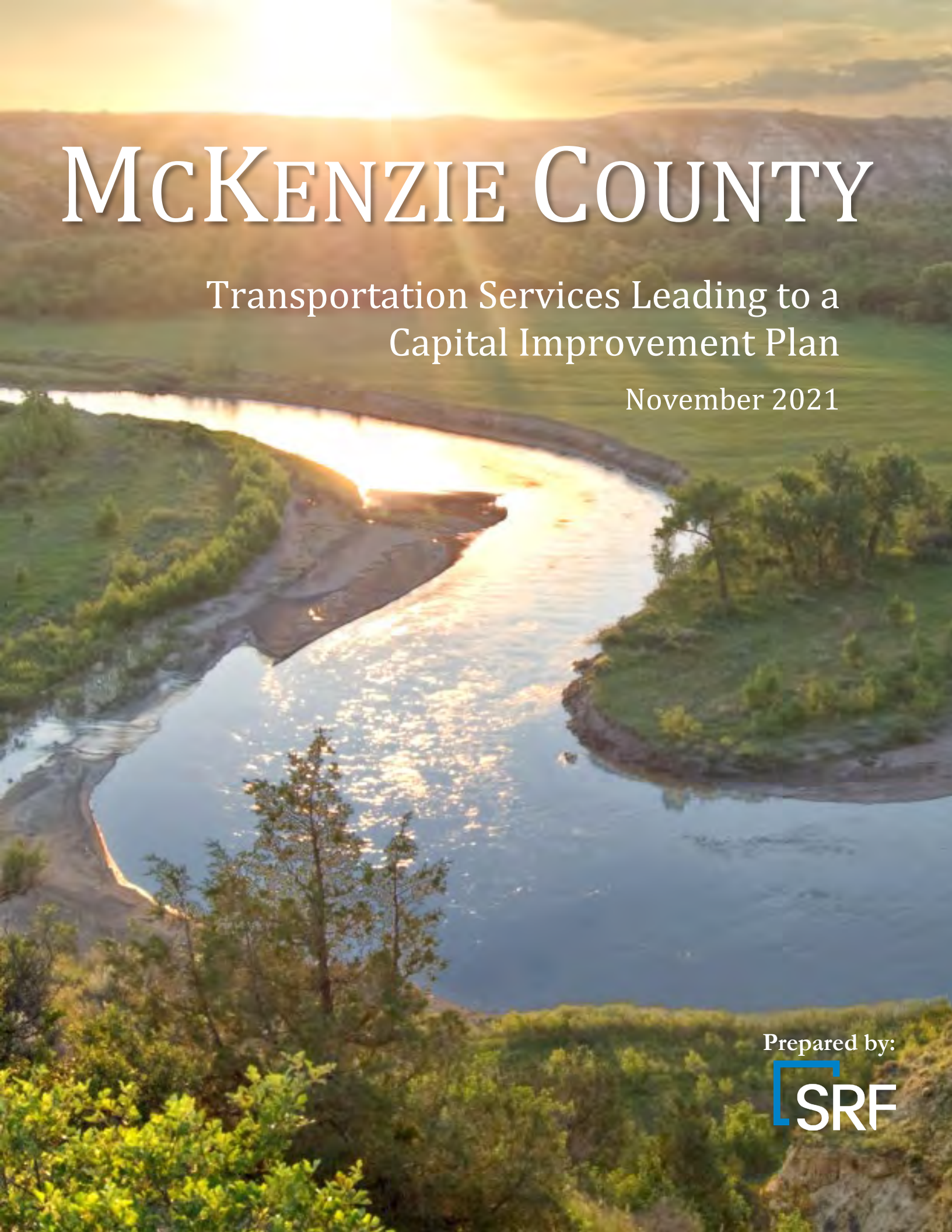

# McKenzie County

## Transportation Services Leading to a Capital Improvement Plan

November 2021

Prepared by:

SRF

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## Figures

# Chapter 1: Project Overview

This report documents transportation services provided by SRF Consulting Group to the McKenzie County Public Works Department in support of the county's 5-year Capital Improvement Plan (CIP) for bridges and roadways. These services assessed travel impacts of forecasted growth in energy production, population, and employment in the County over a 10-year period between 2020 and 2030. The growth projections were used to estimate future traffic demands and evaluated alongside roadway age and condition data to recommend investment priorities over the short and long term. Key findings were presented to the McKenzie County Board in the summer of 2021 for use in CIP decision-making.

## Project Purpose

The overarching goal of the transportation services documented in this report is to promote transparent and cost-effective management of McKenzie County resources when planning roadway improvements. Work undertaken to achieve this goal was performed with acknowledgement of uncertainty about future growth trends and the demand it will place on the roadway network. This effort managed this uncertainty by grounding the CIP process in a robust understanding of current traffic patterns and a scenario-based approach to traffic modeling. This approach enables McKenzie County to identify and prioritize transportation system improvements that respond to a broad range of future needs and opportunities.

## About this Report

This report is organized in three parts: existing conditions, future conditions, and investment priorities.

**Existing conditions.** Chapters 2 and 3 introduce McKenzie County, its vibrant energy sector industries, regulatory environment, and existing roadway network, including year 2018 traffic volumes for autos and trucks.

**Future conditions.** Chapter 4 looks to the future and provides a range of 2030 growth expectations for county energy production, population, and employment. The chapter describes how this range of possible futures are organized into year 2030 scenarios. Chapter 5 details how the 2030 scenarios were applied to generate, distribute, and route future trips on county roadways.

**Investment priorities.** Chapter 6 identifies capital improvement needs on county roadways over the next 10 years based on forecasted traffic volumes, infrastructure condition, and safety analysis. Chapters 7 and 8 translate roadway needs into short-term and long-term priorities for capital investment and a set of tools and strategies for managing the roadway network going forward.

# Chapter 2: County Profile

## Study Area

McKenzie County is located in western North Dakota. It lies within the Bakken Formation, which contains rich deposits of oil and natural gas. The County's northern border is formed by the Missouri River and Lake Sakakawea. It shares its western border with the State of Montana.

The County's terrain varies from prairies to rolling hills. This topography shapes the transportation network, influencing roadway alignments and accessibility. In many areas, vertical and horizontal roadway curves pose a safety hazard. Remote areas have limited vehicle access.

### Jurisdictions

Watford City is the largest municipality, containing roughly half of the County's population. Watford City is centrally located within the County, lying at the junction of Highways 85, 23, and 1806. The County also overlaps a portion of the Fort Berthold Reservation, which is home to the Mandan Hidatsa and Arikara Nation (MHA Nation or Three Affiliated Tribes). Other areas are managed by various state and federal agencies, such as the U.S. Army Corps of Engineers (USACE) and the U.S. National Park Service (See Figure 1).

### County Growth

Over the past decade, the rapid development of oil and gas reserves in western North Dakota fueled historic growth throughout the region. By the end of the decade, McKenzie County was the top oil-producing county in North Dakota and the fastest-growing county in the United States in terms of the percentage of population growth – its population increased from 6,360 in 2010 to 14,704 people in 2020 (131.2% growth). Prospects for continued growth from 2020 to 2030 are a key driver for the traffic forecasts, analysis, and recommendations of Capital Improvement Plan.

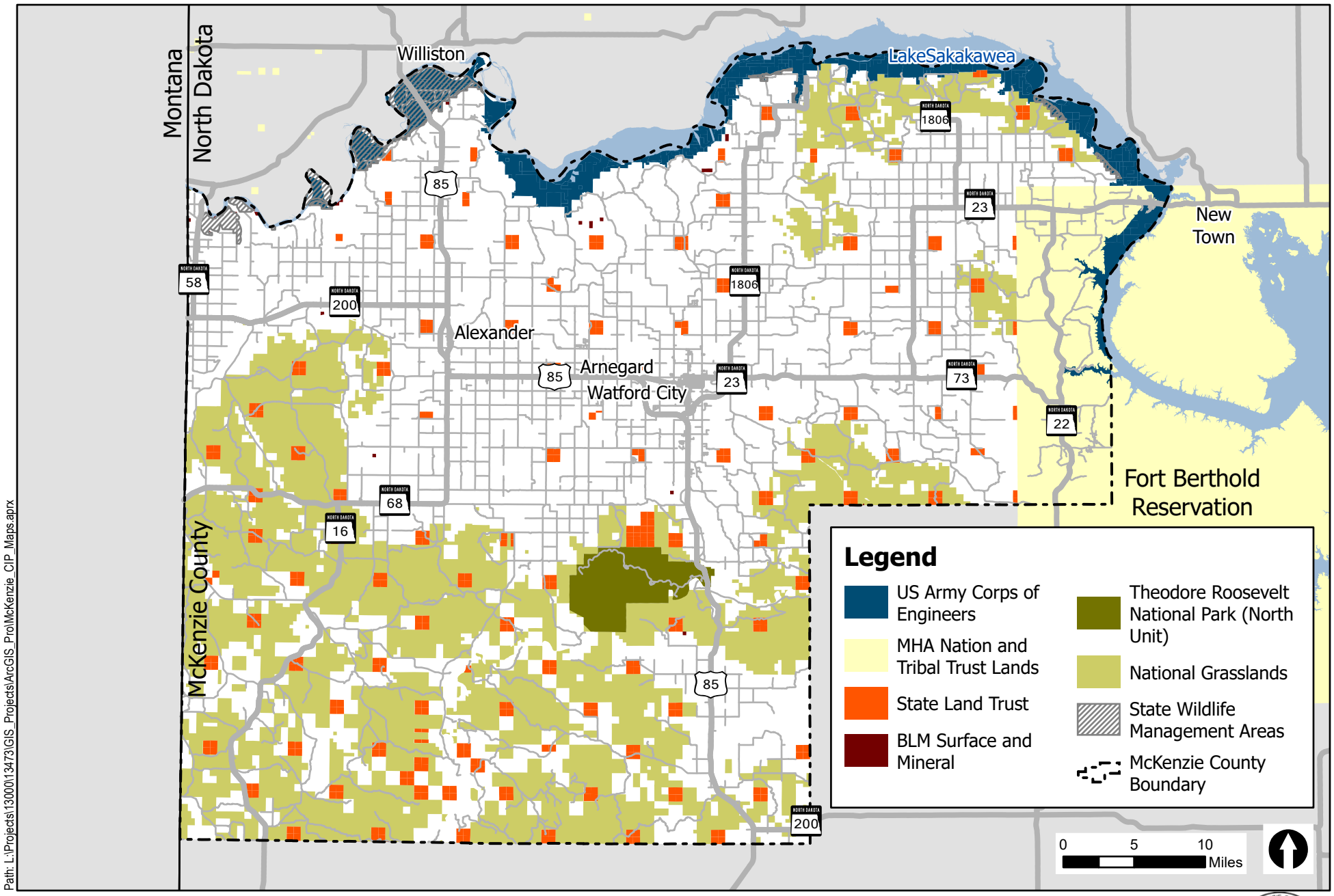


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**Figure 1: Federal, State, and Tribal Lands**

McKenzie County, North Dakota

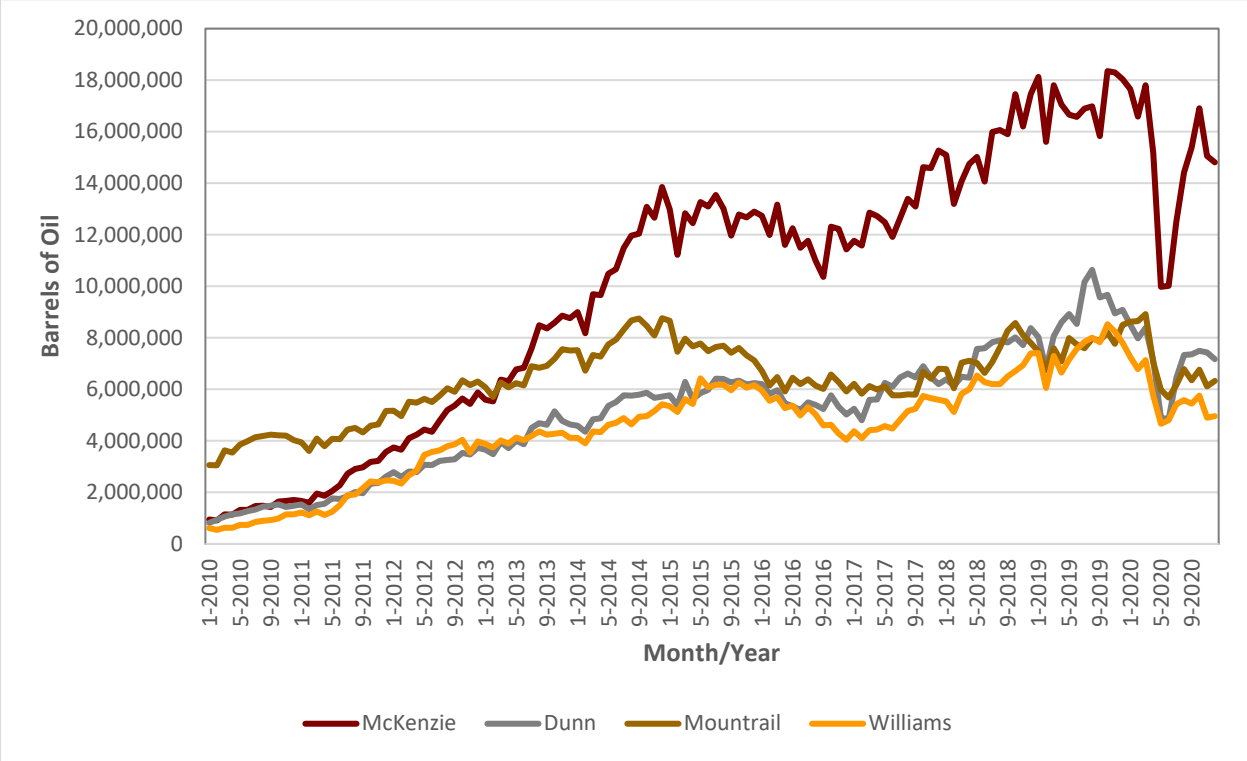
McKenzie County Capital Improvement Plan

# Energy Resources

## Oil and Gas Production

From 2010 through 2020, oil production increased sixfold in McKenzie County, peaking at over 18.3 million barrels per month in October 2019 (See Figure 2). Crude production leveled off in neighboring counties by the middle of the decade, but production rose steadily in McKenzie County. The Dakota Access Pipeline, which opened in June of 2017, facilitated increased oil production and lowered distribution costs, fueling continued growth in McKenzie County. Then, in May 2020, production plummeted following the outbreak of the COVID-19 pandemic. However, by the end of 2020, production had rebounded nearly to previous levels.

**Figure 2. Monthly Oil Production (2010 through 2020)**




Source: North Dakota Industrial Commission, Department of Mineral Resources, Oil and Gas Division

Industry forecasters and demographers anticipate that sustained development of mineral resources will continue to drive population growth in western North Dakota through the 2030 planning horizon for this Capital Improvement Plan. In its expected migration scenario, the North Dakota Census Office projects that McKenzie County's population will reach 23,492 by 2030[1]. With

[1] North Dakota Census Office Population Projections of the State, Regions, and Counties 2016

prospects for continued growth through 2030, McKenzie County must continue to adapt, expand, and maintain its transportation infrastructure.

## Oil and Gas Transmission

The geography of oil and gas extraction, processing, and distribution shapes travel patterns throughout the region. Active oil wells are located throughout McKenzie County, but extraction is most intense in the County's northern and eastern regions. Oil well density is highest near Johnson's Corner, which is located at the junction of Highway 23, Highway 73, and County Road 53.

Johnson's Corner is aligned with the Dakota Access Pipeline (DAPL). A large oil storage complex is located nearby (See Figure 3). This storage complex and others like it receive crude from feeder lines and store raw product prior to transport via pipeline or truck. Active oil wells, oil storage complexes, fracking-fluid disposal sites, and related industrial and commercial nodes generate substantial truck traffic throughout the year.

The Dakota Access Pipeline is a 1,172-mile underground crude oil transmission line. It begins in the Bakken formation in western North Dakota and ends near Patoka, Illinois. The pipeline alignment traverses McKenzie County, passing south of Watford City and parallel to Highway 23. It turns south at Johnson's Corner and passes around Fort Berthold Reservation. When it opened in 2017, the pipeline increased productivity, lowered distribution costs, and helped relieve some of the strain on the regional highway system.

In addition to Dakota Access Pipeline, hundreds of smaller pipelines crisscross McKenzie County. Some of these pipelines feed oil directly DAPL. Others convey oil to storage tanks, which are commonly located adjacent to the state highway system. Alignments for hazardous liquid pipelines are viewable at the National Pipeline Mapping System.

Large storage tanks receive oil from gathering lines and hold it prior to further distribution. Two large storage complexes are associated with DAPL – one is located just east of Johnson's Corner and another is located at Wilson's Station on Highway 85 south of Watford City. Other storage complexes are not connected to DAPL. One is located on Highway 85, about halfway between Alexander and Williston. Another is located on Highway 58, near the state line. This second site has access to rail and transloading facilities, but the capacity to move oil is currently limited because this area has a relatively weak connection to the pipeline system.

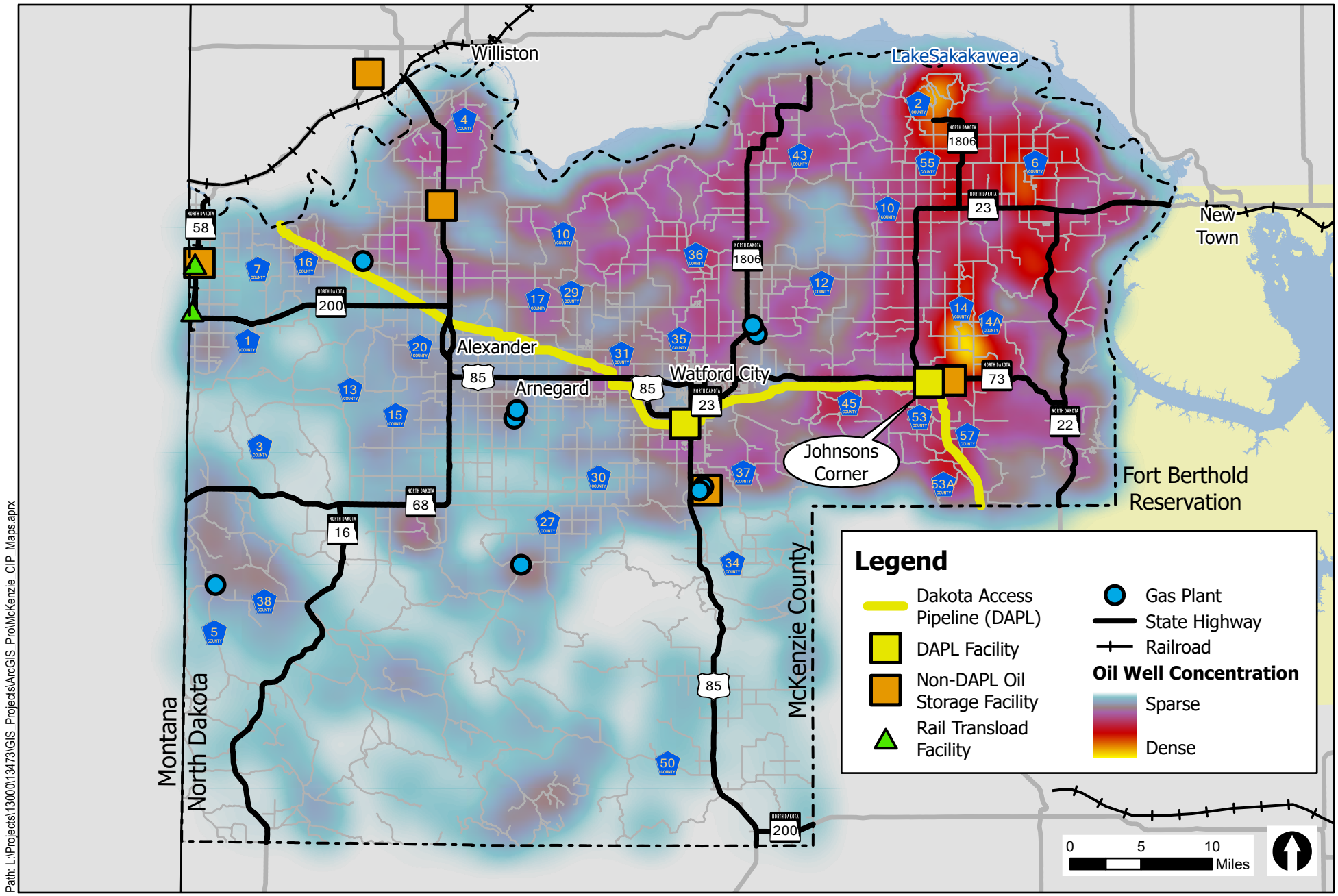



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**Figure 3: Oil and Gas Extraction, Collection, and Distribution System**

McKenzie County, North Dakota

McKenzie County Capital Improvement Plan

## Regulatory Environment

Federal policy influences oil production and distribution in the Bakken. However, federal policy is uncertain; for example, the regulatory environment may shift with changes in Congress or the presidency. This Plan assessed two critical issues/assumptions that impact the ability of the oil economy to expand its footprint and/or increase the rate of production:

1. Continued operation of the Dakota Access Pipeline versus pipeline closure
2. Expansion of oil leasing on federal lands versus a moratorium on drilling

### DAPL Operation

Construction of the Dakota Access Pipeline was controversial, drawing protests from tribal nations and environmental groups. As legal proceedings play out, the future of the pipeline is uncertain. In March 2020, a federal judge ordered the U.S. Army Corps of Engineers (USACE) to complete a full environmental review. A subsequent decision ordered the pipeline to be shut down but was later blocked on appeal. In the interim, Dakota Access was granted permission to add pumping stations to the pipeline's route, which would double the pipeline's capacity to 1.1 million barrels per day. Meanwhile, the oil industry is developing contingency plans, which could make up for some loss in productivity if DAPL were forced to close. One proposal involves converting 27 miles of a gathering line to a transmission line between Johnson's Corner and Wilson Station, located on Highway 85 south of Watford City.

Four of the 2030 forecast scenarios examine how traffic patterns would be affected if DAPL transmission ceases. If this occurred, oil production would decline. However, truck traffic to and from Wilson's Station, Johson's Corner, and other oil storage complex would be expected to increase to compensate for the reduction in pipeline transmission. The forecast scenarios are presented with additional detail in Chapter 4.

### Oil Leasing on Federal Lands

Shortly after his inauguration, President Joe Biden enacted a moratorium on new oil and gas leasing on federal lands. This policy does not affect activity on current leases. Federal land in McKenzie County includes land managed by the U.S. Army Corps of Engineers (USACE), Theodore Roosevelt National Park (North Unit), and national grasslands. Most of this land is located outside of primary oil production areas. Nevertheless, if the moratorium remains in place, it could limit opportunities for the oil and gas industry to expand in McKenzie County. Four of the 2030 forecast scenarios consider the effects of maintaining versus lifting the moratorium. Currently, the Bureau of Land Management has, as of August 2021, continued to issue leases for oil development on federal lands.

# Chapter 3: Existing Roadway System

## Roadway Classifications

Highways in McKenzie County are classified according to their ownership and relative significance in the hierarchy of transportation facilities. Jurisdiction indicates the unit of government responsible for the construction and maintenance of each roadway, whether at the state, county, or municipal level. Functional classification is a system of distinguishing roads based on their role in serving the area's transportation needs, and typically reflect the volume and trip distances of traffic served. Different functional classifications often have differing standards for how they are constructed, maintained, and operated.

### State Highways – NDDOT Classification

NDDOT classifies roads according to function. US Highway 85 is classified as an interregional corridor; as such, it is designed to serve interstate and intrastate trips and convey heavier traffic volumes. State highways in McKenzie County have lower classifications. ND Highways 22, 23, and 73 are classified as state corridors. They are intended to serve medium-distance intrastate trips and connect travelers to and from US Highway 85. Other state highways have a more localized function, serving primarily as farm-to-market roads (or oil-to-market roads). ND Highway 1806 is one example.

### County Roads – CMC/Non-CMC

Roadway data provided by McKenzie County indicates that the County's numbered highway system includes over 444 miles of roadway. Approximately 372 miles are classified as County Major Collectors (84%) (See Figure 4). The 72 remaining miles do not have the CMC designation; therefore, these routes could be considered minor collectors. NDDOT uses the CMC designation to prioritize funding for county routes that provide enhanced connectivity between communities and/or serve a critical economic function.

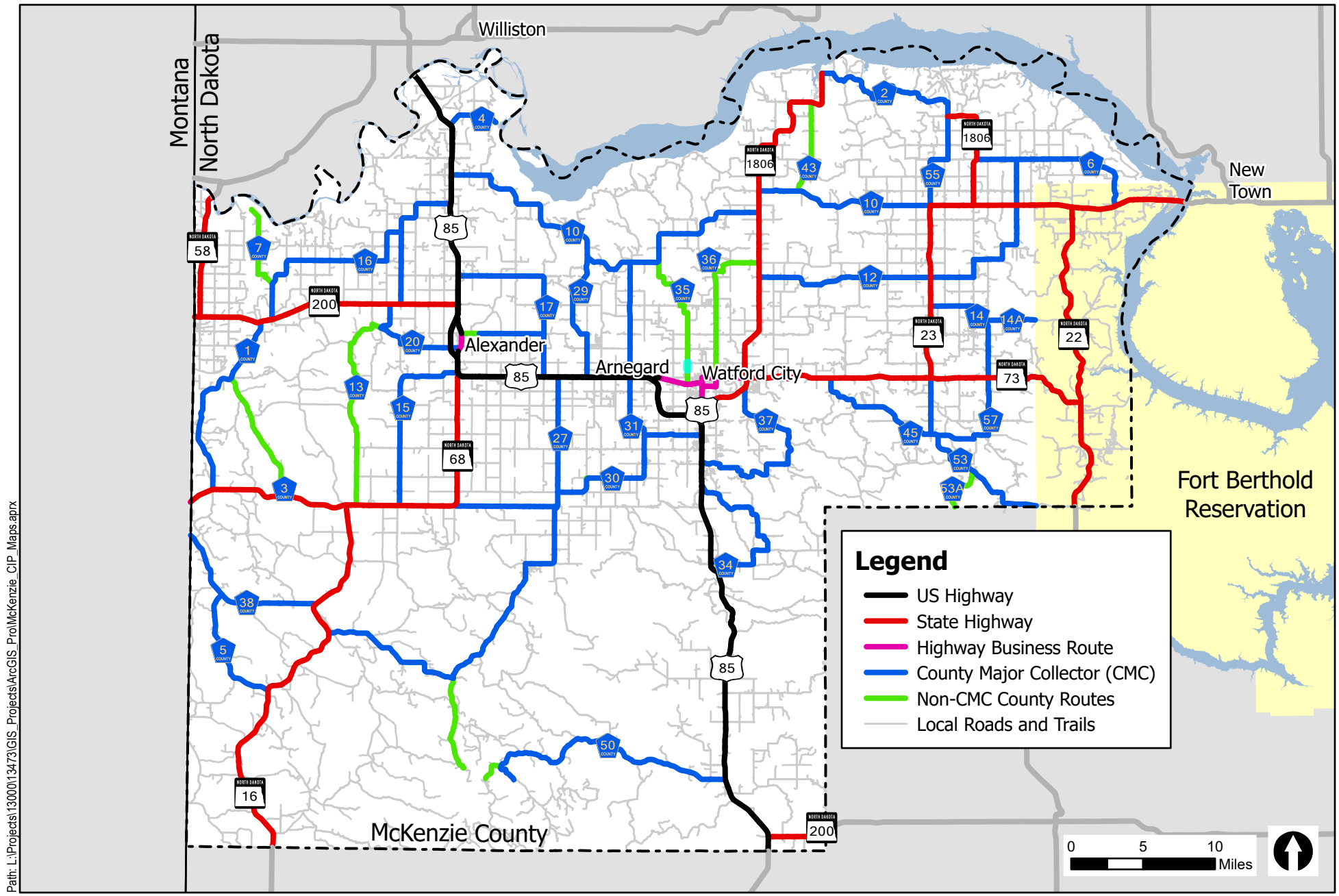


**Figure 4: Existing Roadway Classification**

McKenzie County, North Dakota

McKenzie County Capital Improvement Plan

# Roadway Conditions

## Surface Type

The priority roadway network in McKenzie County consists of paved and gravel roads. (Some very low-volume routes are graded and drained or minimum-maintenance trails.) All state and federal highways are paved. McKenzie County routes are paved asphalt or gravel surface. Figure 5 shows the surface type for the existing highway system. Since the last CIP was completed in 2014, the County has converted considerable mileage from gravel to paved. Table 1 summarizes the paved and gravel mileage for county routes.

**Table 1. Existing Roadway Surface – County Routes**

| Surface Type | County CMC Routes | | County Routes – Non-CMC | | County System Total | |
|---|---|---|---|---|---|---|
| | Miles | Percent | Miles | Percent | Miles | Percent |
| Paved | 208.1 | 55.9% | 4.0 | 5.6% | 212.1 | 47.7% |
| Gravel | 164.3 | 44.1% | 67.9 | 94.4% | 232.2 | 52.3% |
| **Total** | **372.4** | **100.0%** | **71.9** | **100.0%** | **444.3** | **100.0%** |

## Pavement Age

McKenzie County works uses the Geographic Roadway Inventory Tool (GRIT) developed by Upper Great Plains Transportation Institute (UGPTI) to monitor pavement age. In lieu of detailed information on road condition, a general indication of pavement condition can be gleaned from the construction year. GRIT depicts the age of pavement in 5-year increments (0-5 years old, 6-10 years, etc.).

Understanding the age of paved surfaces, as well as the amount of new pavement that will soon be added to the County Road system, is an important step in assessing future system maintenance needs. A typical bituminous surface might have a lifespan of 20-30 years, or less if subjected to sustained heavy loads. Investments in resurfacing and regular maintenance can prolong roadway life and delay the need for more costly improvements. Figure 6 maps pavement age for County Routes. Roads in gray include unpaved roads and State/Federal Highways (data not available). Note that County Road 55 is being reconstructed in 2021.

## Structures

The Capital Improvement Plan does not identify specific improvements to county structures. Structures should be inspected periodically to identify issues and program improvements. McKenzie County's bridge inventory dashboard identifies the current condition of structures in the county.

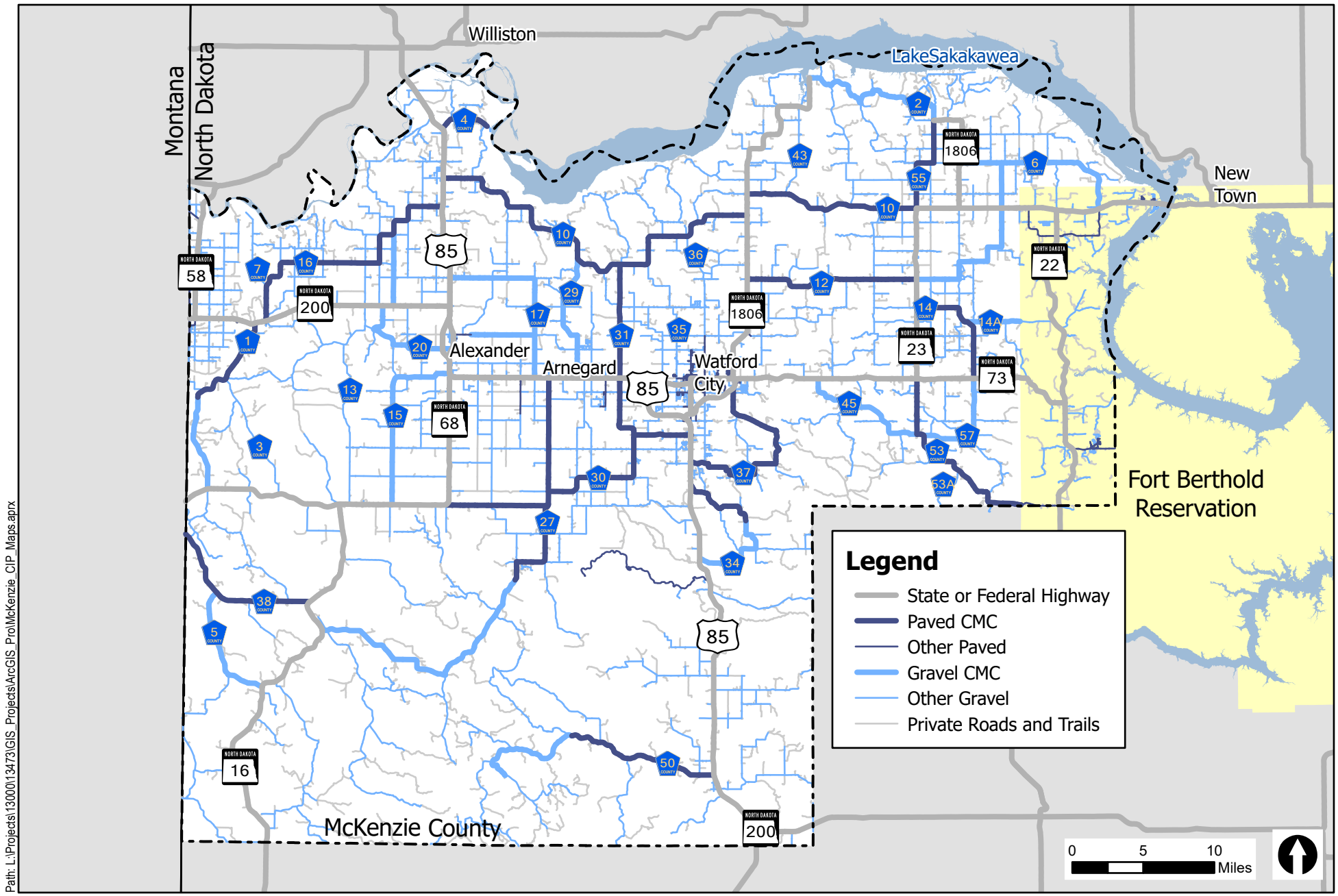


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**Figure 5: Existing Roadway Surface**

McKenzie County, North Dakota

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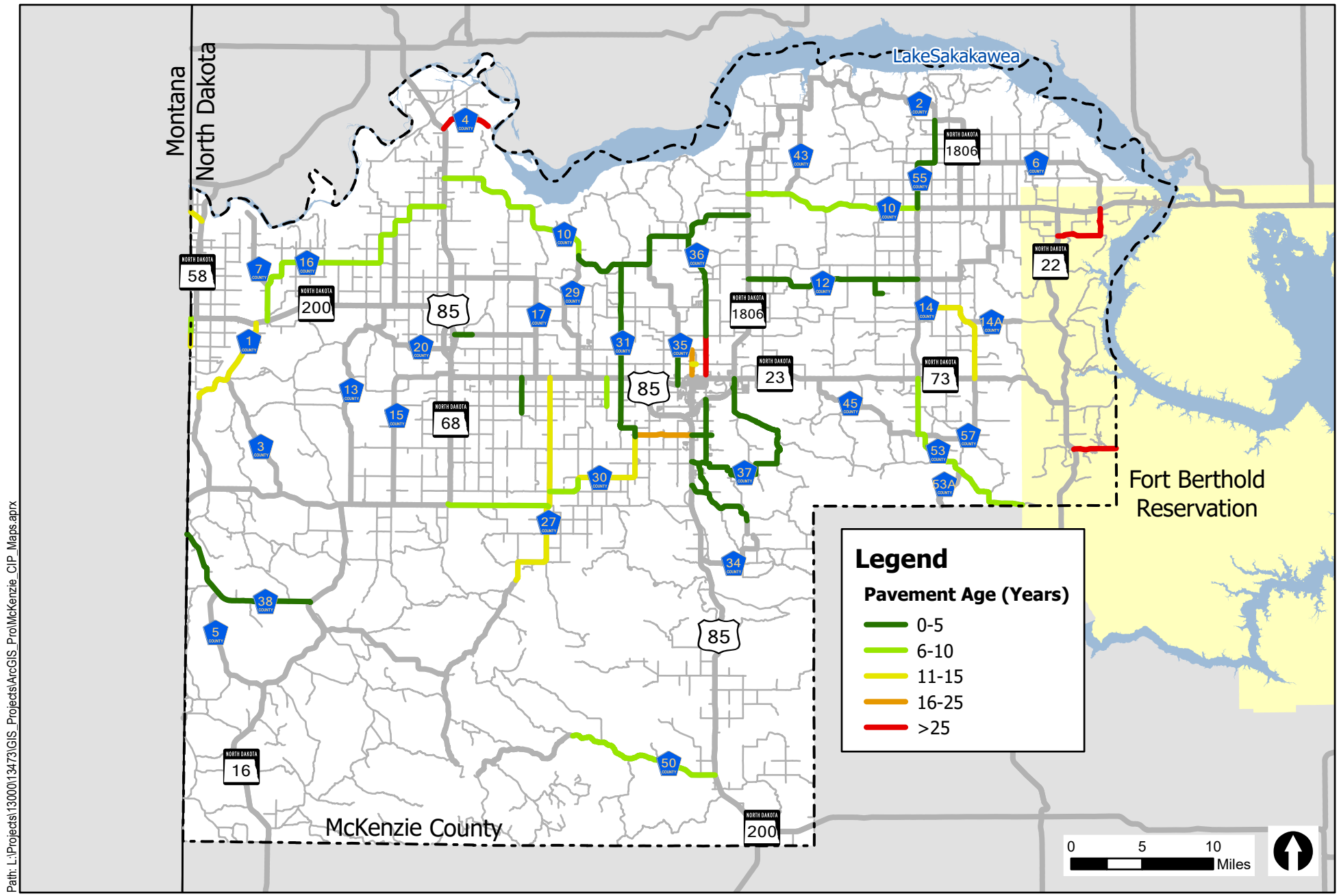


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**Figure 6: Pavement Age**

McKenzie County, North Dakota

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## Traffic Volumes

The North Dakota Department of Transportation provides estimates for average daily traffic and truck traffic on state and federal highways. Traffic counts for the rest of the roadway system are not publicly available. To estimate traffic volumes for county roads and local roads, traffic volumes were compiled using INRIX origin-destination data, then adjusted to reflect available NDDOT data. Figure 7 shows the average daily traffic (ADT) volumes that were modeled for 2019; Figure 8 shows average daily truck traffic. In general, traffic volumes are highest in and around Watford City. ADT exceeds 11,000 vehicles per day on U.S. Highway 85 south of Watford City. Volumes are also higher near Williston and New Town, which generate trips across the County border. In addition, portions of County Road 10 (CR 10) exceed 2,000 vehicles per day; volumes on CR 10 are higher than those for some state highways, including most of Highway 1806, Highway 68, and Highway 58. In this respect, CR 10 carries traffic volumes more typical of a state highway than a county road.

### Truck Volumes

Figure 8 shows existing truck volumes. In contrast to total vehicle traffic, the highest truck volumes are focused within McKenzie County's oil production region. Highways 22, 23, and 73 carry higher truck volumes than Highway 85. On portions of CR 10, truck volumes exceed 500 trips per day, so that trucks constitute approximately 25 percent of all traffic.

Heavy truck traffic has an outsized effect on congestion. This is because semi-trucks and other rigs require more room to maneuver than cars, and because they cannot accelerate or decelerate as quickly as cars can. To capture trucks' effect on forecast traffic volumes, this Plan assumes that each truck is equivalent to three cars and converts car and truck volumes to a single metric called passenger car equivalent (PCE). Using PCE allows for an apples-to-apples comparison of roadway volumes.

### Truck Loads

Trucks exert an even greater impact on roadway deterioration. In order to compare the force of a truck to the force of a car, vehicle weights are converted to a common metric called the equivalent single axle load (ESAL). Truck ESALs will vary depending on the loaded and unloaded weight of the truck and the number of axles. The ESAL for passenger vehicles is roughly 0.0004; the ESAL for semi-trucks ranges from approximately 2.0 to 3.0; and the ESAL for the types of specialized oil trucks that are frequently used in McKenzie County ranges from roughly 3.0 to 9.0, or 7,500 to 22,500 times more than that for a car. To analyze impacts to County roads, this Plan assumes that the force of each truck is equivalent to 15,000 cars. Clearly, roads that are subjected to heavy truck volumes can quickly deteriorate, even if the volume of total vehicles is low or moderate.

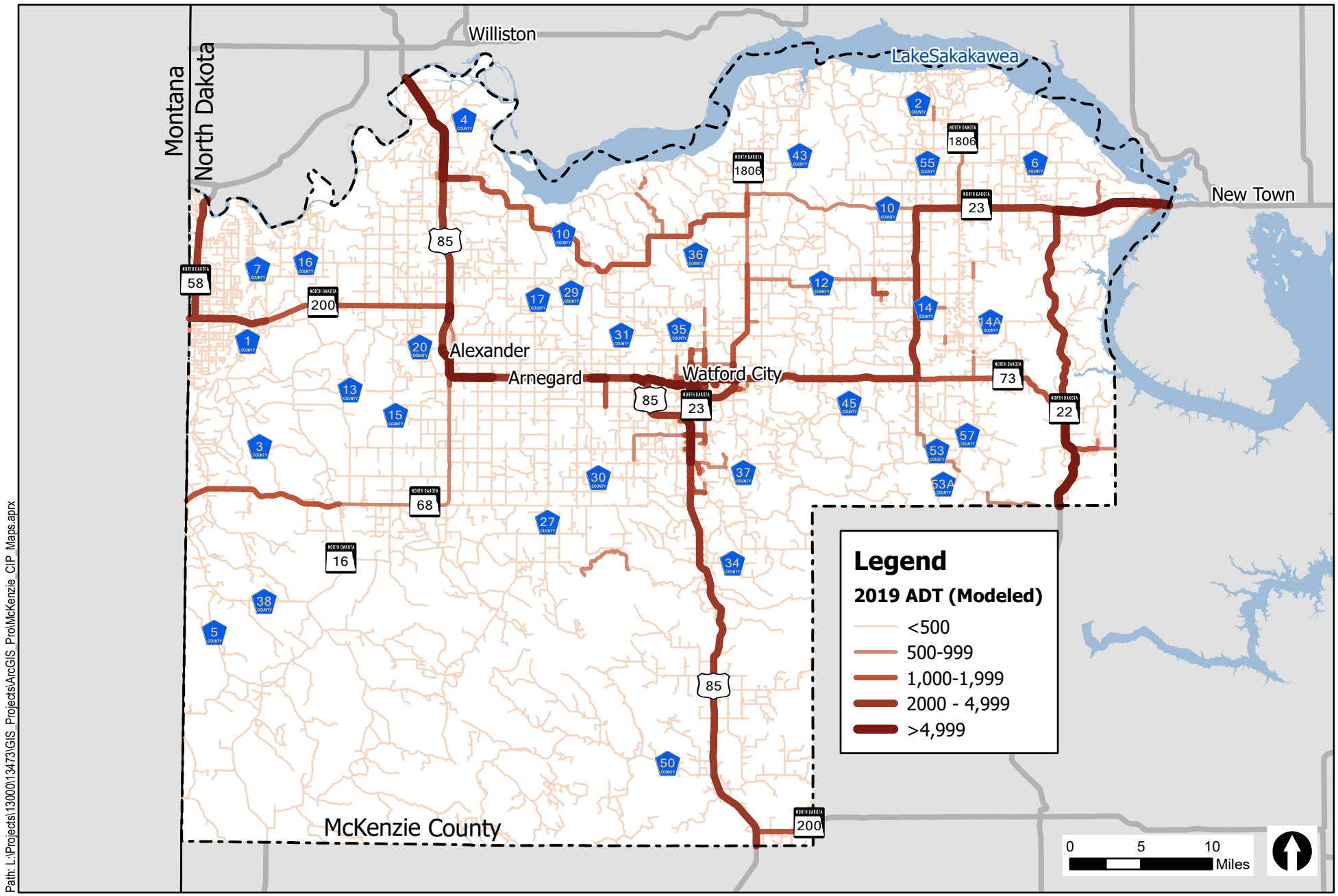


**Figure 7: 2019 Traffic Volumes**

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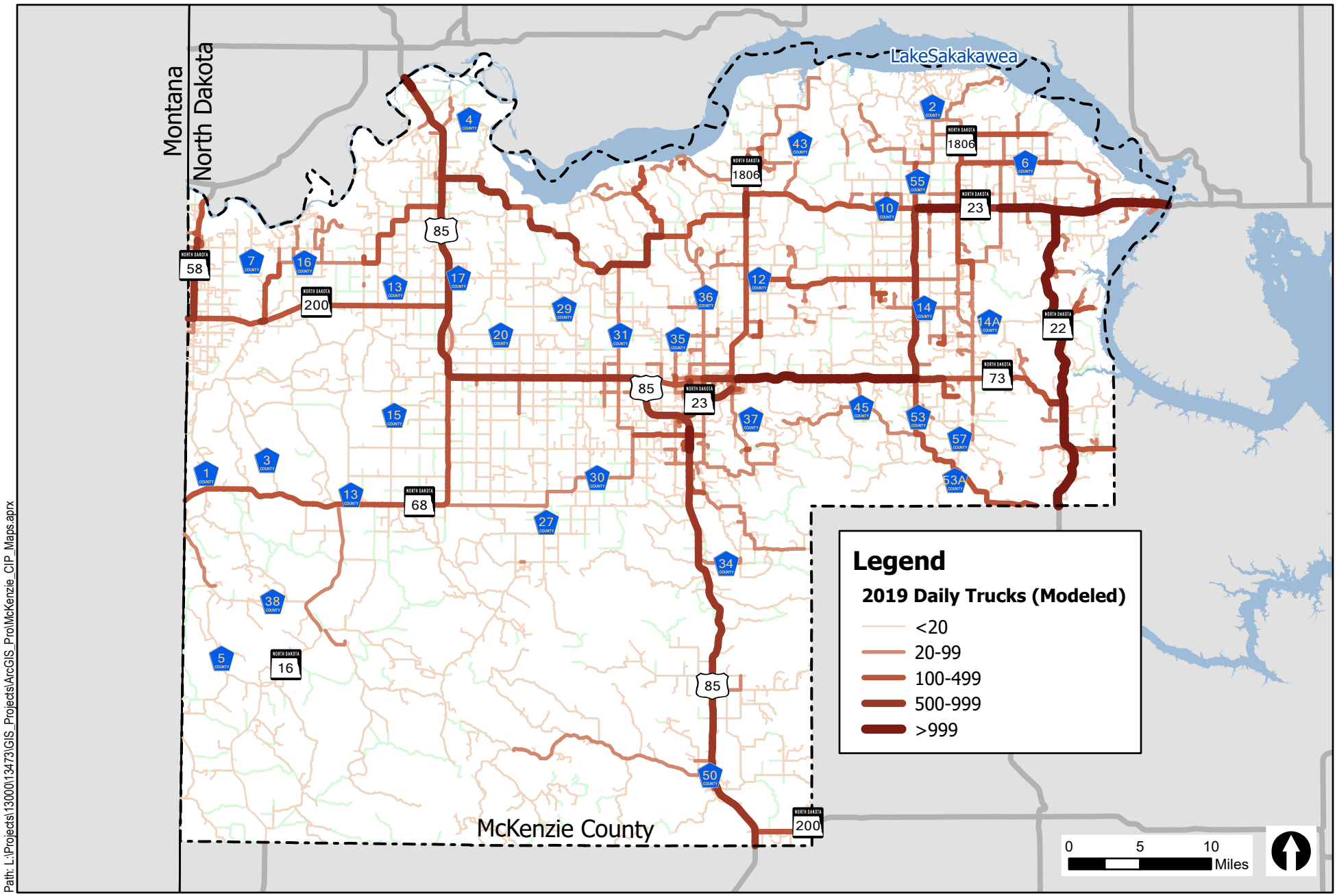


**Figure 8: 2019 Truck Volumes**

McKenzie County, North Dakota

McKenzie County Capital Improvement Plan

# Roadway Safety

## Crash History

From January 1, 2015 through December 31, 2019, 2,136 crashes were documented in McKenzie County, including 43 fatal crashes and 139 crashes that caused serious injury (See Figure 9). The total number of crashes increased each year from 2016 through 2019. Crashes tend to be concentrated within communities, along state highways, and at highway junctions. Fatal crashes tend to occur on high-volume, high-speed roads.

The McKenzie County Road Safety Plan provides a detailed analysis of county crash data and associated risk factors. It identifies high-risk segments of paved and gravel roads (See Figure 10). These findings are integrated into the recommended prioritization of projects that is provided in the Capital Improvement Plan.

**Table 2. Summary of Crash Severity (2015 through 2019)**

| Crash Severity | 2015 | 2016 | 2017 | 2018 | 2019 | 5-Year Total |
|---|---|---|---|---|---|---|
| Fatal Crashes | 12 | 8 | 8 | 5 | 10 | **43** |
| Serious Injury | 41 | 18 | 21 | 32 | 27 | **139** |
| Non-Serious Injury | 48 | 46 | 63 | 68 | 75 | **300** |
| Possible Injury | 53 | 18 | 24 | 24 | 26 | **145** |
| Property Damage Only | 335 | 247 | 265 | 303 | 369 | **1,509** |
| **Annual Total** | **489** | **337** | **381** | **432** | **497** | **2,136** |

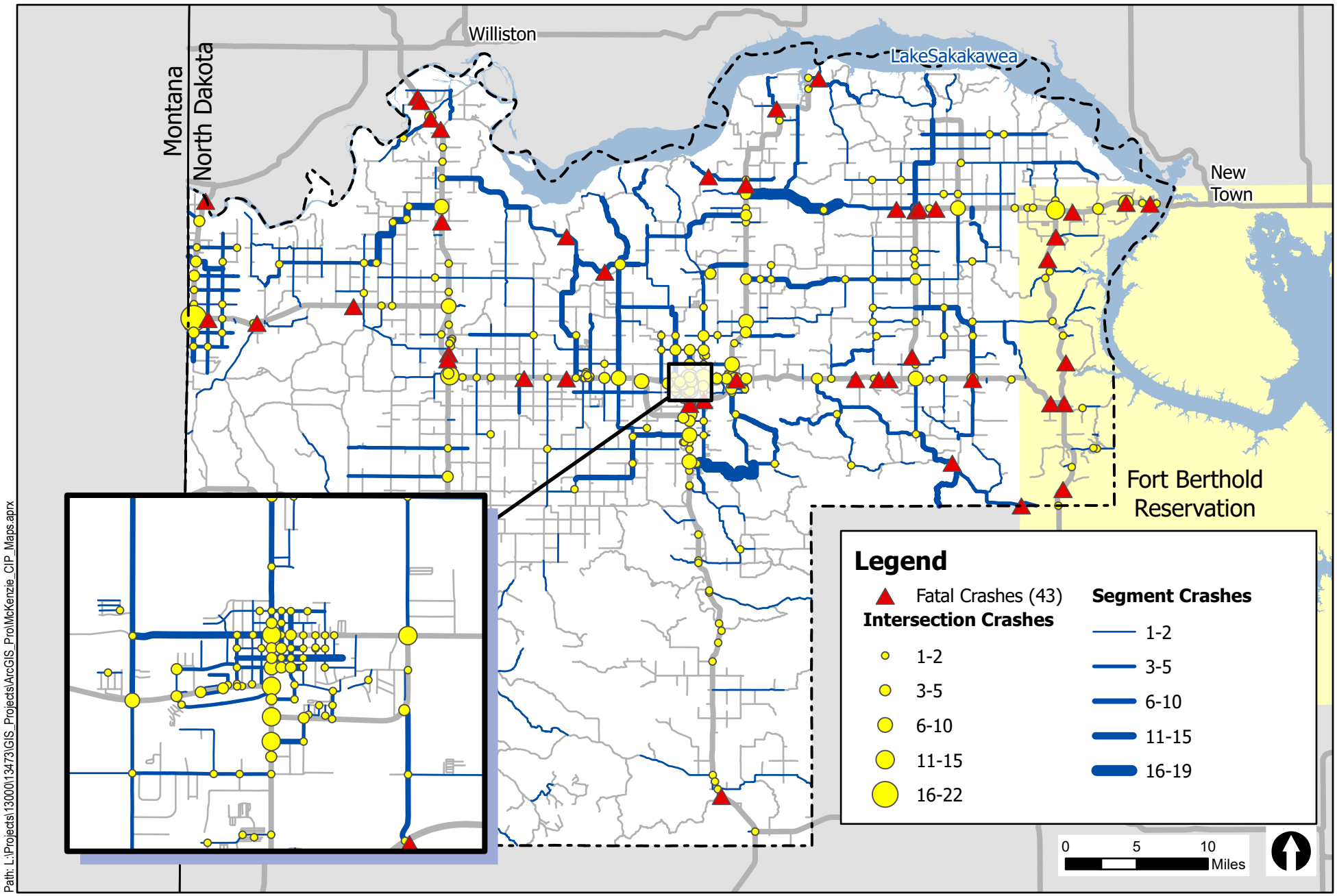


**Figure 9: Crash History (2015-2019)**

McKenzie County, North Dakota

McKenzie County Capital Improvement Plan

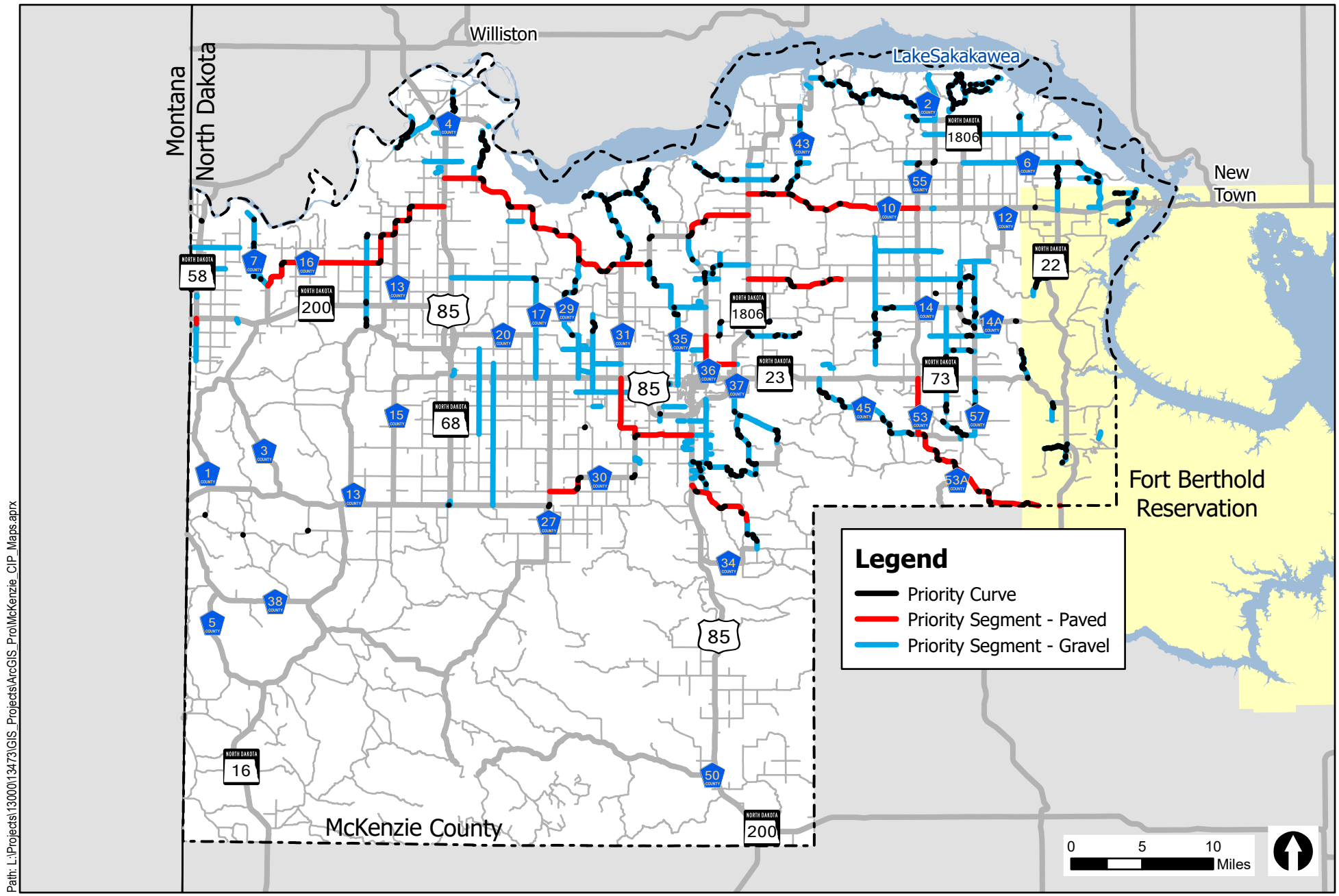


**Figure 10: Priority Safety Locations**

McKenzie County, North Dakota

McKenzie County Capital Improvement Plan

## 2020-2024 CIP

The 2020-2024 CIP provides the starting point for developing the 2030 CIP update. It consists of a list of projects, organized by year, with work descriptions and cost estimates. The estimated cost of projects that were programmed for 2020 totaled over $115 million. In 2021 and 2022, the total cost was approximately $75 million. The CIP was front-loaded in years 2020 through 2022, with fewer projects listed in 2023 and 2024. Annual budgets from the 2020-2024 CIP helped guide the development of the 2030 CIP update.

Four projects in the 2020-2024 CIP have been implemented or will be completed soon. All of these are pavement construction or reconstruction that were planned for 2020. These projects are:

- CR 37/125th Ave (21 miles)
- 2019 ETA Projects: 11th Ave SW, 14th St SW, and CR 35 in Watford City ETA (4.51 miles)
- 23rd St NW (1.25 miles)
- 113th Ave NW (1.5 miles)
- CR 55 (7.25 miles, under construction in 2021)

All projects contained in the 2020-2024 CIP that have not been completed were reviewed to assess whether they should be carried forward. Figure 11 shows the projects included in the 2020-2024 CIP.

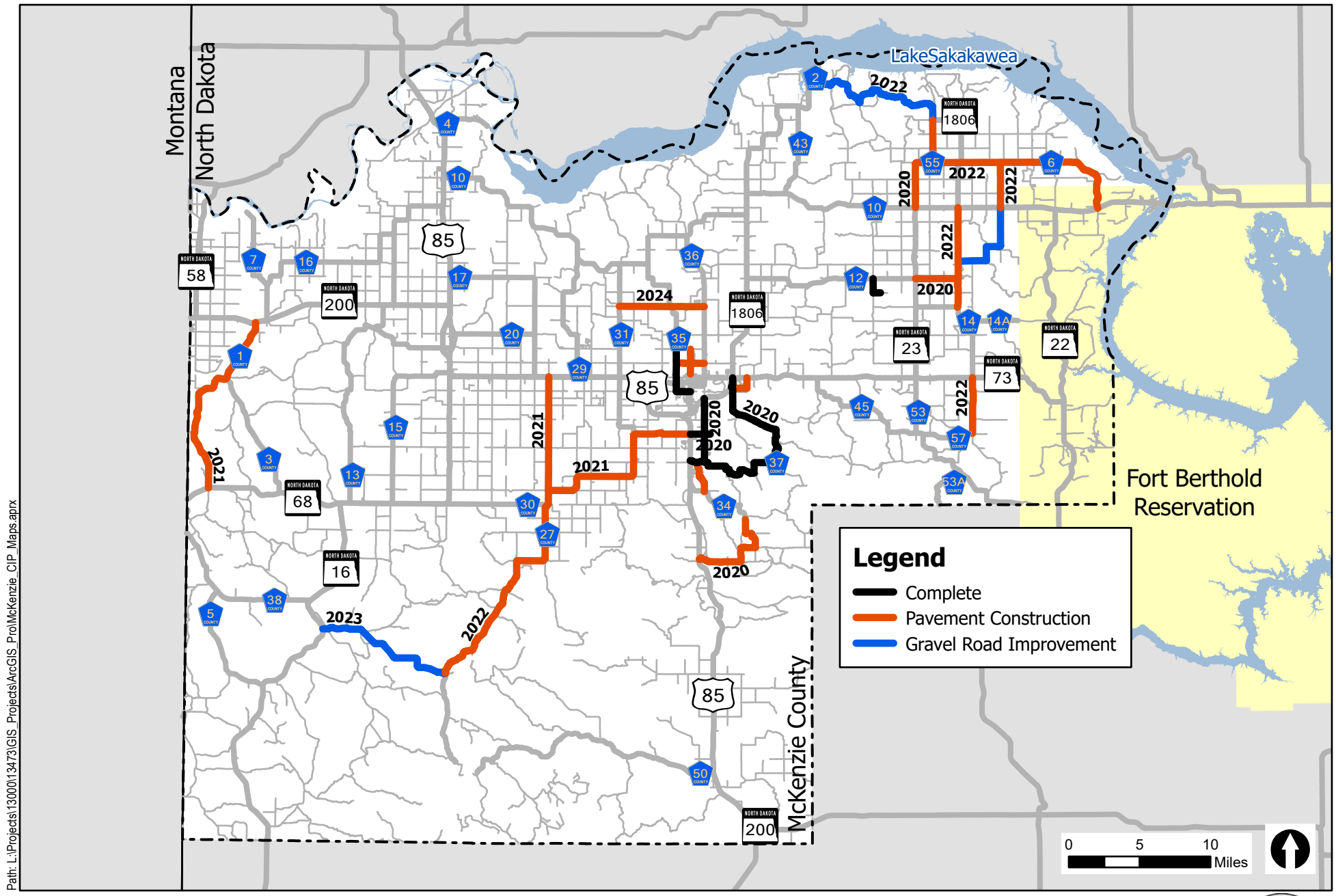


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**Figure 11: 2020-2024 CIP**

McKenzie County, North Dakota

McKenzie County Capital Improvement Plan

# Chapter 4: 2030 Growth Forecasts

The next two chapters are focused on future travel conditions in McKenzie County. This chapter documents the scenario-based approach used to forecast McKenzie County population and employment out to year 2030. Chapter 5 describes how population and employment growth forecasts were translated into estimates of future traffic volumes on McKenzie County roadways.

2030 growth forecasts were developed using a two-step process.

1. Develop growth scenarios.
2. Develop population and employment estimates for year 2030.

## 2030 Growth Scenarios

A scenario-based approach to forecasting acknowledges the future is uncertain, and that any one prediction is almost certainly wrong. Under scenario-based forecasting, multiple forecasts are developed according to factors likely to shape future conditions. These scenarios can then be used to create a range of possible outcomes and a probabilistic assessment of future needs.

2030 growth scenarios for this analysis were developed in consultation with public and private sector stakeholders from McKenzie County and the surrounding region. These stakeholders were invited to a workshop in December 2020 for the purpose of identifying potential drivers of county growth. In this context, a driver is an economic, social, political, or environmental condition that is highly correlated with growth in county population and employment. At the workshop, stakeholders were shown maps displaying year 2018 population and employment and were asked to identify the conditions most likely to result in significant growth over the next 10 years. In addition, the group discussed the conditions most likely to cause growth to slow and stall. Under each scenario, stakeholders were further asked to locate areas most likely to experience above average growth rates.

**December 2020 Workshop**

- Watford City
- MHA Nation
- US Forest Service
- Richland County, MT
- ND Petroleum Council
- Upper Great Plains Transportation Institute
- McKenzie County

### Growth drivers

Stakeholders identified the following drivers of population and employment growth in McKenzie County:

- Energy prices
- Access to federal lands for oil and gas extraction
- Operation of the Dakota Access Pipeline

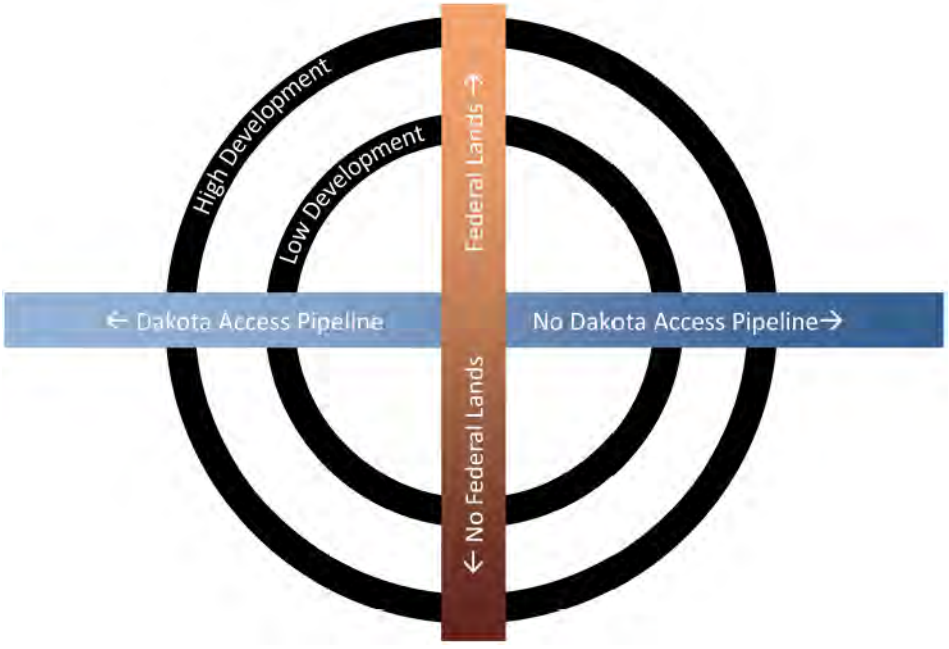
**Energy prices.** Stakeholders identified energy prices as the primary driver of population and employment growth in the county. Assuming high global and/or national demand for oil and gas, stakeholders expect there to be continued oil and gas drilling and a high level of oil and gas production and transport. This activity, in turn, drives employment in multiple energy and energy-dependent sectors and attracts additional households to the county in search of employment opportunities.

**Access to federal lands.** Stakeholders also identified access to federal land as an important driver of where 2030 population and employment would be located. Much of the southern portion of the county is designated as national grassland with additional restrictions and regulations governing oil and gas extraction. Stakeholders indicated that employment could grow in southern McKenzie County if regulatory agencies permit drilling of new oil and gas wells on federal land.

**Operation of the Dakota Access Pipeline.** Continued operation of the Dakota Access Pipeline (DAPL) was another factor brought up by stakeholders as important to how the county develops. As with federal land access, a decision to continue or discontinue DAPL operation would have minimal impact on population and employment growth magnitude, but it could have a significant impact on oil productivity and distribution, with transport shifting to other pipelines and highway freight.

Stakeholder input into the development of year 2030 growth scenarios was summarized in the 2030 Growth Scenario Matrix displayed in Figure 12. This figure combines three stakeholder identified growth drivers – energy prices, federal land access, and DAPL operation – into eight scenarios represented by the intersection of the bars and circles in the figure. The inner circle represents county growth under scenarios with low energy prices. The outer circle represents county growth under scenarios with high energy prices.

**Figure 12. 2030 McKenzie County Growth Matrix**



# 2030 Population and Growth Estimates

The next step in the process of forecasting year 2030 population and employment in McKenzie County was to develop reasonable estimates of county population and employment under high and low growth scenarios. Per the scenarios described in the previous section, these estimates quantify the potential impact of future events on county population and employment. The scenarios, in turn, provide rationales for projecting future employment and assessing the probability of actual 2030 employment approaching the high or low-end estimates.

This step had three parts:

1. Categorize McKenzie County employment in year 2018 into energy sector employment and non-energy sector employment.
2. Generate a range of year 2030 employment projections based on a review of published population, employment, or energy production forecasts for McKenzie County or the surrounding region.
3. Establish high and low county growth targets from selected forecasts.

## Categorize McKenzie County employment

Employment data was collected from US Census estimates for year 2019 in McKenzie County. The data was organized by North American Industry Classification System (NAICS) codes, a standardized job classification system used nationally. This data was available at the census block level and was restructured to the McKenzie County TAZ structure developed for this study. The data maintained the NAICS code system and was grouped into energy and non-energy sector job categories as shown in Table 3. These categories were used because energy and non-energy sector jobs were expected to have different growth trends within McKenzie County. When forecasting future employment, the total expected growth for energy and non-energy jobs was used to grow the NAICS code employment groups by those job sectors accordingly.

**Table 3. Current Employment Classification Summary**

| Sector | NAICS Code | Industry Classification | 2019 McKenzie County Jobs |
|---|---|---|---|
| Energy | NAICS_21 | Mining, Quarrying, and Oil and Gas Extraction | 1,456 |
| | NAICS_22 | Utilities | 11 |
| | NAICS_23 | Construction | 1,062 |
| | NAICS_48_4 | Transportation and Warehousing | 1,521 |
| Non-Energy | NAICS_11 | Agriculture, Forestry, Fishing and Hunting | 26 |
| | NAICS_31_3 | Manufacturing | 4 |
| | NAICS_42 | Wholesale Trade | 414 |
| | NAICS_44_4 | Retail Trade | 471 |
| | NAICS_51 | Information | 30 |
| | NAICS_52 | Finance and Insurance | 101 |
| | NAICS_53 | Real Estate and Rental and Leasing | 198 |
| | NAICS_54 | Professional, Scientific, and Technical Services | 212 |
| | NAICS_55 | Management of Companies and Enterprises | 2 |
| | NAICS_56 | Administrative and Support and Waste Management and Remediation Services | 126 |
| | NAICS_61 | Educational Services | 499 |
| | NAICS_62 | Health Care and Social Assistance | 235 |
| | NAICS_71 | Arts, Entertainment, and Recreation | 438 |
| | NAICS_72 | Accommodation and Food Services | 488 |
| | NAICS_81 | Other Services (except Public Administration) | 241 |
| | NAICS_92 | Public Administration | 1,628 |

## Generate a range of year 2030 employment forecasts

A review of published forecasts of population and employment in McKenzie County and the surrounding area identified two forecasts that were well suited to serve as proxies for growth in energy sector employment and two forecasts that were well suited to serve as proxies for growth in non-energy employment. Table 4 identifies these forecasts by sector.

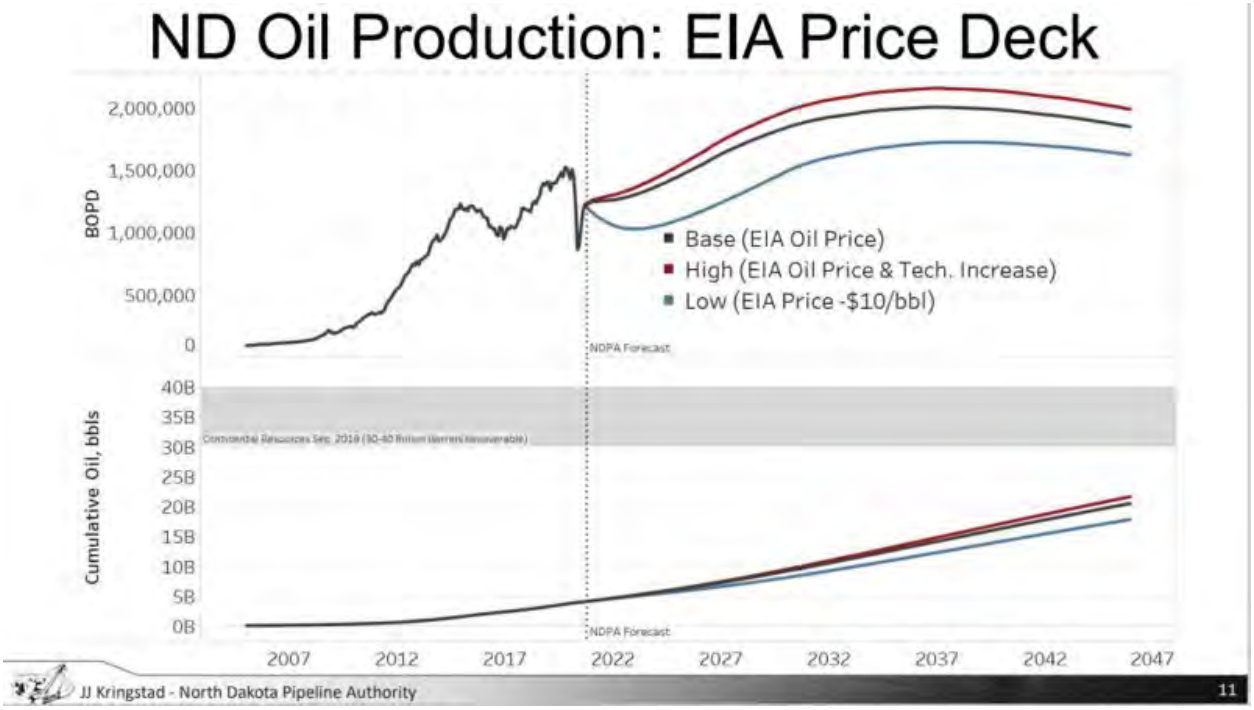
**Table 4. Sources of McKenzie County Employment Growth Rates, by Sector**

| Sector | Proxy forecasts | Source |
|---|---|---|
| Energy | North Dakota Oil Production (published February 2021) | North Dakota Pipeline Authority |
| Energy | Williston Basin 2040 Employment, Population, and Housing Forecast | North Dakota State University |
| Non-energy | 2030 Population Projection | North Dakota Census Office |
| Non-energy | 2030 Enrollment Projection (published January 2021) | McKenzie County School District |

### Energy Sector Employment Forecasts

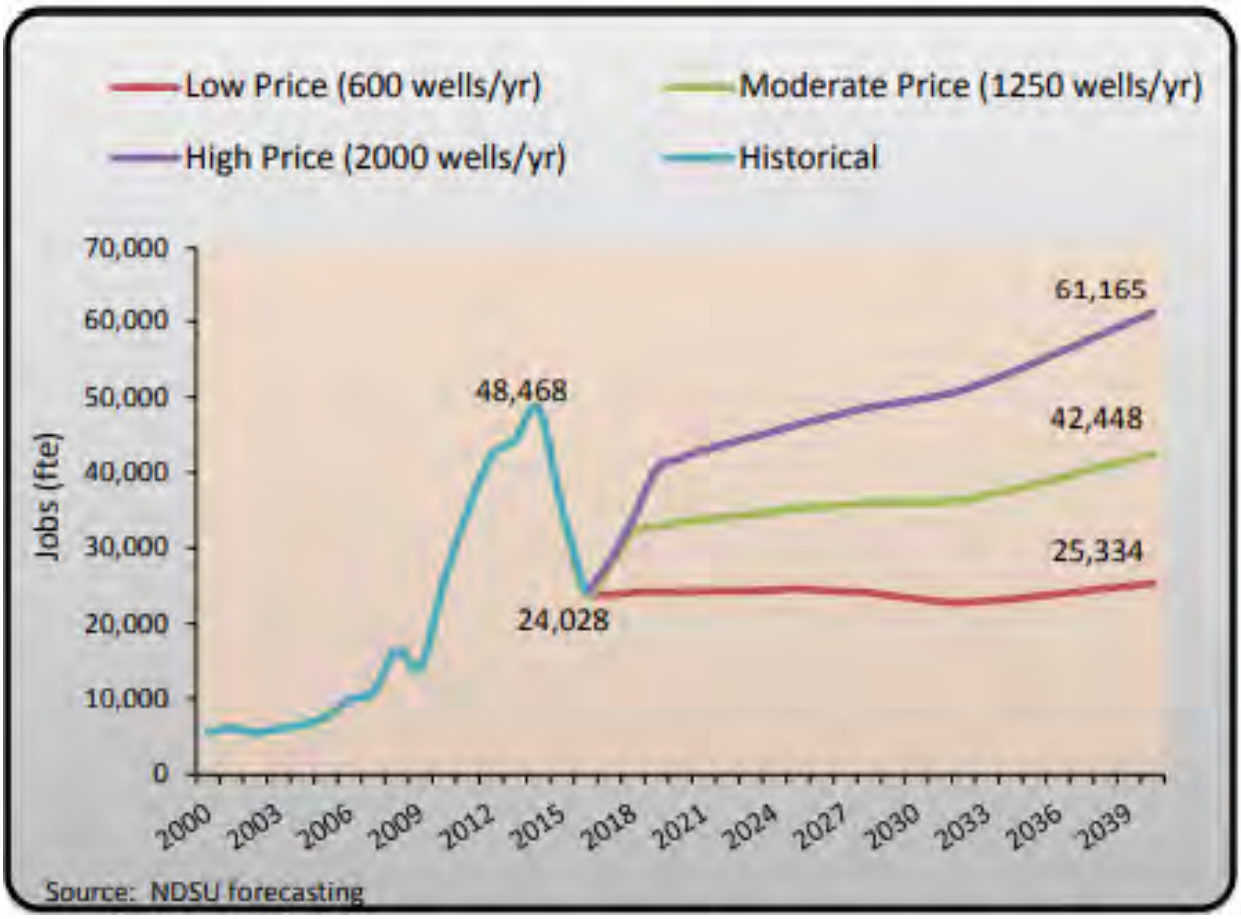
The energy production forecasts used in this analysis were provided by the North Dakota Pipeline Authority (NDPA). The NDPA maintains a series of charts combining industry forecasts of oil and natural gas demand with regional forecasts of oil and natural gas production. Figure 13 presents the NDPA forecasts used in this analysis to estimate year 2030 energy sector activity. The chart shows three trajectories for oil production in the Bakken formation, based on variable oil prices and technology innovation, as well as a forecast for cumulative production through 2047. These trajectories indicate that under a high energy price scenario, barrels of oil produced per day (BOPD) would nearly double from approximately 1.2 million BOPD to over 2.0 million BOPD.

**Figure 13. North Dakota Oil Production Forecasts**



A second forecast used to estimate growth in energy sector employment in McKenzie County was obtained from the Williston Basin 2040 Employment, Population, and Household Forecast, published by North Dakota State University in 2016. Whereas the NDPA forecast looked at the impact of variable energy prices on regional oil production, the NDSU forecast depicted in Figure 14 goes a step further and estimates energy sector employment in the region under high, moderate, and low energy price scenarios. Figure 14 expresses oil production in terms of new oil wells per year. Relative to BOPD, well drilling is both more sensitive to energy prices and labor intensive. This results in much greater differences between the high, medium, and low trajectories shown in Figure 14 than in Figure 13 above.

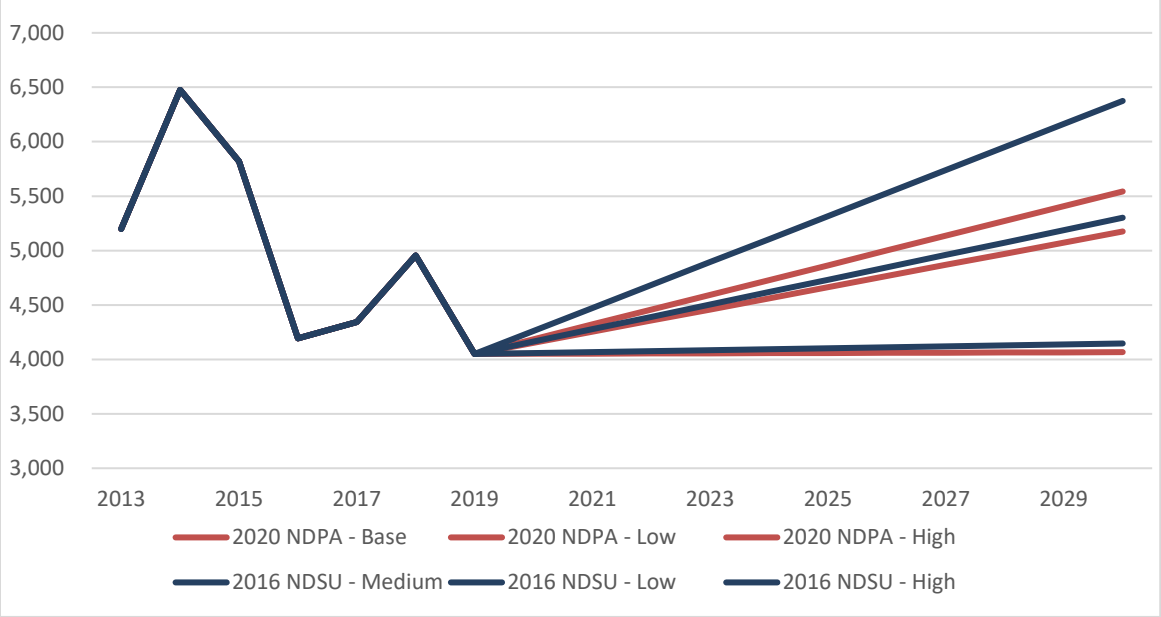
**Figure 14. North Dakota Energy Jobs Forecast by Energy Price**




Year 2018 to year 2030 growth rates were calculated for the high, base/moderate, and low-price scenarios under the NDPA and NDSU forecasts. These rates were then used to project year 2018 energy sector employment in McKenzie County out to year 2030. Figure 15 illustrates energy sector employment under each scenario, with red lines indicating employment projections based on NDPA forecast scenarios and blue lines indicating employment projections based on NDSU forecast scenarios. The figure shows that the NDSU high price scenario generates significantly higher levels of energy sector employment than is generated using NDPA growth rates. In contrast, Figure 15 shows general alignment between energy sector employment projections calculated using NDSU

moderate, NDPA high, and NDPA base scenario growth rates. The figure also shows strong alignment between energy sector employment projections calculated using NDSU low and NDPA low scenario growth rates.

**Figure 15. McKenzie County Energy Jobs Trends**




## Non-Energy Sector Employment Forecasts

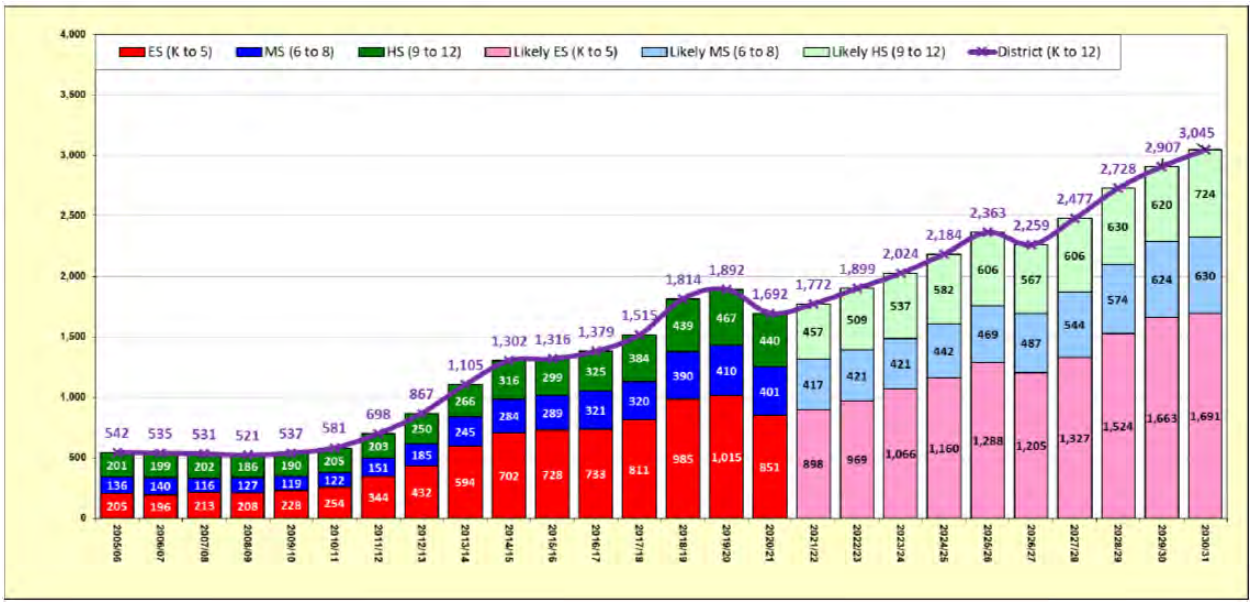
Estimates of non-energy sector employment were based on the North Dakota Census Office's 2030 Population Forecast for McKenzie County and a 2030 student enrollment projection produced for the McKenzie County School District. This approach assumes that while energy sector employment in McKenzie County may grow at rates independent of county population, employment in non-energy sectors is highly correlated with population growth.

As shown in Table 5, the North Dakota Census Office developed McKenzie County population estimates under three scenarios of migration to the state: expected migration, high migration, and low migration. Under a scenario of high migration, the Census Office estimates that McKenzie County population will increase to nearly 28,000 residents, nearly twice the county's current population. Under a low migration scenario, the Census Office estimates McKenzie County population will grow by about 4,000, or 28 percent, to 19,200 residents. MCSD enrollment projections assume a growth rate similar to the Census Office's high migration scenario. As shown in Figure 16, MCSD expects student enrollment to increase by more than 1,200 students, or 70 percent, between year 2021 and year 2030.

**Table 5. McKenzie County 2030 Population Projections**

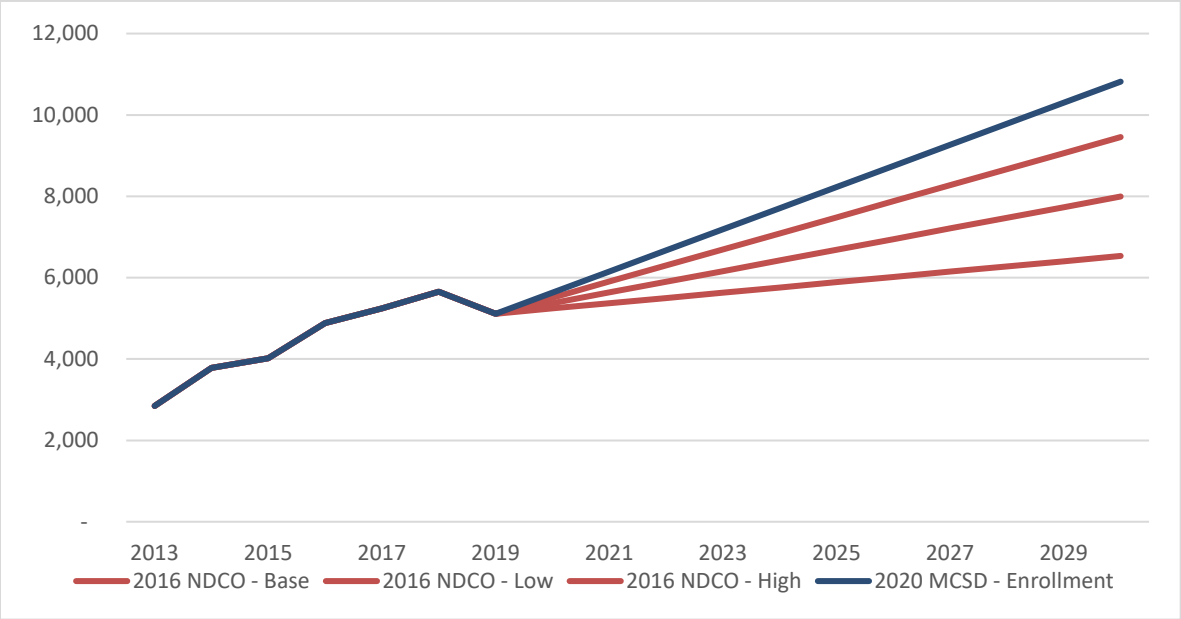
| Scenario | New Residents | Growth Rate | 2030 Population |
|---|---|---|---|
| Expected | 8,468 | 56% | 23,492 |
| Low | 4,176 | 28% | 19,200 |
| High | 12,761 | 85% | 27,785 |

**Figure 16. McKenzie County School District Enrollment Projections**




Year 2018 to year 2030 growth rates were calculated for the high, expected, and low-migration scenario under the North Dakota Census Office forecast and the MCSD enrollment projection. These rates were then used to project year 2018 non-energy sector employment in McKenzie County out to year 2030. Figure 17 illustrates non-energy sector employment under each scenario, with red lines indicating employment projections based on Census Office forecast scenarios and blue lines indicating employment projections based on the MCSD student enrollment projection. The figure depicts a range of 2030 employment estimates, from slightly more than 6,000 non-energy sector jobs under the Census Office low-migration scenario to nearly 11,000 non-energy sector jobs under the MCSD enrollment forecast.

**Figure 17. McKenzie County Non-Energy Jobs Trends**




## 2030 Employment Targets

Year 2030 employment targets were established for a high and low-growth scenarios based on the analysis presented in the previous section. For energy-sector employment, this analysis excluded the employment estimate calculated under the NDSU high-price scenario forecast. A high county growth target for energy sector employment was established by taking the high end of the relatively tight band of employment projections calculated under the NDSU moderate-price scenario, the NDPA high-price scenario, and the NDPA expected price scenario. A low county growth target for energy sector employment was established by dividing the high county growth target in half.

A similar approach was used for establishing non-energy sector employment targets. The high county growth target for non-energy sector employment was established by applying the population growth assumed under the North Dakota Census Office high migration scenario. The low county growth target for non-energy sector employment was established by dividing the high county growth target in half.

This approach resulted in the year 2030 employment targets presented in Table 6. Under a low growth scenario, the county is expected to add about 5,000 residents, 700 energy jobs, and slightly less than 2,000 non-energy sector jobs between year 2019 and year 2030. Under a high-growth scenario, the county is expected to add about 10,000 residents, 1,500 energy jobs, and 4,000 non-energy sector jobs between year 2019 and year 2030.

**Table 6. McKenzie County Year 2030 Growth Targets**

| Growth Area | 2019 Base | 2030 Low-Scenario | 2030 High-Scenario |
|---|---|---|---|
| Population | 15,024 | 20,000 (+30%) | 25,000 (+60%) |
| Energy Jobs | 4,050 | 4,750 (+20%) | 5,500 (+40%) |
| Non-Energy Jobs | 5,113 | 7,000 (+40%) | 9,000 (+80%) |
| Energy Production | 18.3 m | 25 m | 35m |

# Chapter 5: 2030 Traffic Forecasts

Future traffic volumes are a key input to identifying and prioritizing future highway investments. This chapter summarizes the process used to forecast year 2030 traffic throughout McKenzie County. This process uses the employment and population scenarios to grow existing auto and truck trips to estimate future traffic volumes.

## Approach

Year 2030 traffic forecasts were produced from a set of forecasted development assumptions, trip generation, trip distribution, and trip routing processes. The forecast methods relied on U.S. Census Bureau estimates of population and employment, local oil activity data, and existing INRIX trip records.

## Socioeconomic Data/TAZ Allocation

A transportation analysis zone (TAZ) structure was developed for McKenzie County with a total of 610 zones. TAZs are used in transportation planning to spatially aggregate land uses and generate trip productions and attractions to analyze impacts to the transportation system. This TAZ structure was developed by aggregating the year 2010 U.S. Census Block data into larger zones that share a common travelshed. The delineation of these zones considered existing and future land use patterns, existing roadway alignments, geographical features, locations of oil activity, municipal boundaries, and other factors.

Base year 2019 socioeconomic (SE) data was developed for each TAZ, which included data for the number of households, population, number of employees classified by the North American Classification System (NAICS) code, and the number of oil wells, rigs, and gas plants. Households, population, and employment data were all developed using the 2010 U.S. Census data. This data was then replaced with 2019 data, where available, or scaled to estimate 2019 conditions. Data for wells, rigs, and plants was provided by local sources and spatially joined to the TAZ structure to get existing totals by TAZ.

Future year 2030 SE data were forecast using the year 2019 data as a base and allocating growth required to reach the low-growth and high-growth county targets developed for this study. For both the low-growth and high-growth scenarios, SE datasets were developed under a condition that federal leasing is permitted and a condition that federal leasing is not permitted. A second condition was introduced to model the impact of continued DAPL operation versus closure of the pipeline (See Figure 12, 2030 McKenzie County Growth Matrix). With these conditions considered, a total of eight future year 2030 SE scenarios were created:

- Low growth with federal leasing and with DAPL
- Low growth with federal leasing and without DAPL

- Low growth without federal leasing and with DAPL
- Low growth without federal leasing and without DAPL
- High growth with federal leasing and with DAPL
- High growth with federal leasing and without DAPL
- High growth without federal leasing and with DAPL
- High growth without federal leasing and without DAPL

To achieve realistic future SE data forecasts, a set of assumptions were implemented such that growth is allocated in a targeted approach and limited by certain constraints. The first of these assumptions was a tier system which binned TAZs into three categories, ordered by likelihood of development:

- Tier 1 TAZs – focused around existing city centers/developed areas (most likely to develop)
- Tier 2 TAZs – primarily located adjacent to and surrounding Tier 1 TAZs
- Tier 3 TAZs – remaining TAZs with limited development potential (least likely to develop)

Tier 1 TAZs were considered most likely to develop by 2030 and were given priority over other TAZs during the allocation of SE data. Once the Tier 1 TAZs were nearing full development, growth was next allocated to Tier 2 TAZs, followed by Tier 3 TAZs, and lastly to non-tiered TAZs, until the 2030 growth targets were reached. Growth allocation was constrained by limiting development density and requiring minimum developable acreages. These constraints were varied depending on if federal leasing was or was not permitted and is the distinguishing difference between those scenarios. In general, county-wide development targets were sufficiently allocated amongst the Tier 1 and Tier 2 TAZs, resulting in relatively little spillover growth allocated to Tier 3.

Future oil activity was also allocated to TAZs. The tiered method described above was not used for this process, since the geography of oil development is not tied to existing urban development patterns. Instead, oil activity forecasts considered TAZ characteristics such as undeveloped acreages, well density, and population density, all of which varied depending on the assumption if federal leasing was or was not permitted. The number of wells, rigs, and plants allocated in the future scenarios were determined by the oil production targets for the low-growth and high-growth scenarios and assigned to TAZs using the above constraints.

Figures 18, 19 and 20 illustrate the geographic distribution of energy jobs, non-energy jobs, and population growth projections through 2030. These maps depict existing development areas using dot densities; it is important to note that these depict areas of the county based on their relative development density and not individual buildings or properties. The spectrum of shaded areas show general locations where growth is anticipated. These figures represent the "High-Growth with Access to Federal Lands and DAPL Operational" conditions; development maps for other scenarios are available electronically upon request.

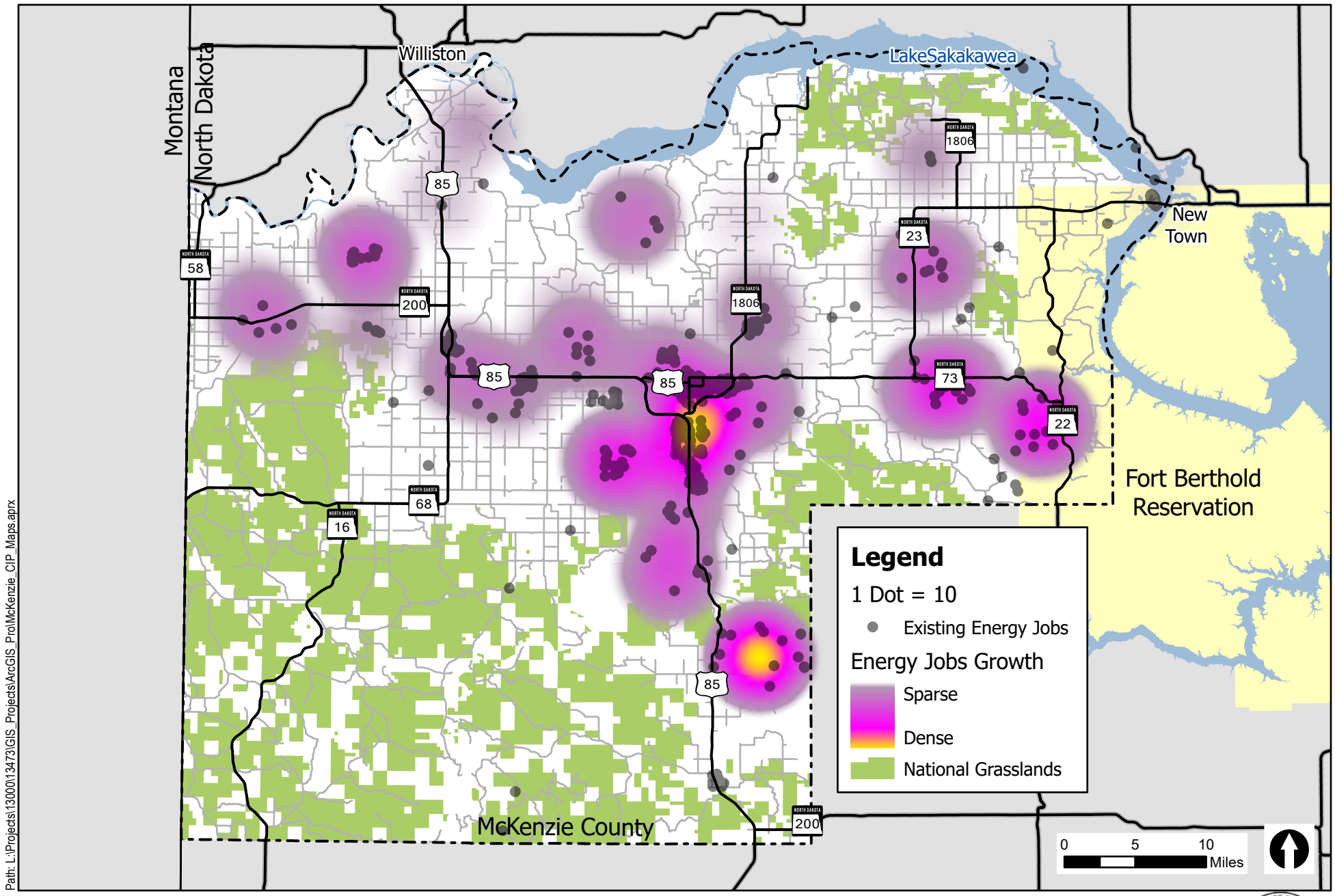



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**Figure 18: Energy Jobs Growth - High Energy Prices, Access to Federal Lands**

McKenzie County, North Dakota

McKenzie County Capital Improvement Plan

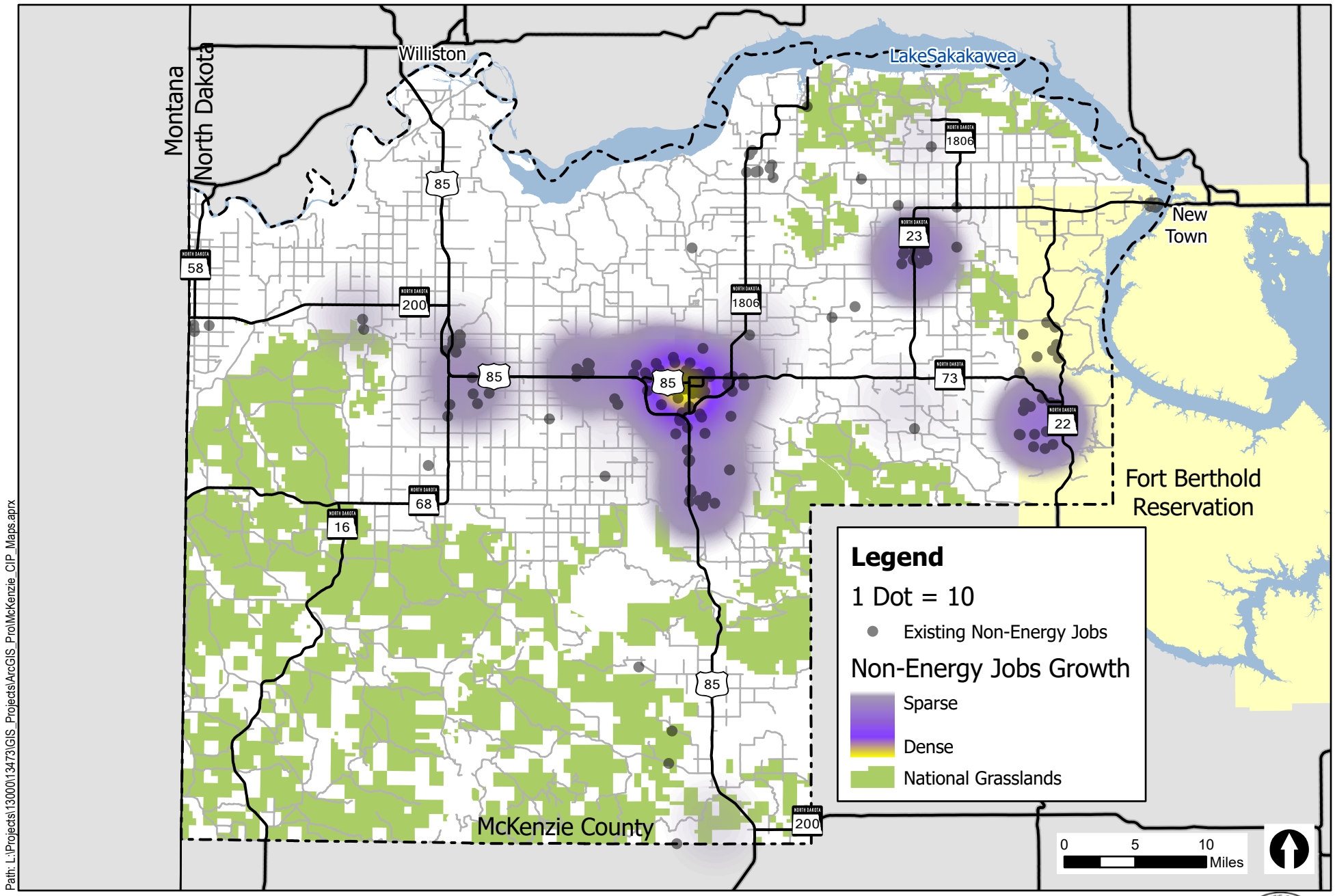


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**Figure 19: Non-Energy Jobs Growth - High Energy Prices, Access to Federal Lands**

McKenzie County, North Dakota

McKenzie County Capital Improvement Plan

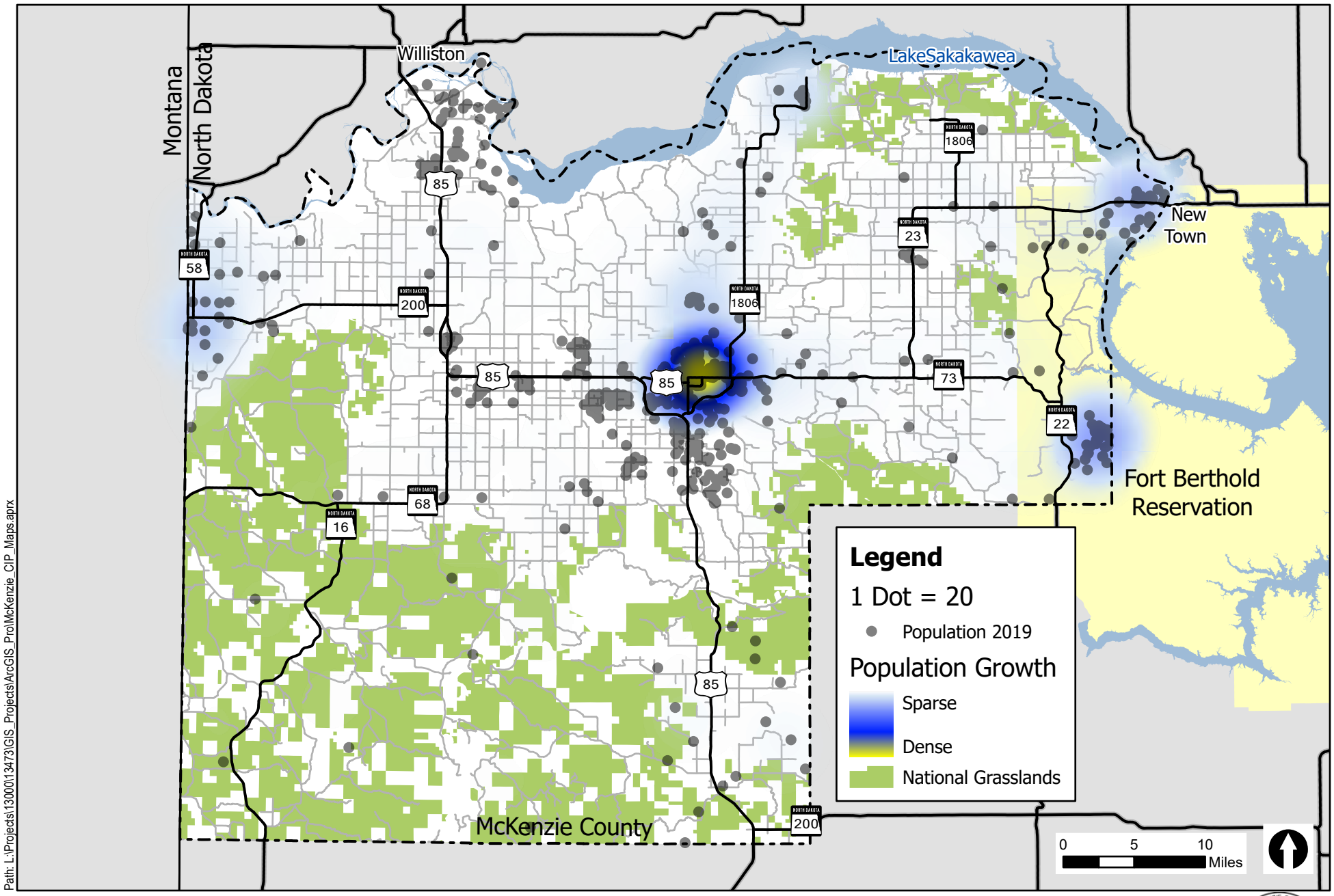


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**Figure 20: Population Growth - High Energy Prices, Access to Federal Lands**

McKenzie County, North Dakota

McKenzie County Capital Improvement Plan

## Trip Distribution

To distribute trips and develop origin-destination (OD) trip tables, the Fratar method of trip distribution was applied. This method of trip distribution that scales existing OD distribution volumes to a new trip target for each TAZ. For this study, INRIX trip data was converted into an OD trip table format to be used as the existing trip distribution input. Trip tables were summarized for both truck and auto trips and then further split into an Internal-External trip table and an External-External trip table for each vehicle type. These four trip tables were then run through the Fratar model which scales these input trip tables to the TAZ trip totals generated from the SE data, trip generation rates, and traffic counts.

## Trip Routing

The outputs of the trip distribution process were combined with existing INRIX trip records to route projected trips on the network. To do this, the projected OD trip tables were compared with the OD tables from the existing data to develop a weighting factor for each origin-destination pair. These factors were then applied to the individual trips, scaling the volume represented by each trip up or down depending on the projected frequency. The projected trip data was then used to develop segment-level volume projections for automobiles, trucks, and passenger car equivalents for each of the growth and development scenarios.

## Results

The traffic analysis process produced a series of highway traffic volumes representing year 2030 conditions for each of the development scenarios introduced in Chapter 4. These include daily auto and truck volumes on each segment of county and state highways throughout the county. Figure 21 illustrates the magnitudes of traffic volumes under the high growth scenario with federal leasing, where the width of blue lines indicates existing traffic and red indicates traffic growth.

The results show that growth is expected all across the county as the result of future population and employment increases. Areas with the most significant growth include ND 23 approaching the eastern county boundary, US 85 approaching the northern county boundary, and both US 85 and ND 23 approaching Watford City. These growth areas are logical based on areas of projected employment growth in the energy and non-energy sectors, and major destination for energy-related truck traffic.

Several McKenzie County highways are also expected to see continued traffic volume growth. These include:

- CR 10 across the northern tier of the county
- CR 27 and CR 30 southeast of Watford City
- CR 14, CR 53, and CR 57 surrounding Johnsons Corner

Full detail of the traffic volume forecasts is made available through an interactive dashboard which can be provided upon request.

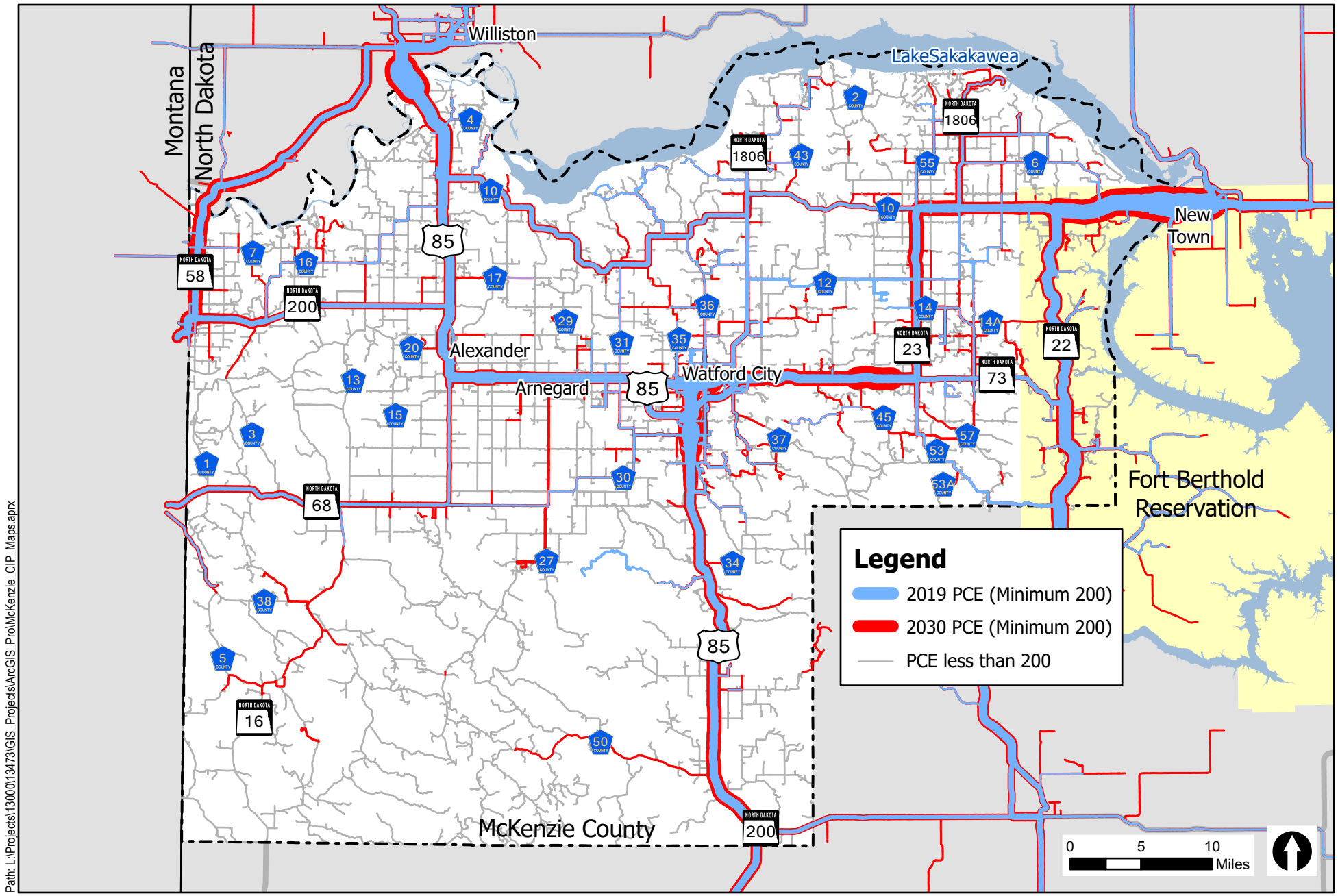


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**Figure 13: Existing Traffic and Future Growth, High Growth with Access to Federal Lands**

McKenzie County, North Dakota

McKenzie County Capital Improvement Plan

# Chapter 6: 2030 System Needs

This Plan used a data-driven approach to identify roadway system needs, develop recommendations, and prioritize improvements. The methods were developed based on an understanding of auto and truck volume thresholds that trigger operational and safety risks, and traffic loads that lead to deterioration of highway surface condition based on age and original design. The process was reviewed with County staff and administrators and other regional stakeholders to ensure methods were reflective of investment needs on the county highway system.

## Approach

Forecast volumes from all scenarios were analyzed to identify system needs at a high level. Model outputs were converted to several metrics to serve the analysis:

1. Average daily passenger car equivalent (PCE)
2. Annual vehicle miles traveled (VMT)
3. Annual equivalent single axel loads (ESALs)

These metrics were combined with available information on pavement age to approximate the condition of paved County roads. A general understanding of lifecycle needs and investment timing was developed by anticipating the age of pavement in 2030. High-priority gravel roads were identified through a similar process.

Additional criteria were introduced to refine and prioritize the project list. These criteria include safety risk, weight restrictions, planning-level cost estimates, roadway jurisdiction, and current commitment to projects that are shovel-ready or partially designed. Project-specific recommendations were tailored to fit available data and respond to stakeholder feedback, incorporating insights from County engineering staff. In addition, Watford City stakeholders were consulted to identify City priorities and coordinate recommendations with the City's ongoing Infrastructure Master Plan.

The roadway needs assessment is rooted in a series of traffic forecasts for 2030. This plan produced forecasts for eight scenarios – one standard high growth scenario and one standard low growth scenario, and variations on these which account for potential shifts in federal policy that would impact the production of oil and natural gas in McKenzie County. Together, these forecasts represent a range of probable outcomes, which attempts to capture the uncertainty of federal regulatory policy and of long-term forecasting in general. A key observation is that the level of certainty improves when there is a consistent demonstration of need across multiple scenarios.

# 2030 Forecast Volumes

Table 3 provides a summary of forecasts for a selection of roadway segments. The table is limited to roads with a PCE above 300 in the standard high growth scenario, as most roads with lower volumes were removed from further consideration. Roads/segments identified with an asterisk were included in the 2020-2024 CIP.

## Note on Traffic Volumes

The 2030 forecast model produced several thousand data points. To maintain consistency with the McKenzie County Road Safety Plan (CRSP), raw data was aggregated and matched to the road segments that were created for the CRSP. Volumes given in Table 3 represent a weighted average for the entire segment. Summarizing data aided analysis and interpretation, enabled conversion of trip data to VMT and ESALs, and removed the effect of extreme values in the dataset. However, raw data remains extremely useful for identifying volumes at specific locations of interest.

## Table 7. 2030 Forecast Summary

| Road/Segment | To/From | Miles | Pavement Age in 2021 | 2030 Forecast PCE (Weighted Average) | | |
|---|---|---|---|---|---|---|
| | | | | Standard High Growth | Standard Low Growth | High Growth No DAPL |
| CR 10 | HWY 85 to 39th St NW | 7.24 | 6-10 | 6,300 | 4,200 | 7,900 |
| CR 10 | 134th Ave NW to CR 29 | 1.81 | 6-10 | 5,800 | 3,800 | 7,300 |
| CR 10 | CR 35 to CR 36 | 5.15 | 0-5 | 5,500 | 3,500 | 7,000 |
| CR 10 | 29th St NW to 134th Ave NW | 4.23 | 6-10 | 5,400 | 3,600 | 6,900 |
| CR 10 | CR 29 to CR 35 | 5.19 | 0-5 | 5,300 | 3,400 | 6,600 |
| CR 10 | CR 36 to HWY 1806 | 5.2 | 0-5 | 5,100 | 3,200 | 6,300 |
| CR 53 | Johnson's Corner to CR 45 | 3.91 | 6-10 | 4,000 | 2,500 | 4,200 |
| CR 10 | 116th Ave NW to HWY 23 | 5.41 | 6-10 | 3,800 | 2,500 | 5,100 |
| CR 10 | HWY 1806 to 116th Ave NW | 7.14 | 6-10 | 3,500 | 2,300 | 4,700 |
| Main St* | 7th Ave to 30th Ave N | 1.75 | 16-25 | 3,400 | 3,100 | 3,400 |
| CR 30 | CR 31 to HWY 85 | 4.06 | 16-25 | 3,000 | 2,600 | 3,800 |
| CR 14 | HWY 23 to HWY 73 | 8.42 | 11-15 | 2,100 | 1,500 | 2,300 |
| CR 38 | County Boundary to CR 5 | 4.85 | 0-5 | 2,100 | 1,800 | 2,200 |
| CR 36* | 7th Ave NE to 30th St NE | 2.74 | >25 | 2,000 | 1,500 | 2,200 |
| CR 53 | CR 45 to CR 3A | 4.75 | 6-10 | 1,900 | 1,300 | 2,000 |
| CR 6* | HWY 23 to approx 41st St NW | 2.22 | (Gravel) | 1,900 | 1,300 | 2,400 |
| CR 35 | 32nd St NW to 30th Ave NW | 3.21 | (Gravel) | 1,800 | 1,500 | 2,000 |
| CR 35 | BUS 85 to 30th Ave NW | 2.48 | 0-5 | 1,800 | 1,500 | 2,000 |
| CR 16 | HWY 200 to CR 7 | 2.47 | 6-10 | 1,700 | 1,300 | 2,100 |
| CR 45** | HWY 23 to CR 53 | 9.52 | (Gravel) | 500 | 500 | 500 |
| CR 55* | CR 10 to CR 2 | 7.29 | 11-15 | 1,600 | 1,100 | 2,200 |
| 26th F St NW* | Hwy 23 to Hwy 23 | 3 | (Gravel) | 1,600 | 1,300 | 1,600 |
| CR 37 | HWY 85 to 122nd Ave NW | 6.23 | 0-5 | 1,500 | 1,000 | 1,900 |
| CR 6* | HWY 1806 to 99th Ave NW | 5.04 | (Gravel) | 1,500 | 1,200 | 2,000 |
| CR 53 | CR 3A to County Boundary | 5.67 | 6-10 | 1,300 | 1,000 | 2,200 |
| CR 16 | 148th Ave NW to HWY 85 | 8.47 | 6-10 | 1,200 | 900 | 1,900 |
| CR 34 | HWY 85 to LTFS854 | 5.47 | 0-5 | 1,200 | 900 | 1,700 |
| CR 37 | 22nd M St NW to HWY 23 | 6.62 | 0-5 | 1,200 | 800 | 1,300 |
| CR 57 | CR 53 to 107th Ave NW | 2.58 | (Gravel) | 1,100 | 700 | 1,100 |
| CR 12 | 115th Ave NW to HWY 23 | 5.39 | 0-5 | 1,100 | 700 | 1,400 |
| CR 36 | 30th St NW to 35th St NW | 4.44 | 0-5 | 1,100 | 700 | 1,200 |
| CR 16 | CR 7 to 148th Ave NW | 8.68 | 6-10 | 1,100 | 900 | 1,500 |
| CR 30 | HWY 68 to CR 27 | 7.11 | 6-10 | 1,100 | 1,000 | 1,500 |
| 17th Ave N* | CR 35 to CR 36 | 1.75 | (Gravel) | 1,100 | 900 | 1,100 |
| CR 6* | 99th Ave NW to 41st St NW | 5.03 | (Gravel) | 1,000 | 600 | 1,500 |
| CR 57* | HWY 73 to 23rd Street NW | 3.94 | (Gravel) | 1,000 | 700 | 1,000 |
| CR 27* | HWY 85 to CR 30 | 9.09 | 11-15 | 1,000 | 800 | 1,400 |
| CR 27* | CR 30 to 141st Ave NW | 7.19 | 11-15 | 900 | 900 | 1,400 |
| 32nd Street NW* | CR 31 to CR 36 | 6 | (Gravel) | 900 | 600 | 900 |
| CR 31 | HWY 85 to CR 30 | 5.09 | 0-5 | 900 | 700 | 1,200 |
| CR 12 | HWY 1806 to 115th Ave NW | 6.92 | 0-5 | 800 | 500 | 1,000 |
| CR 31 | CR 10 to HWY 85 | 8.02 | 0-5 | 800 | 500 | 900 |
| CR 17 | HWY 85 to 137th Ave NW | 5.8 | (Gravel) | 800 | 700 | 800 |
| CR 30* | 134th Ave NW to CR 31 | 6.86 | 11-15 | 800 | 600 | 900 |
| CR 36 | Remainder new CR 36 | 1.88 | 0-5 | 700 | 400 | 900 |
| CR 37 | 122nd Ave NW to 22nd M St NW | 3.21 | 0-5 | 600 | 400 | 800 |
| CR 30* | CR 27 to 134th Ave NW | 2.67 | 6-10 | 600 | 500 | 700 |
| CR 12* | HWY 23 to 35th St NW | 4.22 | (Gravel) | 500 | 400 | 600 |
| CR 12 | 105th Ave NW to HWY 23 | 4.71 | (Gravel) | 500 | 400 | 500 |
| CR 14A | CR 14 to Reservation Boundary | 3.77 | (Gravel) | 500 | 400 | 500 |
| CR 4 | HWY 85 to east | 3.59 | >25 | 400 | 300 | 500 |
| CR 50 | HWY 85 to Forest Service Road | 5.41 | 6-10 | 400 | 300 | 600 |
| CR 53A | CR 53 to County Boundary | 3.99 | (Gravel) | 400 | 300 | 400 |
| CR 50 | Forest Service road to end paved | 5.66 | 6-10 | 400 | 100 | 500 |
| CR 2* | HWY 1806 to 111th Ave NW | 4.87 | (Gravel) | 400 | 200 | 400 |
| CR 35 | CR 10 to 32nd St NW | 4.46 | (Gravel) | 300 | 200 | 400 |
| 104th Ave* | Hwy 23 to CR 6 | 3.00 | (Gravel) | 300 | 200 | 500 |
| CR 34* | 15th St NW to HWY 85 | 5.05 | (Gravel) | 300 | 200 | 300 |

## Road Condition Assessment

A preliminary assessment of road condition was performed for paved and gravel surfaces. To simulate pavement condition, paved segments were indexed according to pavement age and forecasted ESALs (See Table 8). This method suggests the relationship between vehicle loads and roadway quality – a road's lifespan diminishes with increased loadings. Each segment was scored on a scale of 1-6, with 6 indicating the highest level of need. Old pavement is assumed to exhibit a high level of need, but newer roads subjected to heavy loads are also prioritized. Under heavy stress, investment cycles are compressed; some newer surfaces may benefit from continued investment to prolong roadway life.

Note that this exercise assumed full completion of the 2020-2024 CIP. Pavement age was reset to 0 at the programmed construction year, then aged forward. In follow-up discussions, County staff indicated that completion of the 2020-2024 CIP is unlikely. Therefore, this exercise underestimates the level of need for 2025-2030. Nonetheless, it provided a means to scope County routes for inclusion in the CIP, reducing the number of potential projects. Most low-scoring segments were removed from further assessment.

**Table 8. Paved Roads Scoring Index**

| | | ESALs | | | | |
|---|---|---|---|---|---|---|
| | | <50,000 | <100,000 | <200,000 | <400,000 | >400,000 |
| Pavement Age | 0-5 | 1 | 1 | 2 | 3 | 4 |
| | 6-10 | 1 | 2 | 3 | 4 | 5 |
| | 11-15 | 2 | 3 | 4 | 5 | 6 |
| | 16-20 | 3 | 4 | 5 | 6 | |
| | >25 | 4 | 5 | 6 | | |

A base level of need was assigned to each gravel road in the County system in a similar fashion. Because there is limited data for gravel roads, the needs assessment for gravel roads relies on the traffic model. Roads with high volumes and/or truck loads are assumed to have the greatest need. Generally, these are roads that serve higher levels of truck volumes generated by oil activity. However, lower-volume roads elsewhere in the County could have need for repairs if maintenance has been neglected.

The needs assessment for paved and gravel roads was repeated for all forecast scenarios. Scores were averaged based on the assumed probability for each scenario. Roads that were flagged in the County Road Safety Plan were elevated in the rankings. Figure 22 shows the scores for paved and gravel roads in the standard high growth scenario. Darker reds and blues indicate a higher level of need.

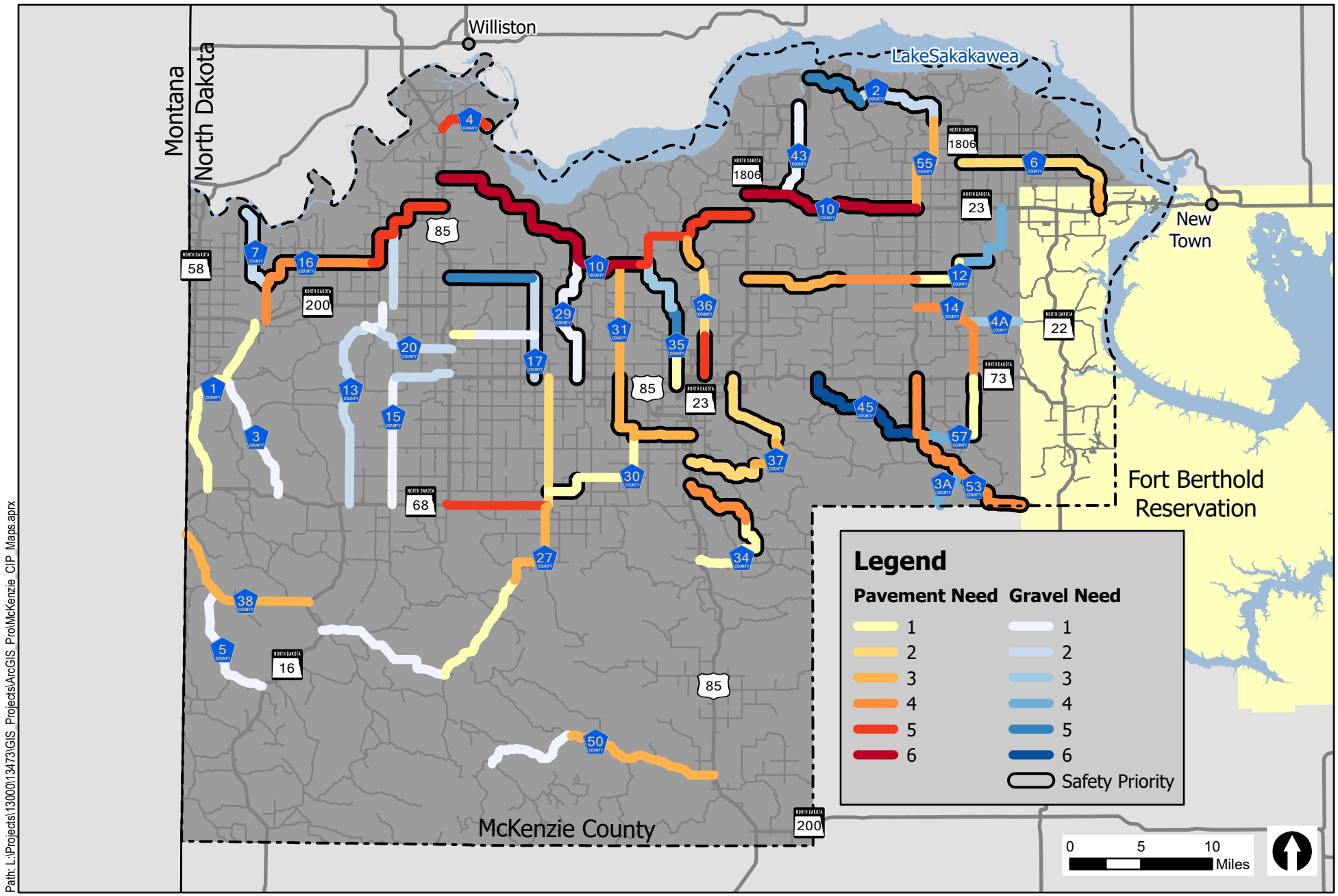



**Figure 22: Preliminary Needs Assessment (High Growth Scenario)**

McKenzie County, North Dakota

McKenzie County Capital Improvement Plan

## Analysis Refinement

At this stage of project, the assumed completion of the 2020-2024 CIP was reconsidered. All incomplete projects listed in the 2020-2024 CIP were brought back for analysis. In most cases, analysis validated the 2020-2024 improvement program.

In addition, local roads were reviewed for inclusion in the CIP. Each local gravel road with a forecasted PCE of 400 or more was considered for paving if it had direct connectivity to an existing paved road. Local gravel roads with elevated truck volumes were also evaluated for gravel road improvements.

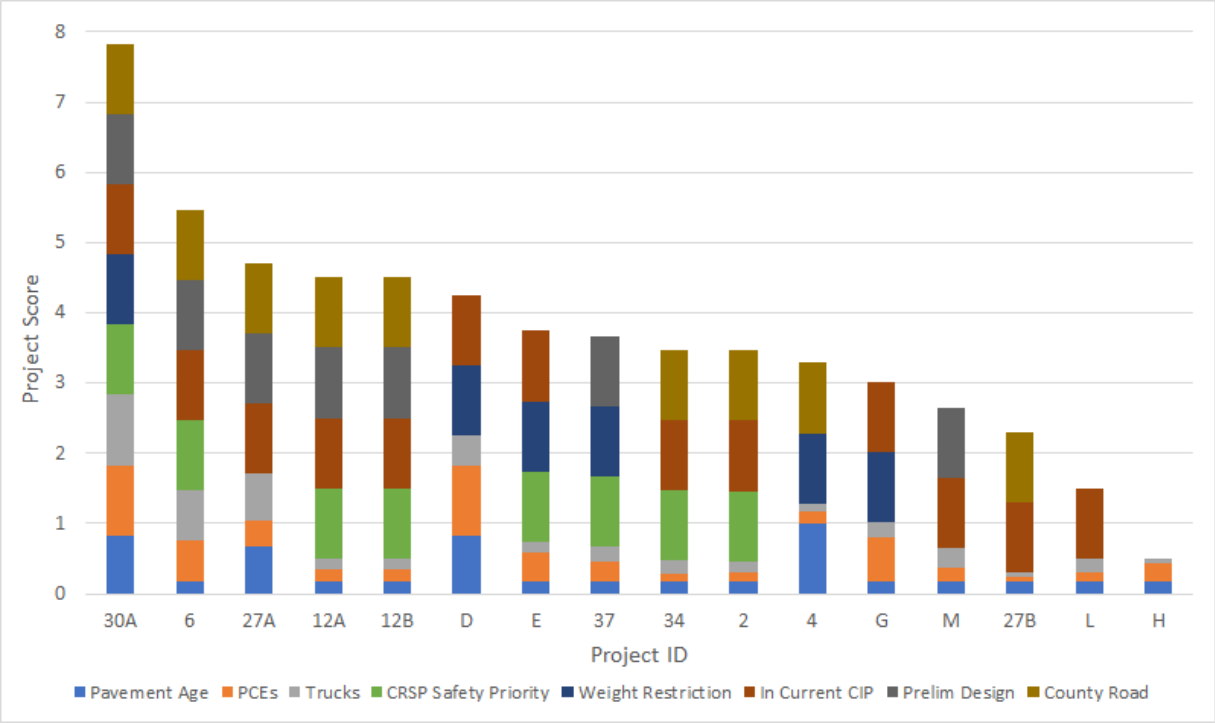
Finally, additional criteria were introduced to better understand the unique characteristics of each roadway, develop suitable recommendations, and further prioritize the project list. Eight scoring criteria were considered at this stage:

- Pavement age
- PCE volumes
- Truck volumes
- Roadway prioritization in the County Road Safety Plan
- Weight restrictions (6 tons per axle, 8 tons per axle, etc.)
- Prior inclusion in CIP
- Existing commitment to project engineering/shovel-ready project
- Jurisdiction (County Road versus local road)

These metrics were used to arrive at a comprehensive list of projects, sorted by tier. Scores and rankings were provided to further differentiate short-term projects and provide more guidance for incoming staff. To develop these rankings, all data was normalized to a 1-point scale. Yes/no variables were scored as 1 or 0 (e.g., roadway prioritization in the County Road Safety Plan). Summing these scores gives a maximum value of 8. Figure 23 shows the rankings in descending order.

Project IDs in Figure 15 reference a specific roadway segment in the county. Numbered IDs indicate county road numbers, and include a letter for county roads with multiple segments. Lettered IDs are for local jurisdiction roadways off the county system. All project IDs can be referenced in Table 10 and Figure 24.

**Figure 23. Prioritization of Short-Term Projects**




The highest-scoring segment was County Road 30 from Highway 85 to CR 27 (30A). County Road 6 and County Road 27 round out the top three. CR 6 scores high for volumes, safety, and prior commitments. CR 27 scores high for volumes and pavement age, in addition to its inclusion in the previous CIP.

## Cost Estimates

Planning-level cost estimates were prepared for each of the specific projects considered in the short-term priorities and extended project list. These were developed using generalized unit costs for major construction features that reflect recent contractor bid prices on comparable project types. In addition, inflation was factored into these to reflect increases in labor and material costs observed over the past year.

Unit costs are applied to project characteristics by multiplying the quantities of major project components – such as pavement area, base and grading, etc. – by the respective unit cost estimates. These are summed for the project to capture the base construction cost. In addition, factors for engineering of 20% and mobilization/construction oversight of 20% are added to the base to provide a realistic estimate for the overall deliver cost. The curves on County Road 16 were used as a typical to estimate the cost of curve realignment. The individual unit costs are provided in Table 9. Individual project cost estimates prepared for proposed CIP improvements are available upon request.

**Table 9. Unit Construction Cost Estimates**

| Construction Element | Cost (2021 dollars) | Unit |
|---|---|---|
| Reconstruction | $2,926,400 | price/mile |
| Mill and Overlay | $265,500 | price/mile |
| Gravel Reconstruction | $2,251,100 | price/mile |
| Curve Realignment | $975,467 | price/curve |

# Chapter 7: Project Recommendations

This section outlines a series of recommendations for county highway investment priorities based on the analysis described in this report. These recommendations are presented for short-term and extended timeframes, and reflect current and anticipated needs on the highway system based on traffic volumes, roadway surface condition, and other factors. Approximate cost ranges for recommended improvements are also provided.

## Short-Term Priorities

The list short-term priorities includes 17 projects. These project segments are depicted on Figure 18 and listed in Table 7. All cost estimates are given in 2021 dollars. Numbered codes correspond to County routes/segments, while lettered codes refer to local roads. The order of the table reflects the project prioritization described above. Top-rated segments are further described in the text that follows the map and table. Project types that make up the short-term priorities include:

- Reconstruction of existing pavement
- Construction of new pavement
- Gravel road improvement (e.g., reconstruction)

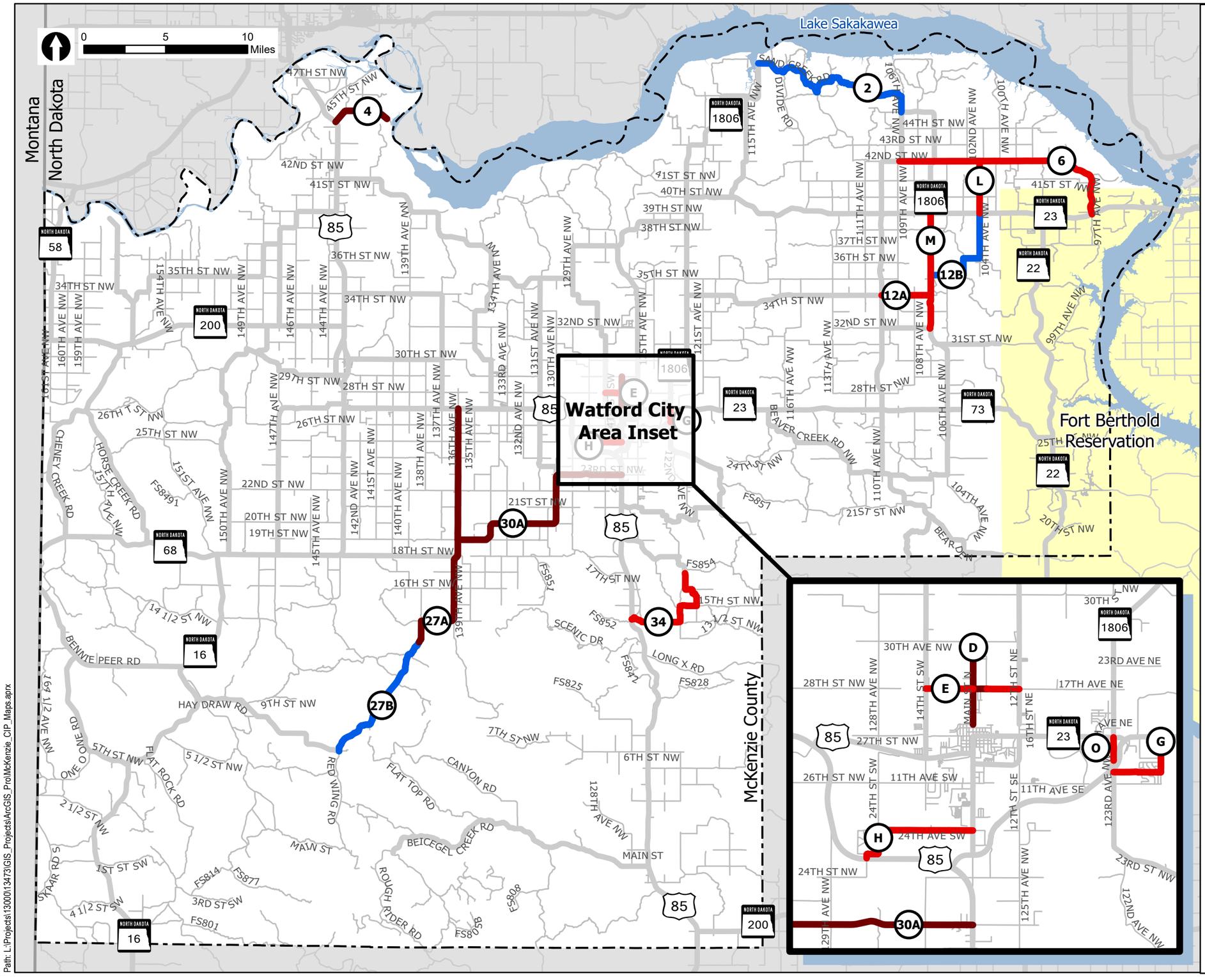



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**Figure 24: Short Term Priorities**

McKenzie County, North Dakota

McKenzie County Capital Improvement Plan

## Legend

- Reconstruct Existing Pavement
- Construct New Pavement
- Gravel Road Improvement

*Segment labels correspond to Table 10. Numbered segments are County Roads. Segments indicated with a single letter are local roads (e.g., township roads).

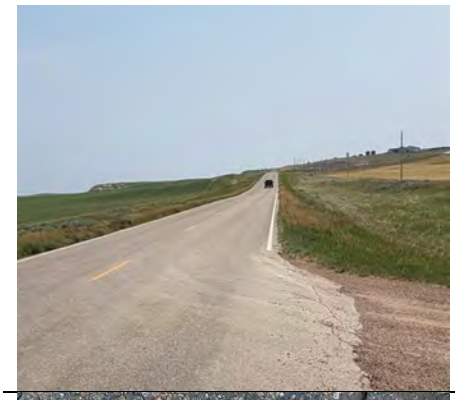
SRF

## Table 10. Short-Term Priorities

| Map ID | Name | Limits | Miles | Work | Cost Est. (Millions) |
|---|---|---|---|---|---|
| 30A | CR 30 | HWY 85 to CR 27 | 13.59 | Reconstruction | $39.8 |
| 6 | CR 6 | HWY 23 to CR 55 | 14.40 | New pavement | $42.1 |
| 27A | CR 27 | HWY 85 to end paved section | 16.29 | Reconstruction | $47.7 |
| 12A | CR 12 | 107th Ave NW to HWY 23/34th St | 3.00 | New pavement | $12.4 |
| 12B | CR 12 | 107th Ave NW to HWY 23/104th | 6.71 | Gravel improvement | $15.1 |
| 27B | CR 27 | Gravel section to Red Wing Rd | 8.80 | Gravel improvement | $19.8 |
| D | Main Street N | 7th Ave N to 30th Ave N | 1.75 | Reconstruction | $5.1 |
| E | 17th Ave N | CR 35 to CR 36 | 2.00 | New pavement | $5.9 |
| 37 | CR 37 | HWY 1806/23 to 5th Ave SE | 0.49 | New pavement | $1.4 |
| 34 | CR 34 | Gravel section to HWY 85 | 7.55 | New pavement | $22.1 |
| 2 | CR 2 | HWY 1806 to CR 55 | 12.31 | Gravel improvement | $27.7 |
| 4 | CR 4 | HWY 85 to end paved section | 3.59 | Reconstruction | $10.5 |
| G | 26 F St NW | HWY 23 to HWY 23 | 1.75 | New pavement | $5.1 |
| M | 107th Ave NW/CR | HWY 1806 to 32nd St NW | 7.02 | New pavement | $17.1 |
| L | 104th Ave NW | CR 6 to CR 23 | 3.00 | New pavement | $8.8 |
| H | 24th Ave NW/128th | HWY 85 to Main St S | 2.82 | New pavement | $8.3 |

## County Road 30

County Road 30 extends from Highway 85 to Highway 68, forming the primary east-west connection south of Watford City. Socioeconomic forecasts show continued growth of energy-related jobs within the County 30 corridor between Highway 85 and County Road 27. County Road 30 was prioritized due to aging pavement, weight restriction (8 tons per axle), forecast traffic growth, and safety needs. Forecasted PCE for the 4-mile segment from Highway 85 to County Road 31 ranges from 2,500 to 3,000 in the standard growth scenarios, approaching 3,800 in the maximum growth scenario. The forecasted PCE ranges from approximately 700 to 1,400 on the remaining segments. Staff indicated that the last improvement on County Road 30 was a surface overlay, resulting in a temporary fix that did not correct underlying pavement issues. Pavement exhibits alligator cracking and other signs of deterioration. Minimal shoulders increase the likelihood that motorists will veer off the roadway, while steep inslopes compound the hazard of lane departure. Reconstruction was programmed for 2021 and should continue to be a high priority moving forward.



There is little paved shoulder width beyond the lane edge. A vehicle lane departure has a high likelihood of losing control and entering the ditch.

Surface cracking and rutting on CR 30 shows significant deterioration of the pavement.

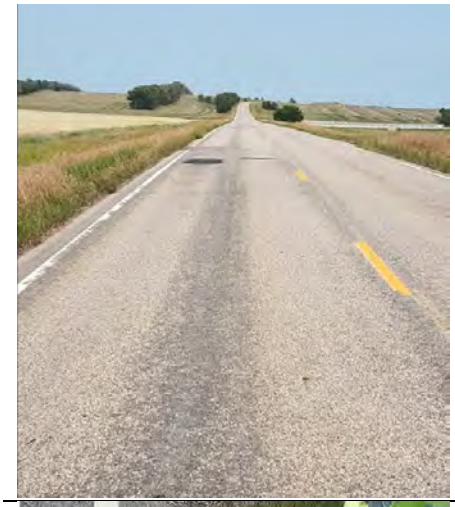
Steep inslopes pose a safety hazard by making a lane departure unrecoverable and increasing the risk of overturning.

## County Road 27

County Road 27 connectivity to south-central McKenzie County. The road consists of a paved segment with gravel extension to County Road 38. The paved segment (27A) intersects with County Road 30 and continues to the Red Wing gas plant and Oneak facility. The base forecast for this segment ranges from 800 to 900 PCE, surpassing 1,400 PCE in the maximum growth scenario. The modeled truck volume is 225-275.

Like County Road 30, the paved portion of County Road 27 has a weight restriction of 8 tons per axle. This indicates that the road was not built to the highest standard; pavement has subsequently deteriorated under increased volumes. The surface has been treated with extensive repairs, patching, and seal coats, but these types of repairs do not address underlying issues, and they will have less utility as the road ages. Reconstruction was programmed for 2021 and should continue to be a priority moving forward.

The gravel portion of County Road 27 (27B) has much lower volumes. Forecasted PCE is under 200. This segment was programmed for paving in 2023. It may need regrading, but volumes do not justify asphalt construction. This segment is now shown as a gravel improvement.



The paved surface of CR 27 is showing significant deterioration and requires frequent patching and repairs.

Shoulder pavement on CR 27 is observed to slough off in numerous locations, resulting in unsafe conditions for a vehicle that may drift over the line.

### County Road 6

County Road 6, a gravel road, was programmed for asphalt construction in 2022. This road is the backbone for oil-field access routes in northeast McKenzie County. The eastern segment, which curves from approximately 97th NW to Highway 23 in Fort Berthold Reservation, was identified as a high-priority segment in the County Road Safety Plan. Forecasted volumes are highest near the intersections with Highway 23 and Highway 1806, with PCE ranging from 1,200 to 1,850 in the standard growth scenarios. The modeled truck volume is 250-300.

### County Road 12/107th Ave NW

County Road 12/107th Avenue were programmed collectively in the 2020-2024 CIP. This project is designed and moving to bid. The 3-mile segment from Highway 23 to 107th Ave NW (12A) is shown as asphalt paving. Paving is also shown on 107th Avenue NW (M) from Highway 23 to County Road 14. The eastern segment of County Road 12 (12B) is shown as a gravel road improvement. Forecasted PCE on these segments range from 450 to 550, right on threshold for paving.

### County Road 4

County Road 4 was selected due to aging pavement. The road surface is more than 25 years old, making it one of the oldest roads in the County system. This segment is shown for pavement reconstruction, but it could also be considered for turnback to gravel. It has limited connectivity and low volumes. The forecasted PCE ranges from 400 to 500, with truck volumes below 50.

### County Road 2

County Road 2 was included in prior CIP and identified as a high priority in the County Road Safety Plan, primarily due to the high number of sharp curves. Reconstruction of the gravel road was planned for 2022. This recommendation is carried forward if road conditions warrant, but challenging terrain may constrain roadway expansion. A variety of surface treatments and other low-cost interventions could also be considered to reduce the crash risk. The 2030 PCE ranges from 250 to 400 for most of the road, however forecasted PCE levels as high as 1,500 are observed near the western junction with Highway 1806. County staff noted that oil drilling continues to expand around County Road 2, but few pipelines are being permitted.

### 104th Ave NW

Pavement construction on 104th Ave NW (L) was planned in the 2020-2024 CIP. This road is essentially an extension of County Road 12. The improvement would tie into the planned construction on County Road 6 and County Road 12, completing a good travel network in northeast McKenzie County. The forecasted PCE ranges from 300 to 500. Therefore, a gravel improvement could also be considered, matching the gravel section of County Road 12.

## Watford City Area Improvements

Short-term priorities include several projects in and around Watford City. Most of these projects were programmed as joint ETA projects; that is, these projects are located within Watford City's extraterritorial growth area, where the City and County have shared zoning authority. ETA improvements may involve additional coordination with the City. The County and City should coordinate on ETA projects to design improvements that are acceptable to both, determine maintenance responsibilities, and define expectations for jurisdictional transfer, if needed. Watford City area projects include:

- **Main Street N (D):** Improving Main Street N is a high priority for both the City and the County. This segment was programmed for reconstruction as a joint ETA project for 2020. It is the top-ranked transportation project in Watford City's Infrastructure Master Plan. The City sees a need to connect its northern growth areas to the city core, with an opportunity for trail improvements from 7th Avenue N to 30th Ave N. The forecasted PCE on this segment ranges from 3,100 to 3,400, with little variability across the scenarios. This segment is not intended to serve through trucks, and modeled truck volume is less than 200.
- **17th Ave N (E):** This segment was also included in the 2020 joint ETA program. The forecasted PCE ranges from 870 to 1,150, with truck volumes around 50-60. Based on these volumes, this road is an ideal candidate for paving. The existing road includes a paved segment, about 0.3 miles long, which provides access to adjacent subdivisions. This segment may need to be reconstructed when the road is improved.
- **County Road 37 (O):** Completing the 0.5-mile segment would tie Highway 1806 into 14th Ave S, which was recently constructed. This would also provide an opportunity to connect the trail system across Highway 23. This project would require coordination with NDDOT, but is viewed as a promising opportunity for the County. This segment was not included in the 2020-2024 CIP.
- **24th Ave SW/128th Ave (N):** Paving this road is a priority for both the City and the County, since it will support the development of the fairgrounds. The forecasted PCE is around 330. However, traffic could increase substantially during temporary events, so capacity improvements are important.
- **26th F St NW/122nd Ave NW (G):** This is another existing ETA project, originally planned for 2021. Forecasted PCE ranges from 1,300 to 1,600, with around 80 trucks. Again, this combination of high auto traffic with low truck volumes makes the road an ideal candidate for paving. Pavement construction will directly benefit many residents in adjacent subdivisions, and community members expressed support for this project through public engagement in the County Road Safety Plan.

The projects prioritized in and around Watford City should be relatively easy to implement, with lower costs than highway projects. Cost was not a factor in project rankings, but this does make implementation of the short-term project list more tractable.

## Extended Project List

The extended project list includes 38 segments, including the short-term priorities identified in the previous section, and is shown in Figure 25. The remaining projects are recommended for continued evaluation, so that the next series of projects can be adopted in future funding cycles. Many will require substantial planning and engineering effort. Table 11 provides additional detail on the locations and endpoints for the additional projects that were not designated as short-term priorities. All cost estimates are given in 2021 dollars. In addition to reconstruction projects, the extended project list identifies segments to prioritize for pavement preservation. These segments are shown as minor rehab, which typically consists of a mill and overlay or surface overlay.

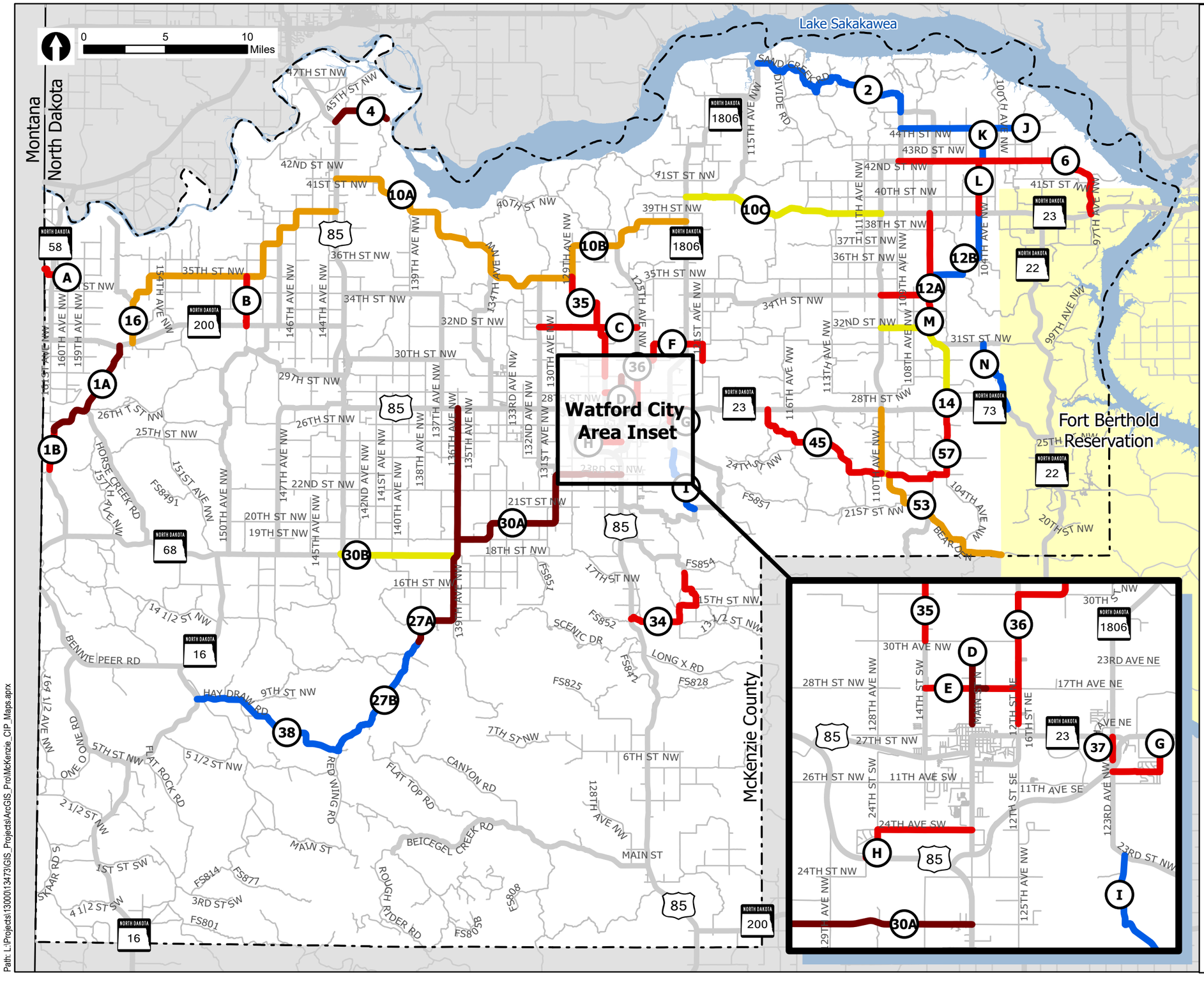



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**Figure 25: Full Project List**

McKenzie County, North Dakota

McKenzie County Capital Improvement Plan

## Legend

- Reconstruct Existing Pavement
- Construct New Pavement
- Minor Rehab/Spot Repair
- Minor Rehab
- Gravel Road Improvement

*Segment labels correspond to Tables 10 and 11. Numbered segments are County Roads. Segments indicated with a single letter are local roads (e.g., township roads).

## Table 11.Long-Term Projects

| Map ID | Name | Limits | Miles | 2030 PCE (Approx) | Cost Est. (Millions) | Notes |
|---|---|---|---|---|---|---|
| A | 35th St NW | HWY 58 to boundary | 0.80 | 1,000-1,400 | 2.3 | County receives many overweight permits for trucks going to Montana |
| B | 149th Ave NW | CR 16 to HWY 200 | 3.04 | 1,000 | 8.9 | Frequently used as a cut-across road for CR 16 |
| C | 32nd St W | CR 31 to CR 36 | 5.76 | 850 | 16.9 | Included in prior CIP; vertical curves and grading issues |
| F | 30th St NW | CR 36 to 30th Street NW | 5.91 | 670 | 17.3 | Provides connectivity to gas plant |
| I | 122nd Ave NW | CR 34 to CR 34 | 4.31 | 1,300 | 9.7 | Ongoing industrial development in this area; truck forecast around 500 |
| J | 44th St NW | HWY 55 to 95th Ave | 8.00 | 1,950 | 18.0 | Heavy oil activity area. Consider gravel improvement with option to pave in long-term |
| K | 101st Ave NW | CR 6 to 44th St NW | 2.00 | 500 | 4.5 | Gravel reconstruction or paving option |
| N | 102nd Ave NW | HWY 73 to 31st St NW | 4.87 | 930 | 11.0 | Trucks coming from HWY 73 have issues navigating the climb; forecast truck volumes around 250 |
| 1A/1B | CR 1 | HWY 200 to River Road | 9.68 | 200 | 28.3 | Serves as bypass to Sidney and Fairview; combination of new pavement and reconstruction |
| 10A/10B* | CR 10 | HWY 85 to HWY 1806 | 22.90 | 3,000-7,000 | 7.7 | Route functions like state highway; lifecycle improvements are coming due; curve realignments recommended |
| 10C* | CR 10 | HWY 1806 to HWY 23 | 12.55 | 3,500-5,000 | 3.3 | Route functions like state highway; lifecycle improvements are coming due; curve realignments recommended |
| 14 | CR 14 | HWY 23 to HWY 73 | 8.42 | 1,500-2,100 | 2.2 | Pavement preservation opportunity |
| 16* | CR 16 | HWY 85 to HWY 200 | 19.63 | 1,000-1,400 | 5.2 | Pavement preservation, spot reconstruction, and safety projects |
| 30B | CR 30 | HWY 68 to CR 27 | 7.11 | 750-900 | 1.7 | Extends improvements to HWY 68; pavement preservation opportunity |
| 35 | CR 35 | 30th Ave N to CR 10 | 7.90 | 1,500-1,850 | 23.1 | Provides additional capacity between Watford City and CR 10 |
| 36 | CR 36 | 7th Ave N to 30th St NW | 2.74 | 1,450-2,000 | 8.0 | Aging pavement; extends improvements to CR 10 |
| 38 | CR 38 | HWY 16 to CR 27 | 10.19 | 170 | 22.9 | Aging gravel road may need lifecycle improvements |
| 45 | CR 45 | HWY 23 to CR 53 | 9.52 | 500 | 27.9 | Gravel reconstruction or paving option; enhances network near CR 53 |
| 53* | CR 53 | HWY 53 to County line | 14.33 | 1,000-2,000 | 3.8 | Lifecycle improvements coming due; curve realignments recommended; volumes around 4,000 at Johnson's Corner |
| 57 | CR 57 | HWY 73 to CR 53 | 7.85 | 730-1,000 | 23.0 | Ties into recommendations for CR 14 and CR 45; enhances network around CR 53 |

*Base cost for mill and overlay. Excludes cost for curve realignment and spot reconstruction.

# Chapter 8: Tools and Strategies

This Plan promotes several tools and strategies to help the enhance the quality of McKenzie County's roadway system in a cost-effective manner. These strategies include:

- Prioritizing investment in pavement preservation at critical junctures to extend roadway life and avoid more costly repairs
- Converting gravel roads to paved surface when ADT warrants and truck volumes are low
- Maintaining oil-access routes as gravel roads while heavy truck traffic persists; asphalt construction may be considered as truck traffic abates
- Considering turnback from paved to gravel surface for roads with low ADTs and/or limited function
- Pursuing jurisdictional transfers with NDDOT, municipalities, or BIA to align ownership/maintenance responsibilities with the appropriate agency
- Promoting a connected network with extended roadway continuity, designated truck routes, and alternate routes/reliever routes as needed
- Realignment of curves to improve safety and mobility on high-volume roads
- Enforce roadway weight restrictions to increase compliance and sustain roadway design life
- Planning effectively to allow time for design/environmental work, construction management, right-of-way coordination, and other needs
- Implementation of the County Road Safety Plan

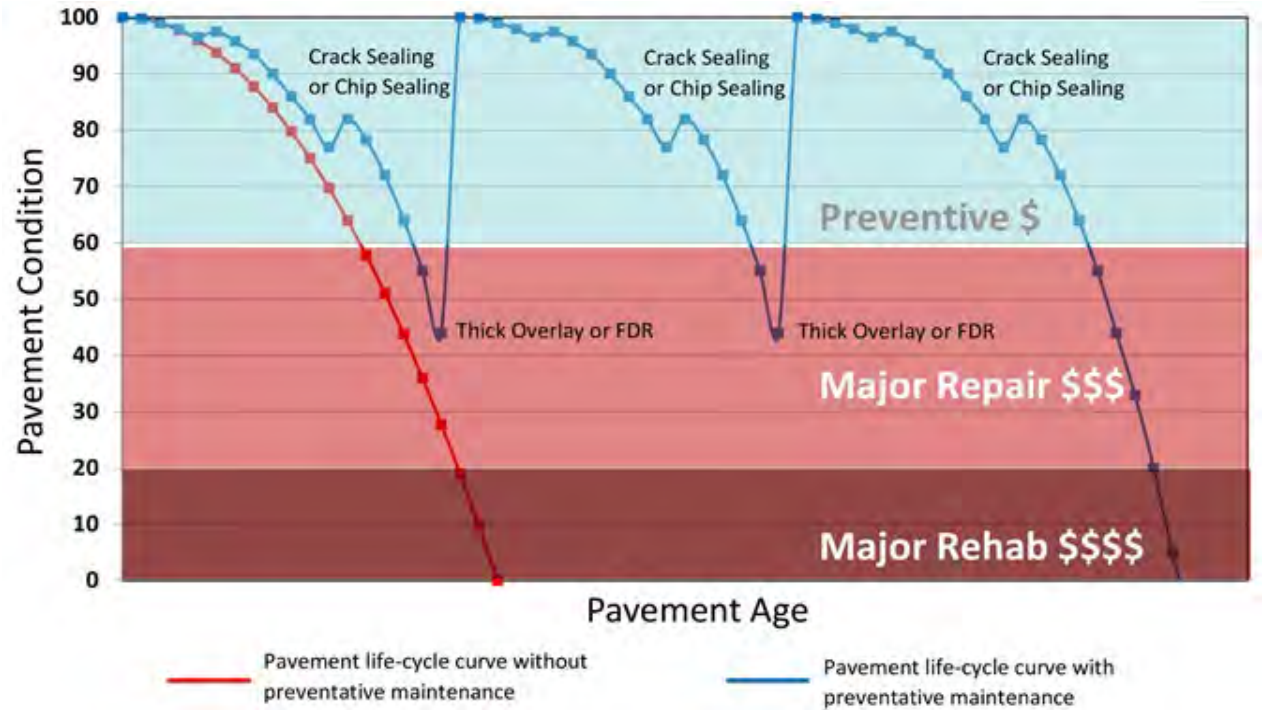
## Pavement Preservation

System preservation is a proactive approach to managing the entire pavement system. Well-timed pavement maintenance and repairs extend pavement life and protect the County's past investments in road construction. Implementing a schedule for surface maintenance and rehabilitation projects will provide significant savings over time. The cost for full-depth reconstruction is significantly greater than the cost for minor rehabilitation work, such as mill and overlay.

Figure 26 illustrates several crucial points. First, minor roadway rehabilitation can typically be performed two to three times before reconstruction is needed. The rate of roadway degradation accelerates over time, but well-timed investments can extend a roadway's life by decades. Rehabilitation projects need to be implemented when roads remain in fair condition. Once a road falls into poor condition, these types of repairs lose their effectiveness. If the subsurface has failed, for example, surface improvements will have limited effect. Conversely, once the condition of a road deteriorates beyond the point where rehabilitation is no longer beneficial, the County may prefer to delay reconstruction to maximize remaining roadway life, while focusing investments in other areas. Note that maintenance cycles are condensed for roads subjected to heavy truck volumes, so preventative repairs may need to be implemented sooner than the County is accustomed to. County

Road 10 is an example where more frequent preservation investments are needed to maintain acceptable pavement condition.

**Figure 26. Pavement Preservation Strategy Comparison**




Enforcing weight restrictions is critical to preserve pavement life. The recommendations in this Plan assume compliant truck weights. Heavy trucks in violation of weight restrictions will accelerate deterioration and reduce the effectiveness of pavement preservation strategies. Roads that are routinely subjected to loads that exceed design capacity will require major repairs sooner than desirable. If this occurs throughout the County, the potential cost is tens or hundreds of millions of dollars in additional highway spending over the coming decades.

## Pavement Construction

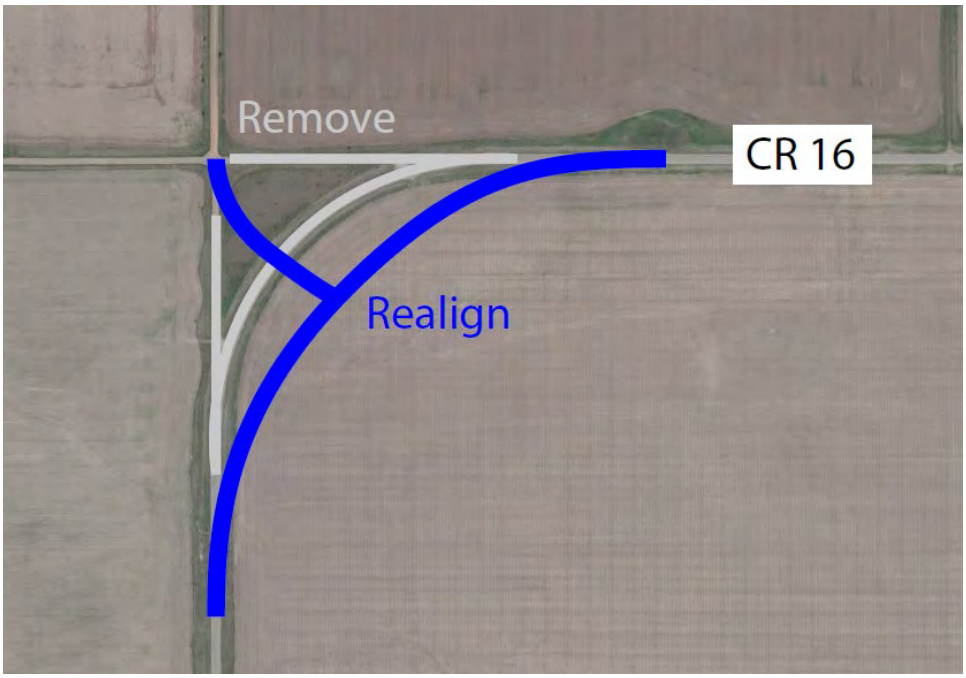
A focus on pavement preservation has implications for pavement construction. When new pavement is added to the system, maintenance costs increase. Therefore, new construction should be carefully considered. This Plan recommends corridors for pavement construction when supported by data. Specifically, the County could consider paving a road when PCE reaches 400-500. However, most gravel segments that are depicted for pavement construction have higher volumes, above 1,000 in some cases.

In addition to total volumes, truck traffic must be considered. Under heavy loads, gravel surface is more forgiving than pavement and easier to maintain. A gravel surface should be maintained if the road serves primarily trucks, especially if truck activity is anticipated to be temporary. Roads with high truck volumes *and* high auto volumes require a paved surface. Such routes typically provide important connectivity and are critical components of the transportation network.

## Safety Improvements

Project recommendations in this Plan support the County Road Safety Plan. Safety priorities identified in the CRSP were elevated in the project rankings. In some cases, low-cost interventions may be sufficient to mitigate safety risks. In others, reconstruction will be required. Reconstruction activities can address shoulder widening, correct steep inslopes, or correct alignment issues, among other hazards. Realignment of curves should be considered on County Roads 10, 16, and 53. In the last five years, at least one crash has occurred at six curves along County Road 16. Intersection realignment would mitigate this safety hazard.

**Figure 1. Curve Realignment Example**




## Jurisdictional Transfers

The jurisdictional organization of transportation systems is designed to match each road with the agency that is best positioned to carry out management and maintenance responsibilities. As Watford City grows, some County roads may be transferred to the City. The County may also accept roads from other jurisdictions if they are in a good state of repair. The biggest opportunity may be negotiating a transfer of County Road 10 to NDDOT. In return, the County could accept Highway 1806 or a similar road. An arrangement of this sort has been discussed by by NDDOT and County

administrators, but conversation has stalled. Reviving this idea should be explored. The reality is that County Road 10 has begun to function like a State highway, with heavy volumes, heavy truck traffic, and extended continuity across the County's northern belt. Year 2030 PCE volumes could reach 6,000-8,000 between Highway 85 and Highway 1806. These volumes far exceed 2019 counts on State Highways 68, 200, 1804, and 1806. Ongoing maintenance and investment will be required to maintain safety and functionality on County Road 10 moving forward. NDDOT may be better positioned to execute plans and finance improvements for this road.

## Project Delivery

Implementing roadway improvements is a complex undertaking that requires coordination of several processes, including right-of-way acquisition, roadway design, environmental review, construction management, funding coordination, and other processes. Aligning these processes for smooth project delivery requires proper planning. Poor preparation can prolong a project and produce unnecessary costs, such as missed opportunities to utilize available funding aid. Sticking to the established CIP program is important because it gives the County time to plan ahead and implement projects as efficiently as possible.