2019, aggregated and analyzed through MnDOT's StreetLight platform. This data was primarily generated by GPS tracking devices installed by private trucking companies and used to monitor fleet performance and driver behavior. The GPS units transmit information back to centralized computer systems on a regular basis. Aggregated data from hundreds of companies and thousands of trucks can be used to measure traffic speed and system performance.

Using and Interpreting StreetLight Data

Data and performance measures extracted from the StreetLight platform can provide planners with an understanding of traffic phenomena. However, the tool has some limitations, including:

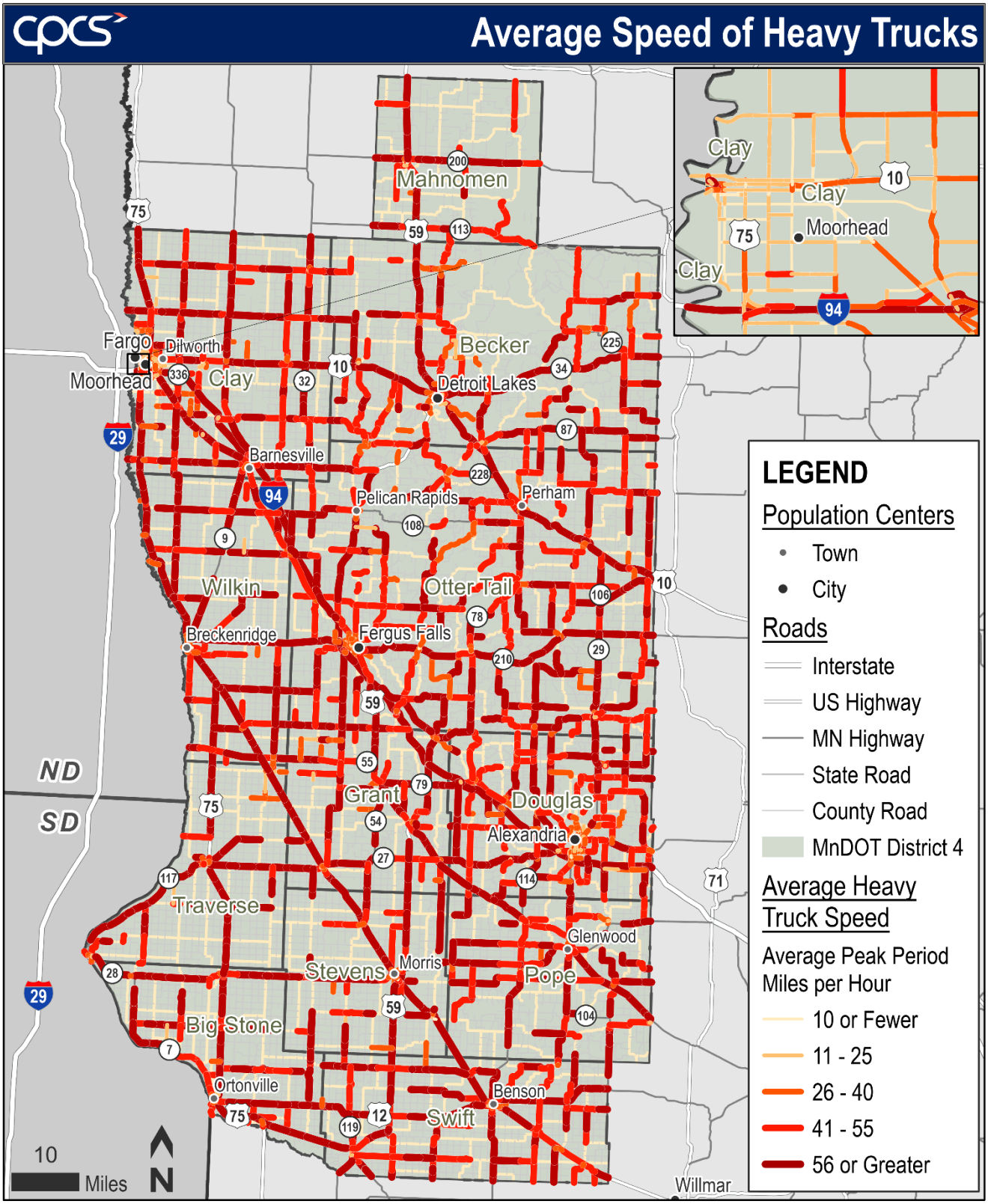
- The relatively small sample of trucks and vehicles used to compute results which may not be representative of all road users;
- The tool favors larger commercial fleets due to use of standardized GPS tracking systems across all their vehicles, which makes it less likely for smaller fleets and owner-operators to be represented in the data;
- Since the tool favors large fleets, it may underrepresent industries primarily served by smaller fleets or owner-operators, such as logging, agriculture, and some manufacturing;
- Reliance on cell phone coverage to communicate GPS data in near-real time to central services means that sparsely-populated areas with poor cell phone service may have reduced data availability.

Therefore, consultations with companies and individuals in these industries will be used to address these data gaps and ensure holistic freight planning.

Truck Speed

Examining truck speeds provides an in-depth understanding of truck mobility and system performance in District 4. Figure 68 shows the average speeds along highways and local roads of the District. As the figure shows, average truck speeds are particularly low where major highway corridors cross urban areas such as I-94, US-10, and US-75 in Moorhead, I-94, MN-210, and County Road 88 in Fergus Falls, I-94, MN-29, and County Road 82 in Alexandria, and US-10, US-59, and MN-34 in Detroit Lakes. Average truck speeds are 55 miles per hour (mph) or greater along major highways in rural areas, indicating no major problems with truck congestion in these areas.

Figure 68: Average Speed of Heavy-Duty Trucks in District 4, 2019



Source: CPCS Analysis of StreetLight Data, 2021.

Truck Travel Time Index

Travel Time Index (TTI) is a ratio of the travel time along a road segment during the peak period to the travel time along the same segment when vehicles are traveling at free-flow speed. TTI measure can be used to describes a roadway's traffic congestion and is typically weighted based on traffic volumes to enable comparison between similar road segments.[38]

StreetLight data is used to calculate the TTI measure for trucking activities in District 4. StreetLight tool provides the ratio of average and free-flow truck trip speeds along each segment on the road network, using the following formula:

Truck Travel Time Index = Average Truck Trip Speed/Free Flow Truck Speed

where Free Flow Truck Speed is the maximum average truck speed observed in any 1-hour time period of a single day, averaged over all days in the data period. Free Flow Truck Speed is calculated through the following procedure:

1. Calculating the average speed of all truck trips for every 1-hour time window on a specific day (24 windows);
2. Taking the maximum of 24 average truck speeds;
3. Repeating steps 1 and 2 for all days in the data period;
4. Taking the average of all maximum average truck trip speeds, which will be the Free Flow Truck Speed for a given segment for the data period.

TTI calculation using StreetLight data nearly always produces values equal to or less than 1 since the Free Flow Trip Speed (the denominator in the TTI formula) is calculated dynamically from the data and not based on static parameters like the posted speed limit. Therefore, to better understand truck congestion at peak times, the truck TTI measures calculated based on StreetLight data for the AM and PM peak periods (6-10 AM & 3-7 PM, respectively) are averaged, and the result is displayed in percentage of peak period free-flow speeds for each road segment. Figure 69 shows the TTI for heavy-duty truck trips, while Figure 70 shows the TTI for passenger vehicles.

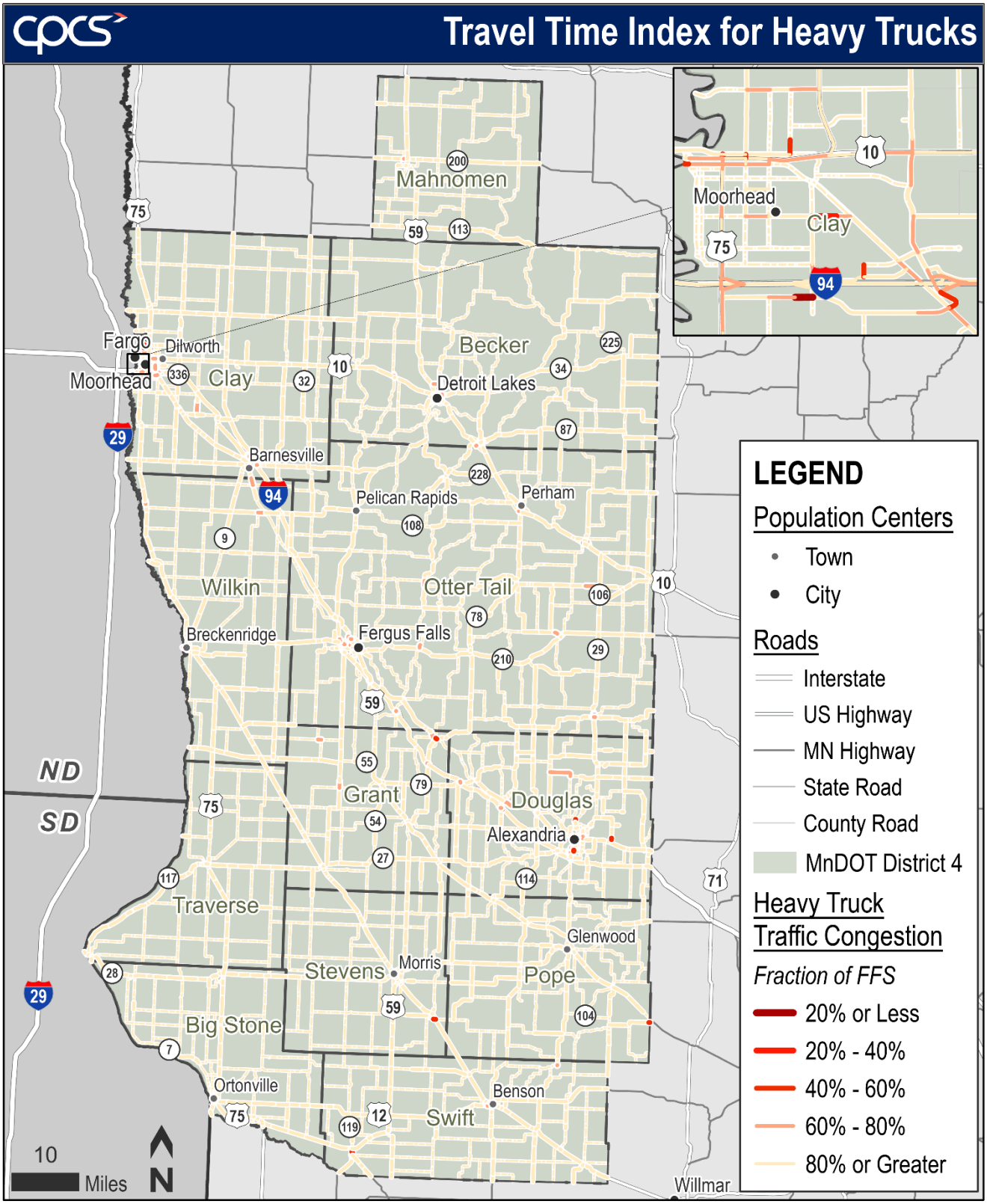
TTIs shown in these maps indicate the relative "slowness" of traffic; for instance, TTI values of 80% or greater mean that traffic is moving at 80% of free-flow speeds or higher, while TTI values of 20% or less indicate that the traffic is moving at speeds equal to 20% of free-flow speeds or less. Therefore, the TTI measure reveals areas where traffic congestion may be more likely, particularly at peak times.

Examination of traffic in Figure 69 and Figure 70 shows that the District's highways and corridors do not experience significant peak-time congestion due to trucking activities. Meanwhile, heavy passenger vehicle traffic congestion occurs on some road segments such as US-10 between Perham and Wadena, MN-29 in Parkers Prairie, and US-75 in Breckenridge. For both heavy trucks and personal vehicles, the lowest TTI values (corresponding to high congestion) occur most commonly at intersections, interchanges, and the partial road segments in their vicinity. It is likely that this pattern is a statistical effect deriving from the low sample counts on the freight network.

Peak-hour congestion for trucks and personal vehicles is generally a problem at highway intersections and interchanges across the District.

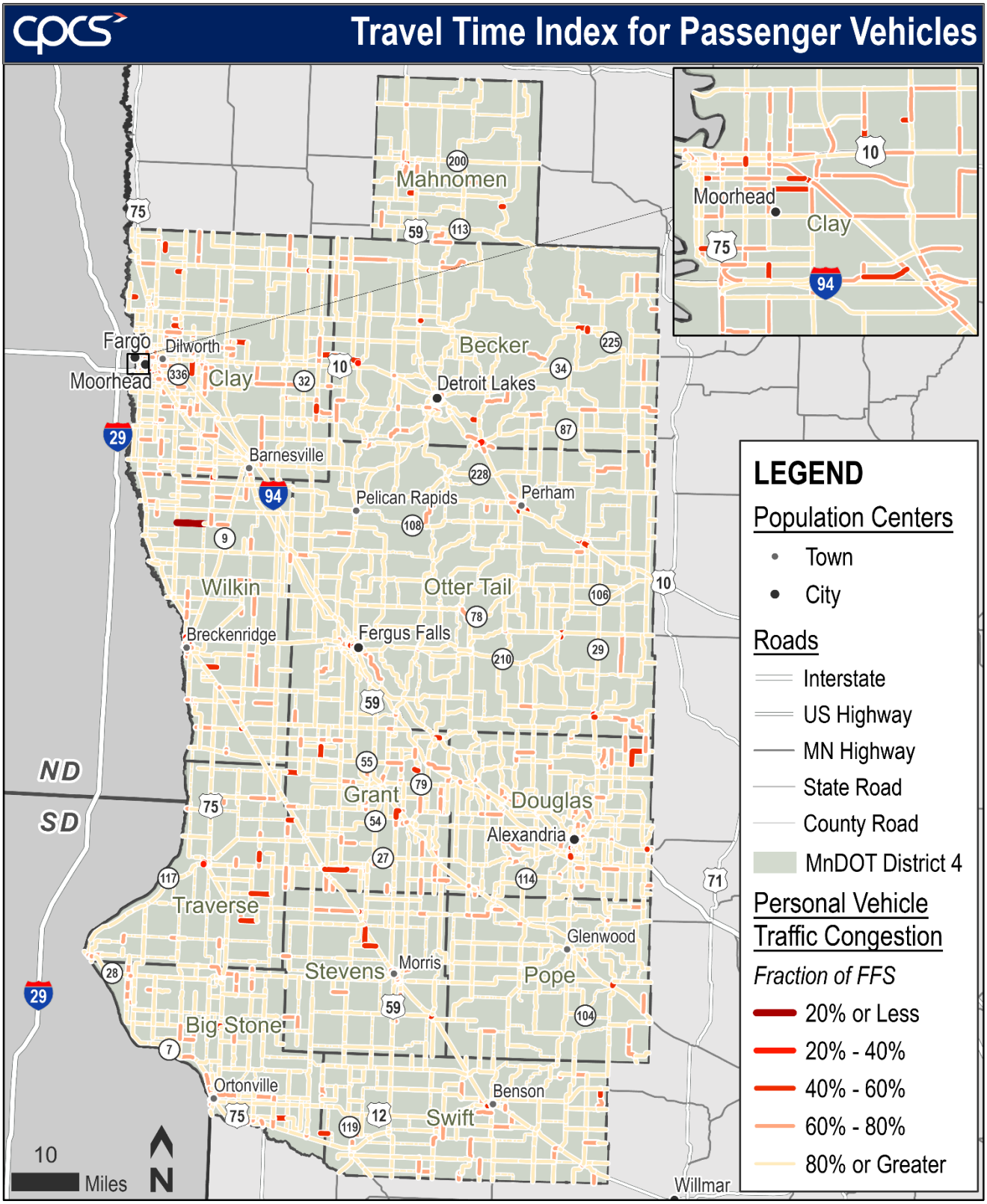
[38] FHWA, The Urban Congestion Report (UCR): Documentation and Definitions, 2015.

Figure 69: Heavy-Duty Truck Travel Time Index in District 4, 2019



Source: CPCS analysis of StreetLight Data, 2021.

Figure 70: Passenger Vehicle Travel Time Index in District 4, 2019



Source: CPCS analysis of StreetLight Data, 2021.

Truck Travel Time Reliability

Truck Travel Time Reliability (TTTR) is the ratio of average truck travel time in peak hours to free-flow truck travel time. TTTR measure indicates the degree by which travel time delays are unexpected to the road users. Indicating whether the delays on a roadway system are expected or not is important as shippers, businesses, and commuters can plan trips to accommodate expected delays at peak congestion, but unexpected delays cannot be planned for and can disrupt operations. The StreetLight platform does not directly provide the TTTR measure. Therefore, the Travel Time Reliability (TTR) measure for District 4's roadway system is calculated (for both passenger vehicles and trucks) through interpolation of StreetLight outputs and other available data and using the following formula:

Travel Time Reliability = 50th percentile Travel Speed/95th percentile Travel Speed

StreetLight's results provide information on the percentage of trips within specified bins of travel speed and duration. For example, it is known that, for a given segment, 3 percent of trips had an average speed between 10 and 20 mph.[39] These percentages are used to locate the bin in which the 50th and 95th percentile travel speeds occurred, and interpolation was used to estimate the final values used to calculate TTR. The resulting TTR values for both trucks and passenger vehicles are shown in Figure 71 and Figure 72. Lower values (presented with thinner lines and brighter colors) indicate a more reliable travel speed, while higher values (shown with thicker lines and darker colors) represent more variable (or unreliable) travel speeds.

As the maps show, travel times in the region are higher along major corridors such as I-94, US-10, and US-59, as well as routes serving urban areas, including Alexandria, Detroit Lakes, Fergus Falls, and Moorhead. TTTR values are highest on routes that provide access to major highways such as I-94 and US highways. Examples include:

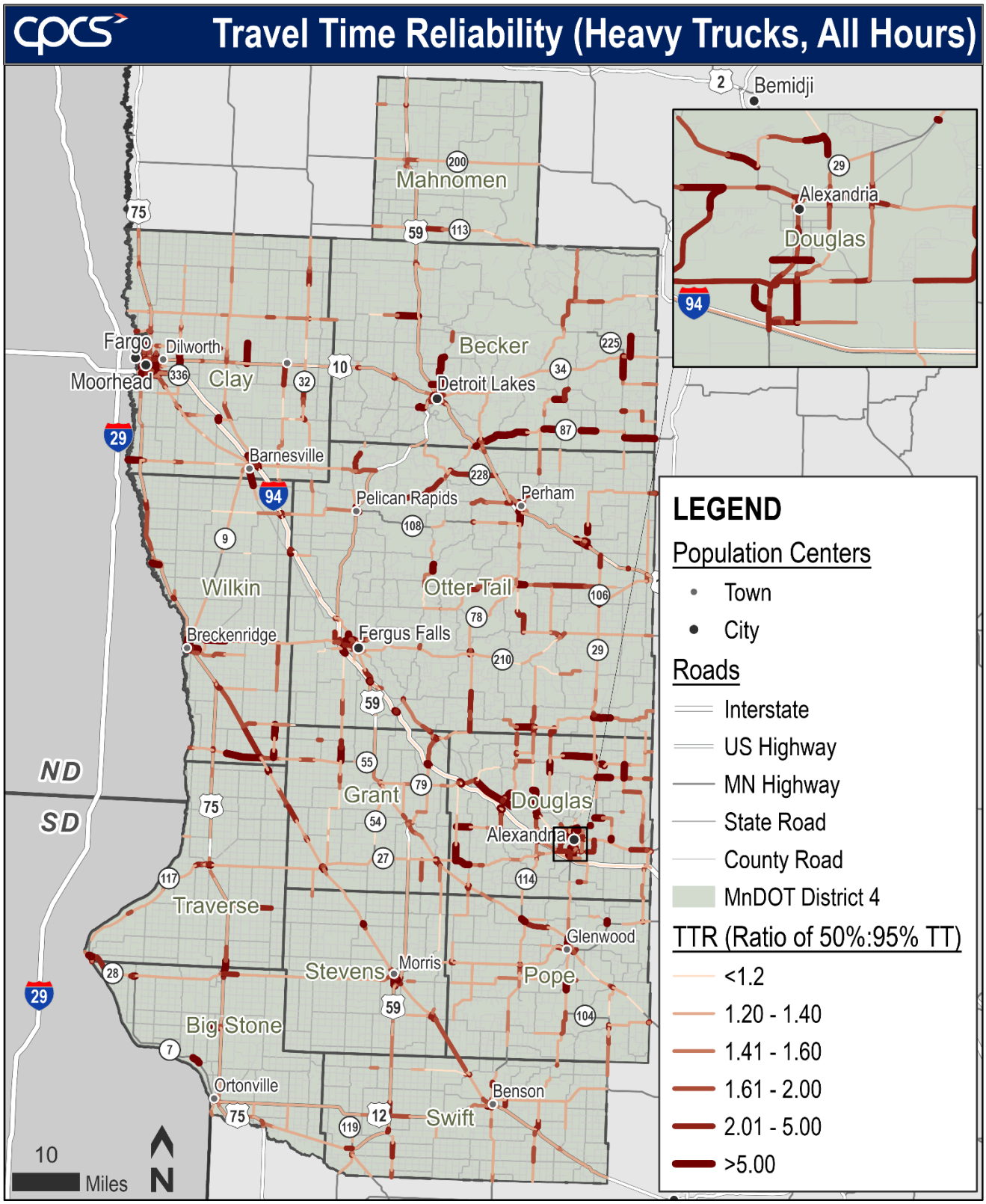
- County Road 82 west of Alexandria, connecting north-south traffic on MN-29 with east-west traffic on I-94;
- MN-27 east of Wheaton providing access to MN-9;
- MN-87 east of Frazee providing access to US-10; and
- County Road 228 connecting to US-10 north of Perham.

Concurrent analysis of Truck TTI and TTR measures for District 4 suggests that freight mobility challenges are more closely related to the general performance characteristics of trucks, such as their slow speed and heavy mass, and the need for infrastructure such as turning lanes and passing lanes to support safe truck movements.

While truck congestion and travel speeds are not an issue for District 4, appropriate infrastructure investments can continue to support reliable freight mobility.

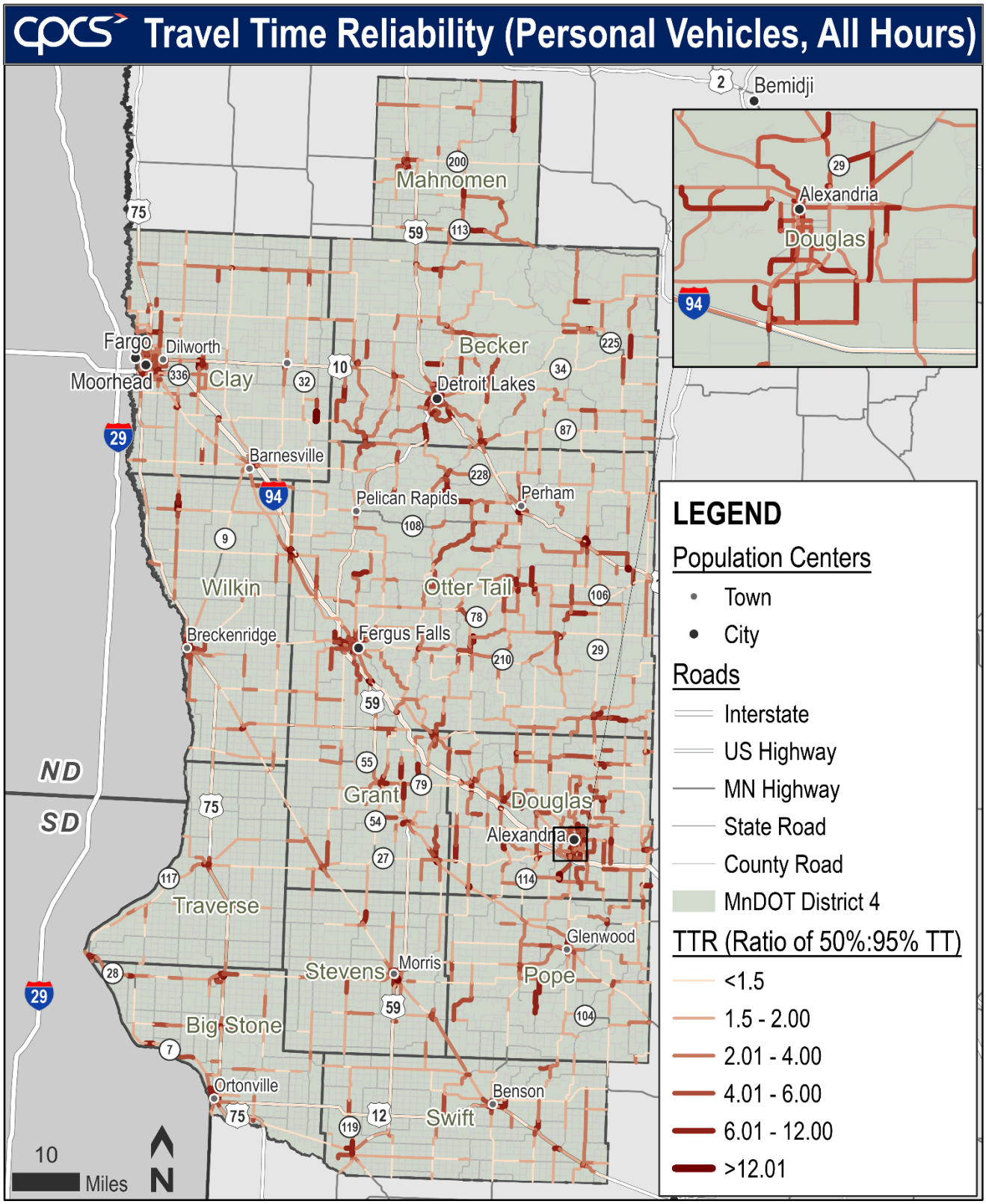
[39] StreetLight's results provide up to 50 speed and duration bins with a range of no less than 1 mph or 1 minute each.

Figure 71: Travel Time Reliability for Heavy Trucks



Source: CPCS analysis of StreetLight Data.

Figure 72: Travel Time Reliability for Passenger Vehicles



Source: CPCS analysis of StreetLight Data, 2021.

Bridge Clearances

Truck movements can be affected by the roadway geometric design elements such as the dimensions of curves, roadside elements, and bridges. Low bridge clearances create a localized barrier to trucking activities and, in particular, the movement of trucks carrying oversize-overweight (OSOW) loads, which may exceed the dimensions of a normal truck. This section provides a discussion of bridge clearances in District 4. Figure 73 shows the location of road bridges in the District and highlights potential limitation areas. In general, bridges are broken down into four categories:

- Red icons indicate bridges over roads with a vertical clearance of less than 13'6", which present significant barrier to all truck movements. The maximum truck height allowed without a permit per Minnesota Commercial Truck and Passenger Regulations is 13'6". Based on FHWA's recommendation, bridges should be constructed with at least one foot of additional clearance above maximum truck height.
- Orange icons indicate bridges with a vertical clearance of 14'6" above the road surface. These bridges can accommodate truck traffic but also pose limitations to some truck movements.
- Yellow icons indicate bridges over roads that have enough clearance to accommodate regular truck traffic but are below the 16'6" minimum height requirement for MnDOT Super Load OSOW Corridors.

As the figure shows, District 4 has several bridges that would create barriers to general truck traffic due to height clearance. Over half of these bridges are located in Moorhead, on the following locations:

- I-94/US-75 interchange;
- Pedestrian bridge on US-75 near Concordia College;
- BNSF rail bridge on US-10 west of 21st Street;
- BNSF rail bridge, 20th Street bike path, and 20th Street bridge on US-52.

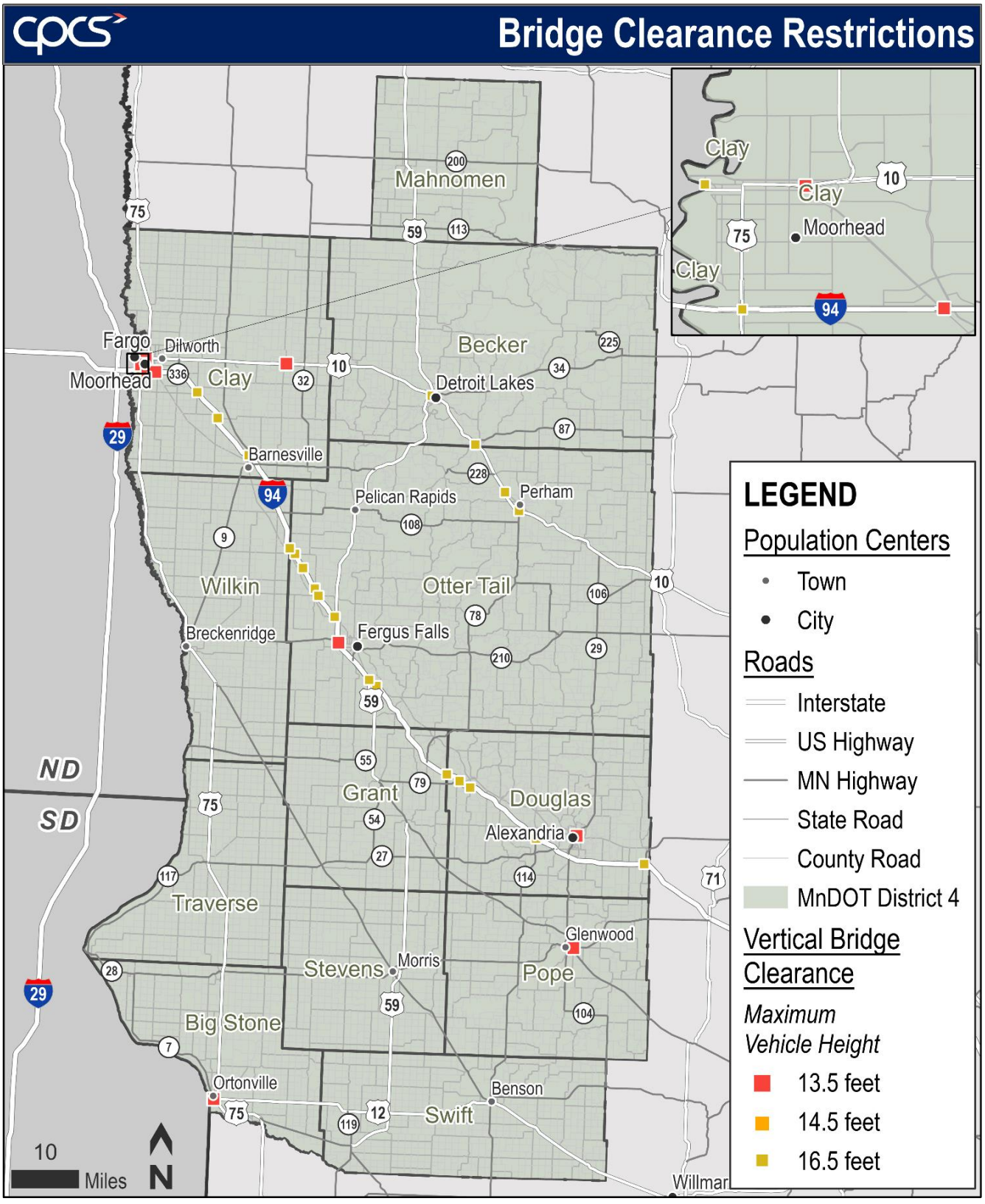
OSOW Operations

Oversize and overweight loads have a width, height, and/or higher than the maximum legal limits. Trucks carrying OSOW loads are usually required to obtain OSOW permits prior to moving loads. Such permitting systems are designed to mitigate damages to road infrastructure (pavement and bridges) and ensure the safety of other road users. MnDOT issues permit for interstate, US, and state highways, while some counties and municipalities may require specific permits for local roads.

MnDOT provides route and cargo-specific permits, for instance, monthly route-specific permits for construction cargo and seasonal permits and exemptions for agricultural and forestry commodities. MnDOT's permitting system classifies OSOW loads as loads with a height greater than 13'6" and a width greater than 8'6". Loads wider than 14'6", taller than 16'0", and longer than 110'0" are not eligible for annual OSOW permits and are often restricted from movement on high-volume days such as holidays and summer weekends. MnDOT defines overweight loads based on truck axle counts, axle groups, and weight per axle.[40]

[40] MnDOT, Transporting Oversize / Overweight Loads in Minnesota, 2017.

Figure 73: Bridge Vertical Clearance in District 4



Source: CPCS analysis of MnDOT Bridge Office Data, 2021.

In 2016, 2,267 permits were issued to OSOW trips either starting or ending in District 4, which is about 20.5% of the total OSOW permits issued across the state. Figure 74 provides a list of MnDOT's permit types and criteria. Permit type definitions are provided below:

- **Transactional permits:** for load dimensions that present minimal problems for routing;
- **Collaborative permits:** for loads that require more coordination, and according to MnDOT's OSOW analysis documents can inform decisions regarding investments in "improvements to existing infrastructure that accommodate the collaborative range of dimension;"[41]
- **Consultative permits:** for "mega loads" or "super loads," which require unique planning processes.

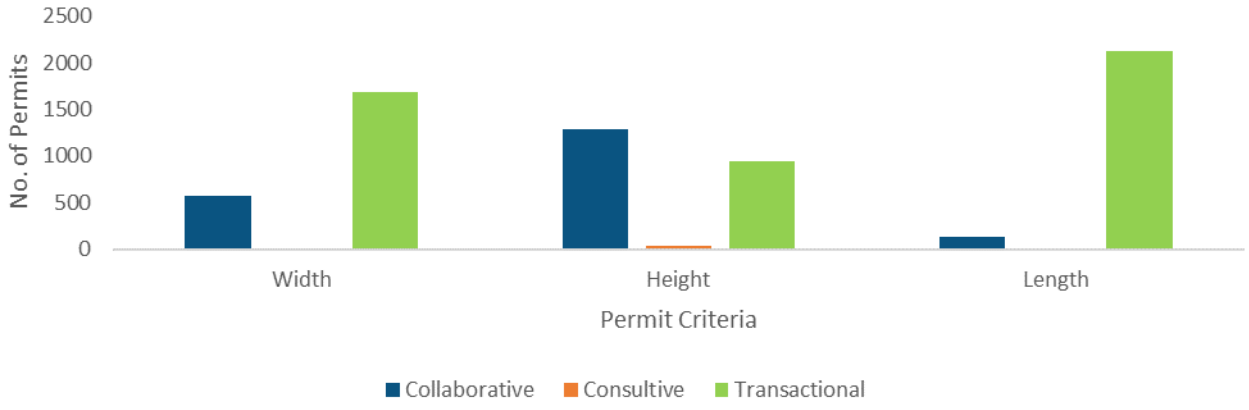
Figure 74: MnDOT OSOW Permit Types and Criteria

Permit Type	Height	Width	Length	Gross Vehicle Weight (1000s of lbs)
No Permit	Up to 13.5 feet	Up to 8.5 feet	Up to 75 feet	Up to 80
Transactional	13.5 to 15 feet	8.5 to 15 feet	75 to 140 feet	80 to 187
Collaborative	15 to 16.5 feet	15 to 17 feet	140 to 180 feet	187 to 255
Consultative	Over 16.5 feet	Over 17 feet	Over 180 feet	Over 255

Source: MnDOT Oversized/Overweight Permit Data, 2016.

Figure 75 provides a breakdown of the dimensions listed on permits for District 4 in 2016 and a breakdown of load dimensions into respective permit types. As shown, the majority of the OSOW permits in District 4 fall into the transactional category for width and length, but most of the permits fall into the collaborative category for height. Based on height alone, 57% of District 4's OSOW permits would be considered collaborative.

Figure 75: Height, Width, and Length on OSOW Permits with Origin or Destination in District 4, 2016



Source: CPCS analysis of MnDOT OSOW permit data, 2021.

The 2016 OSOW permit data provided by MnDOT provided relatively limited information on load weights, with the majority of permits listed with "0" weight. About 38% of the loads with origin or destination in District 4 had weight information, almost all of which had weights considered transactional. Four consultative permits were issued for OSOW movement in District 4 in 2016.

Analysis of bridge clearance and OSOW permitting system in District 4 shows that several corridors pose restrictions to OSOW movements. According to maps provided by MnDOT Oversize/Overweight Permit Office,

[41] MnDOT, Oversized/Overweight Permit Data, 2016.

the following are designated OSOW corridors in District 4, some of which have limitations due to various restrictions:

- I-94 is a superload corridor but has several vertical restrictions between Alexandria and Fergus Falls and in Moorhead;
- MN-9 is a superload corridor but has one weight restrictive bridge in Campbell;
- MN-28 is an OSOW corridor between Little Falls and Sauk Centre and from Morris to South Dakota border with no limitation for superload movements;
- MN-27 between Alexandria and Herman is an OSOW corridor with no limitation for superload movements;
- MN-200 is a superload corridor with several height, width, and safety restriction points.

3.4 Condition

The physical condition of the transportation infrastructure is critical to freight activities as deficient structures may create barriers for truck movement, and rough road surfaces can create bumps and shocks that damage or dislodge cargo. Infrastructure condition measures define the physical suitability of the network to serve transportation activities and can inform inspection and maintenance investment decisions. The condition analysis conducted for the District 4 Freight Plan focuses on pavement and bridges, using the information provided by MnDOT Headquarters Office as well as the District 4 Office of Planning and Programming.

Pavement Condition

MnDOT collects pavement condition data using Digital Inspection Vehicles (DIV) that are equipped with laser measurement devices and take measurements of the pavement's longitudinal profile approximately every 1/8" while traveling at highway speed.[42] The measurement results are used as input in a mathematical simulation that calculates pavement condition indices, including Ride Quality Index (RQI), which is shown for District 4 in Figure 76. RQI is a scale between zero and five, representing ride smoothness: the higher the scale, the smoother the ride. Road segments with RQI ranging between 3 and 5 are considered in good condition. Meanwhile, segments with RQI of 2 to 3 are in fair condition, and segments with RQI of lower than 2 are in poor condition. As shown, pavement surfaces of almost all major highways in District 4 are in fair or good condition.

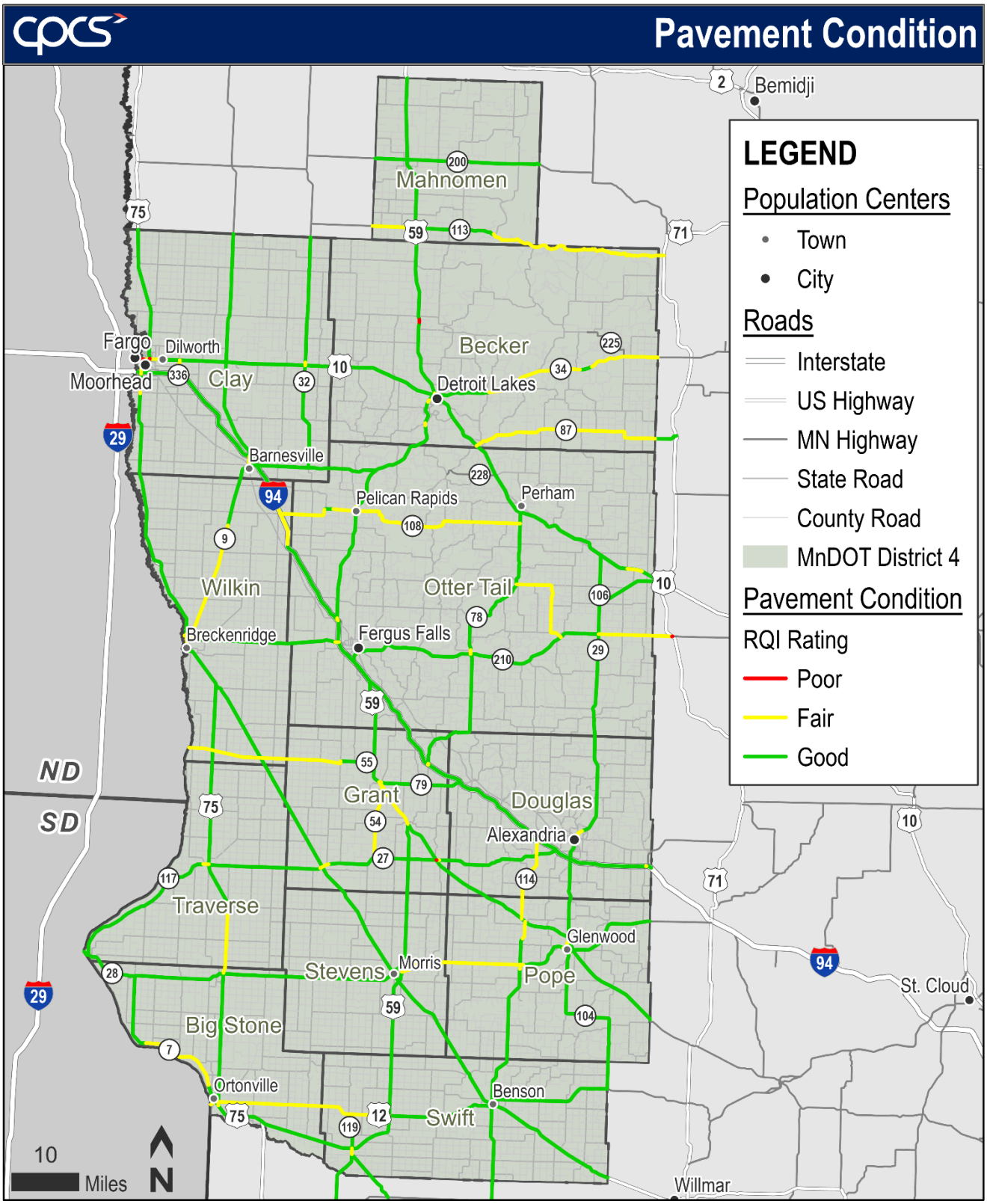
Bridge Condition

Figure 77 provides a summary of road bridge inventory and condition in District 4. Interstate bridges are clustered in Clay, Douglas, and Otter Tail Counties. Clay County has the highest number of road bridges, accounting for over one-quarter of the total bridges in the District, followed by Wilkin County, with 17 percent, and Traverse County, with about 10 percent of the District's total road bridges.

In terms of bridge Sufficiency Rating (SR), District's bridges are on average serviceable. SR is a measure of the sufficiency of a bridge for remaining in service and is calculated based on factors such as structural adequacy and safety, functional obsolescence (deck geometry, waterway adequacy, etc.), and importance for public use. An average SR higher than 80 indicates serviceability, while SRs equal to or lower than 80 indicate eligibility for receiving federal funding for improvement projects under Highway Bridge Program funds.[43]

[42] MnDOT, An Overview of MnDOT's Pavement Condition Rating Procedures and Indices, 2015.
[43] MnDOT, Bridge Inspector Reference Manual, 2012.

Figure 76: Pavement Condition in District 4



Source: CPCS analysis of MnDOT Data, 2021.

Figure 77: Count, Average Age and Condition of Bridges 10 Feet and Over, 2019

County	Interstate	Trunk Highway	County Road	Other Local Road	Total	Average Age	Average Sufficiency Rating
Becker	0	21	38	34	93	27	96
Big Stone	0	11	11	15	37	42	94
Clay	24	55	188	176	443	30	93
Douglas	21	4	34	24	83	32	95
Grant	4	8	23	25	60	37	92
Mahnomen	0	9	30	22	61	38	90
Otter Tail	24	34	76	68	202	39	93
Pope	0	9	26	38	73	33	98
Stevens	0	15	22	32	69	33	98
Swift	0	23	47	66	136	29	95
Traverse	0	21	84	58	163	38	96
Wilkin	5	36	126	123	290	31	96
Total	**78**	**246**	**705**	**681**	**1,710**	**33**	**94**
% of MN	**6.42%**	**23.66%**	**14.34%**	**14.69%**	**12.95%**	**-**	**-**

Source: CPCS analysis of MnDOT Minnesota Bridges, 2021.

Figure 78 demonstrates the number of deficient bridges in each county in District 4 by roadway system. A bridge is considered "deficient" if it has a rating of 80 or less. There are a total of 68 deficient bridge structures in District 4. Clay County (Moorhead) has the highest number of structurally deficient bridges, accounting for 29 percent of the District's deficient bridge structures. Over half of the deficient bridges are located on the county system in District 4. The bridge condition on the trunk highways is relatively better, which is critical to the efficiency and safety of the freight movements in the District. Nevertheless, the higher percentages of deficient bridges on the county and township roadway systems could impact the last and first mile connections within the District.

Figure 78: Counts of Deficient Bridges, by System and County

County	Trunk	County	Township	City	Total
Becker	0	1	1	0	2
Big Stone	0	0	1	0	1
Clay	0	11	8	1	20
Douglas	1	0	0	0	1
Grant	1	4	1	0	6
Mahnomen	0	4	3	0	7
Otter Tail	2	6	1	1	10
Pope	0	0	1	0	1
Stevens	0	0	1	0	1
Swift	0	0	1	0	1
Traverse	1	2	2	0	5
Wilkin	0	7	6	0	13
Total	**5**	**35**	**26**	**2**	**68**
% of District 4's Total Bridges	**2.03%**	**4.96%**	**4.22%**	**1.01%**	**3.98%**

Source: MnDOT, Minnesota Bridges, December 2018.

4 Conclusions and Next Steps

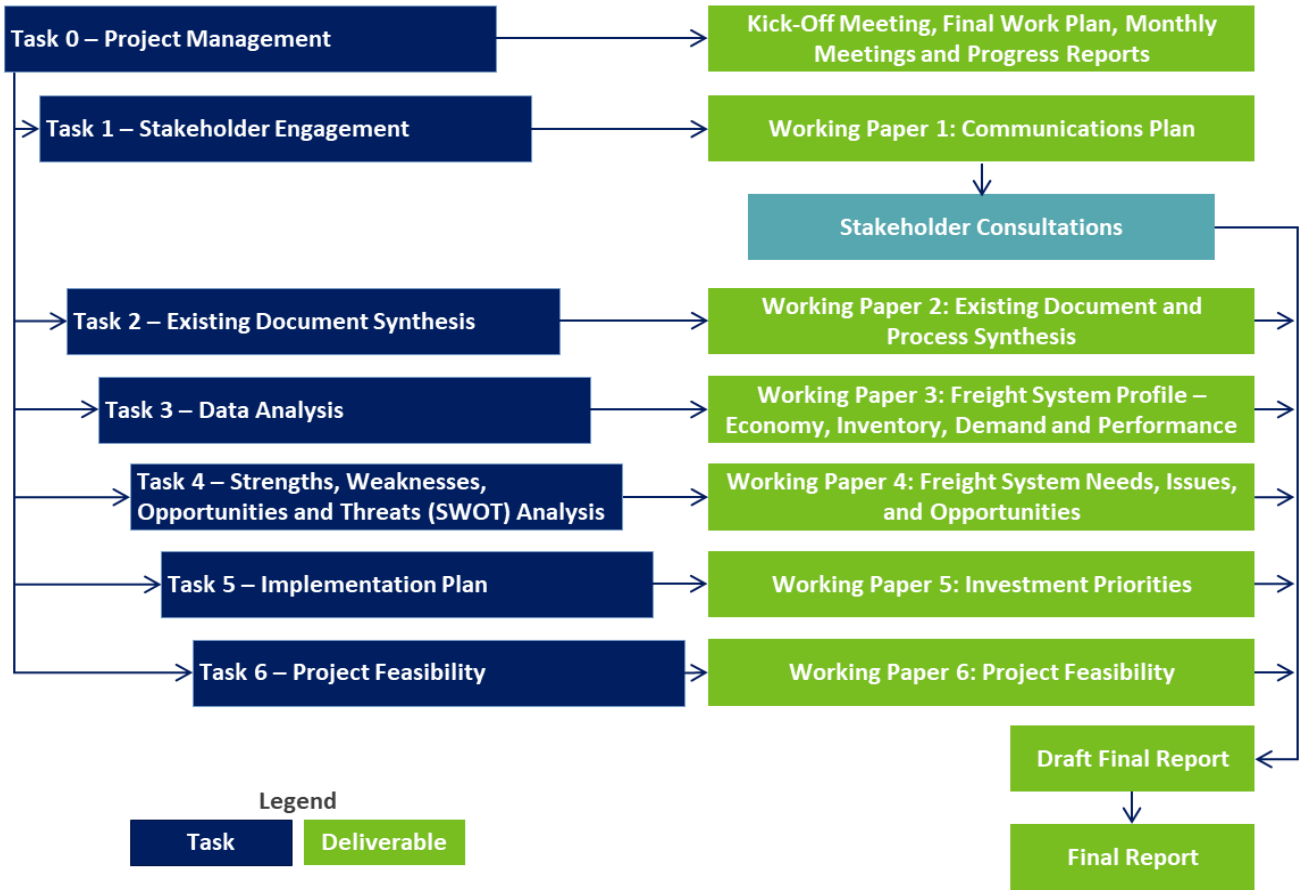
4.1 Conclusions

District 4's freight system consists primarily of road and rail assets, which provide an extensive range of freight services and support the continued economic well-being of the district, particularly in agriculture and manufacturing. The District's freight system performance is mixed; while generally, traffic congestion is not an issue, infrastructure design and condition, as well as rail crossing safety and truck-related crashes, create concerns for the movement of goods across the District.

4.2 Next Steps

As shown in Figure 79, this Working Paper represents the output of Task 3 and provides a baseline understanding for all future tasks. The data analysis created for this Working Paper will be complemented by stakeholder insights from ongoing engagement, and together these two sources of information will inform a complete assessment of District 4's freight system strengths, weaknesses, opportunities, and threats (SWOT) in the next Working Paper.

Figure 79: District 4 Freight Plan Project Approach



Source: CPCS

Appendix A Location Quotient and Shift Share Analysis Methodology

Location Quotient Analysis

Location Quotients use employment as a proxy for regional strength due to the availability of data. As with all economic models, certain assumptions are made in order to analyze across different variables. Using both Location Quotients and the Shift Share Analysis more accurately depicts regional strength. The Location Quotient methodology makes the following assumptions about the US economy:

- **Uniform labor productivity:** labor productivity is the measure of economic output per labor hour, meaning the region's real Gross Domestic Product divided by aggregate labor hours in the region. Changes in labor productivity depend on investments and savings, new technologies, and human capital. Industries located in different regions in the US may not have the same labor productivity as there are differences in infrastructure investments, tax and other regulatory policies, educational opportunities, technology investments by businesses, and so on.
- **Identical consumption between local regions:** this factor is also not expected in the real economy. Different regions also consume different baskets of goods based on geographic availability, cultural preferences, and socioeconomic levels. However, freight-dependent commodities in mining, agriculture, and forestry/fishing tend to be less substitutable goods (many agricultural goods and paper products) or those with a higher replacement cost (e.g., renewable energy in lieu of mining goods).
- **Homogeneous goods being produced:** this assumption in District 4 is less of a concern for the agricultural industry. However, manufacturing is one of the dominant industries in the District, which is typically less homogeneous in terms of commodities, and therefore, there can be premium goods and services that are not captured by Location Quotients.
- **Closed economy:** meaning that the region does not compete with international markets. This assumption can be problematic for imported goods and services the US is dependent upon, such as in manufacturing. A high Location Quotient does not necessarily mean that the industry is able to successfully export its goods and services to other regions of the country if similar or substitute goods and services can be imported from international markets. The District's manufacturing Location Quotient of 1.5 shows relative specialization in this sector compared to the rest of the country. According to the Location Quotient analysis presented in Chapter 1, District 4's manufacturing is highly concentrated around food processing, fabricated metal production, printing and support activities, and machinery manufacturing.

Shift-Share Analysis

The shift-share formula used is as follows:

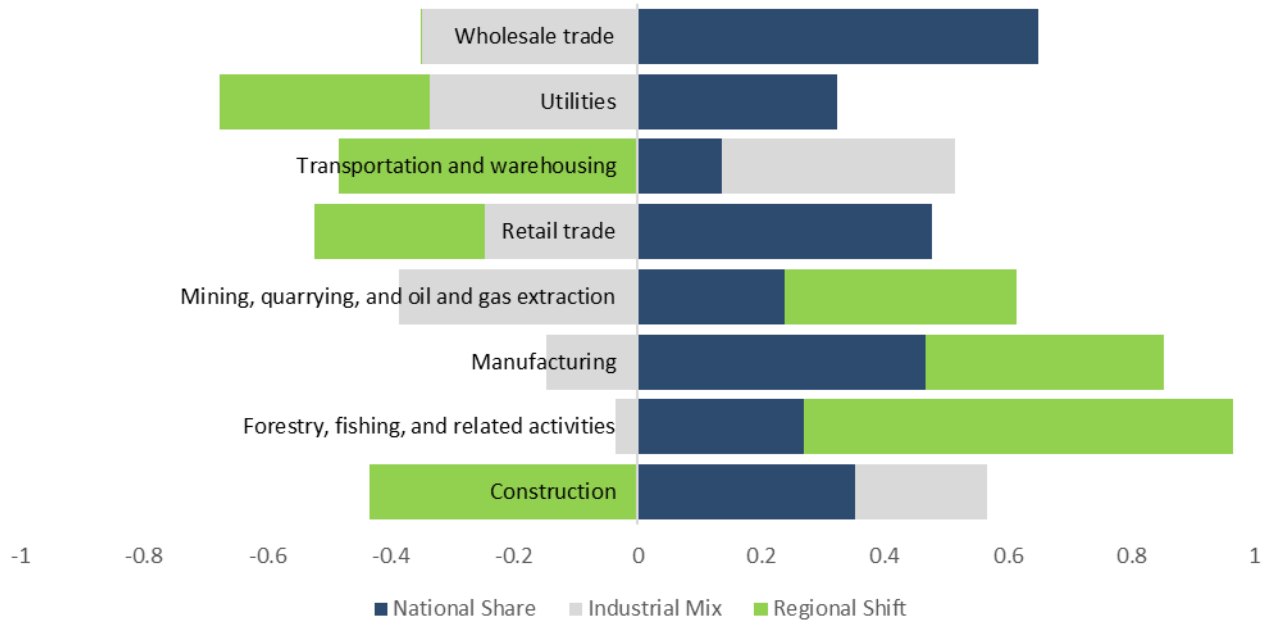
Actual Employment Change = National Share + Industrial Mix + Regional Shift

- **National Share** refers to the amount of employment change due to overall national trends.
- **Industrial Mix** provides the amount of employment change based on national trends for a specific industry.

- **Regional Shift** indicates the amount of employment change due to changes in regional competitiveness for a specific industry.

The following graph provides additional detail for all three factors of shift-share analysis affecting the District's freight-related industries: national share, industrial mix, and regional shift. Employment growth is portrayed as an index between -1 and 1, with negative numbers indicating a negative growth and positive numbers indicating positive growth based on employment.

Figure A-1: Regional Employment Change by Freight-Related Industry – District 4 (2010 to 2019)



Source: CPCS analysis of US Census 2010 and 2019 County Business Pattern Data.

As the figure shows, the national trends (National Share) positively impact employment growth in District 4 across all freight-related industries. The national impact is especially prominent in wholesale and retail trade as well as manufacturing businesses. This is while industry trends (Industrial Mix) only positively impact employment growth in transportation and warehousing and construction industries. Employment declines in District 4 were affected by regional trends (Regional Shift) most significantly in transportation and warehousing, utilities, and construction businesses. The regional trends also indicate a positive competitive effect for forestry, fishing, and related activities, manufacturing, and mining industries. This means that these industries are growing in the District, with a rate higher than the national average.