Roads and Bridges

CHAPTER 7

Roads and Bridges

The roads and bridges of a region are the backbone of its transportation network. The characteristics of a roadway, such as its classification and traffic volume, are important to determining its needs and solutions. The conditions of a roadway are critical for the efficient movement of people and goods. Bridges are also crucial for making sure that people and goods can get to where they need to be, especially in a tri-state region. DMATS is also a leader in Intelligent Transportation Systems (ITS) infrastructure, so ensuring the completeness of the network can help poise the region as an example for others to follow. This chapter will analyze the characteristics and condition of the roads and bridges within the DMATS transportation network.

Federal Functional Classification

Roadways are assigned a functional classification category based on the type of service they provide. Roadways provide two basic types of service: land access and mobility. The degree to which a roadway provides access and/or mobility determines its functional classification. The key to planning an efficient roadway system is finding the appropriate balance between mobility and accessibility. A roadway's assigned functional classification is referred to as its Federal Functional Classification or FFC.

The Federal Highway Administration uses functional classification to determine if a roadway is eligible for federal funds. The federal-aid eligibility of each classification is depicted in Table 7.1. Table 7.2 on the following page provides descriptions of each classification.

TABLE 7.1

FFC Federal-Aid Eligibility

ELIGIBLE	NOT ELIGIBLE
Principal Arterial	Rural Minor Collectors
Minor Arterial	Local Streets
Major Collectors	
Urban Minor Collectors	

TABLE 7.2 Federal Functional Classifications

CLASSIFICATION	CHARACTERISTICS
Principal Arterial	• Primarily serve as mobility function • Minimal land access • Serves rapid movement of people and goods for extended distances • High-capacity, high-speeds • Ex. US Highway 20
Minor Arterial	• Interconnects with and augments principal arterials • Serves intercommunity trips of moderate length • Primarily used for mobility, but provides more land access than a principal arterial • Ex. John F. Kennedy Road in City of Dubuque
Collector Streets	• Channel trips between local streets and arterials • Balance between mobility and land access • Parking and direct driveway access to street usually allowed • Usually wider, have higher capacity and permit somewhat higher speeds than local street network. • Broken down into two categories in rural areas, Major Collectors and Minor Collectors • Ex. Chaney Road in City of Dubuque
Local Streets	• Primarily provide local land access • Lowest level of mobility • Uncontrolled intersections • Posted speed limits of 25 mph or less • Few restrictions on parking • Not a significant consideration in metropolitan planning

Source: FHWA

The Northwest Arterial, shown in Figure 7.1, is an example of a Principal Arterial.

FIGURE 7.1
Northwest Arterial Reconstruction at Chavenelle Rd
Source: City of Dubuque

Figure 7.2 below maps the roadways in the DMATS area by their Federal Functional Classification.

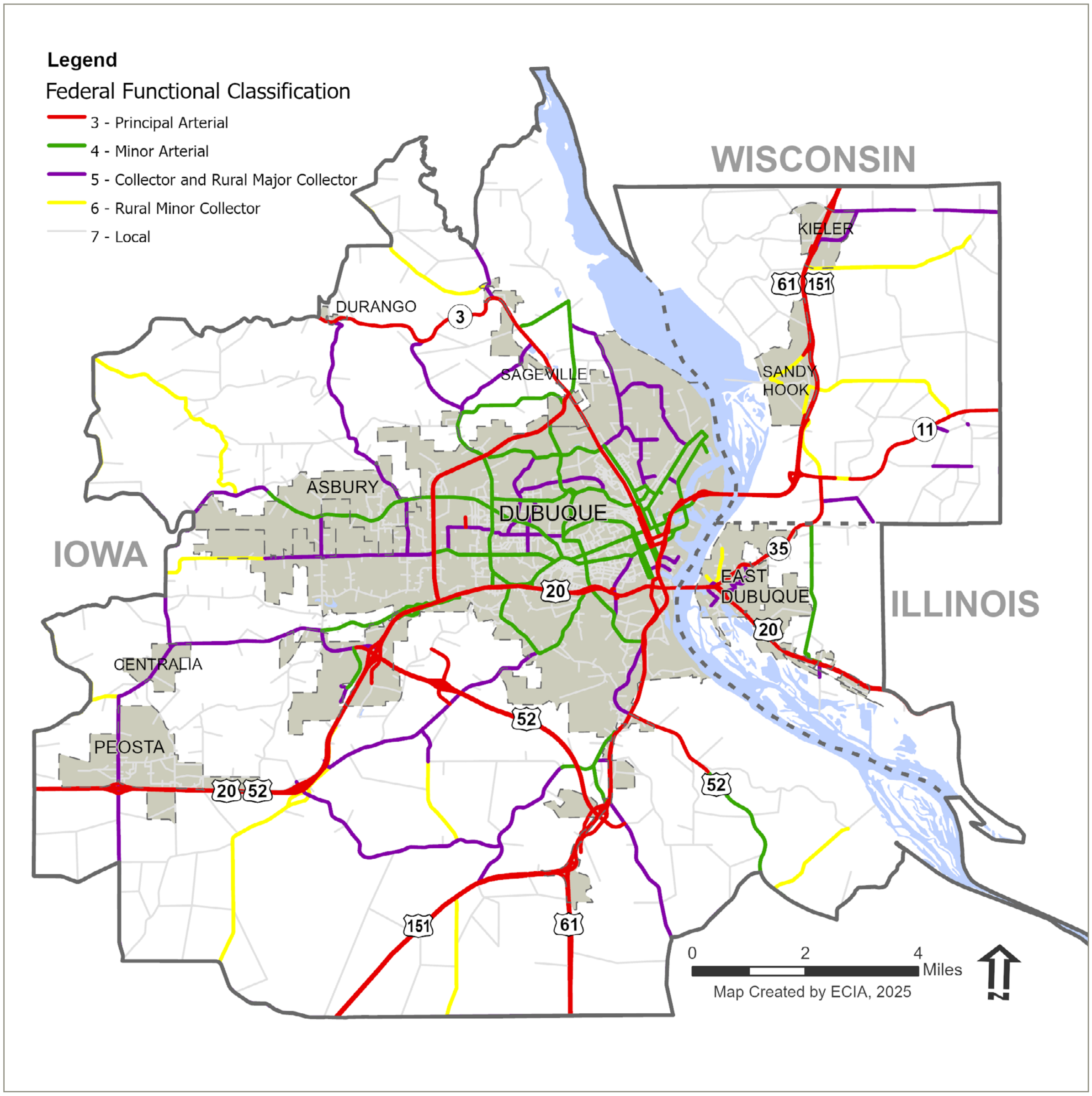

FIGURE 7.2

DMATS Federal Functional Classification

Source: Iowa DOT, Illinois DOT, Wisconsin DOT

Traffic Volume

Transportation planners use average annual daily traffic (AADT) to measure the use of the roadway system. AADT is an annualized measure of traffic volume on a road segment. AADT numbers are based on traffic counts that local and Iowa DOT engineers periodically collect on area roads. Traffic counts provide one-time "snapshot" views of traffic on area roads that traffic engineers then extrapolate into an annualized daily average using a mathematical process. This plan reports 2021 traffic data as 2021 is the base year for the DMATS Travel Demand Forecast Model. Figure 7.3 below displays the 2021 traffic volumes from the Iowa DOT that are used to input into the Travel Demand Forecast Model.

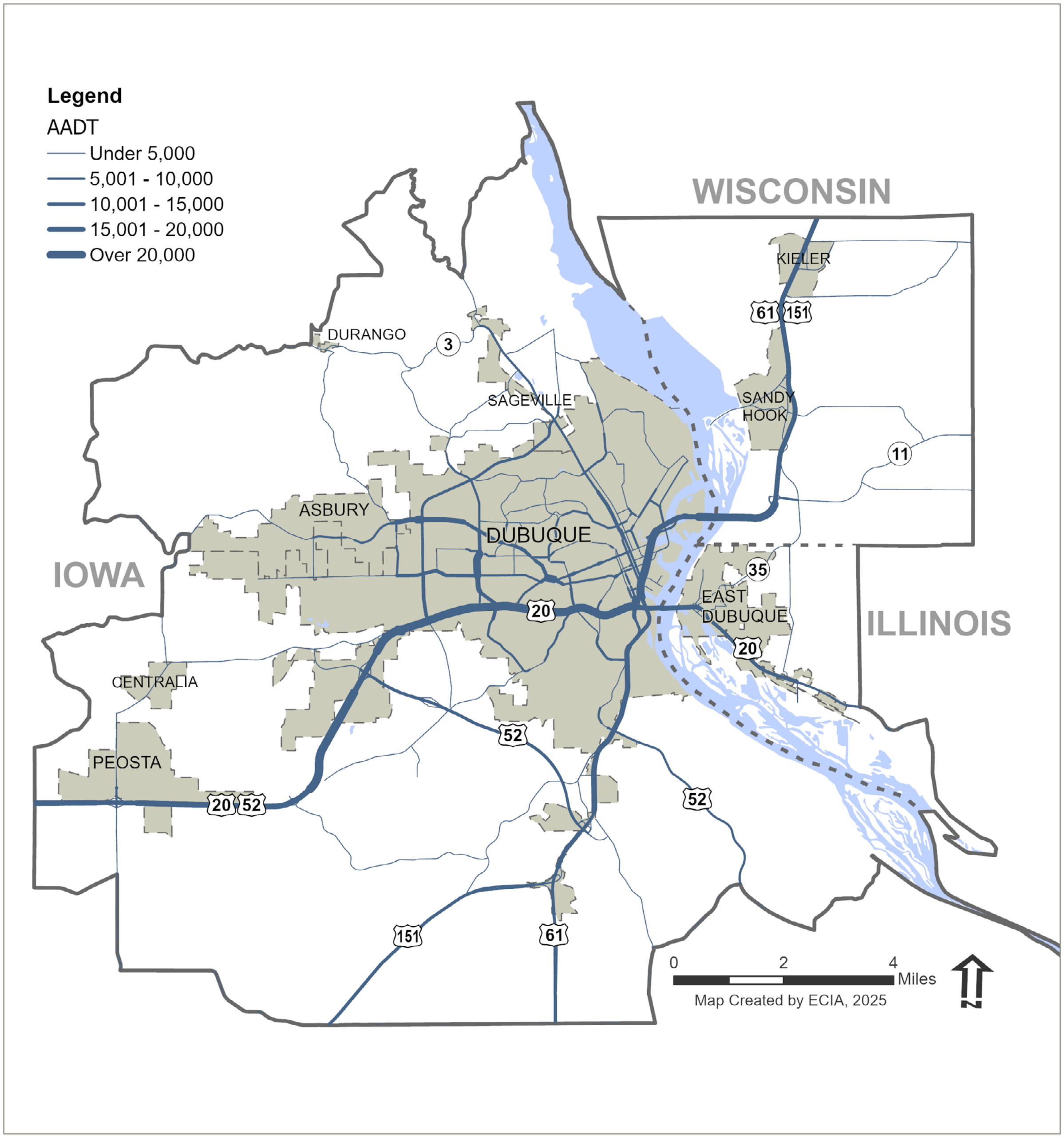

Figure 7.3.
2021 DMATS Average Annual Daily Traffic
Source: Iowa DOT, Illinois DOT, Wisconsin DOT

Roadway Conditions

Pavement Condition Index

Pavement Condition Index (PCI) is a numerical rating system that assesses pavement health by identifying surface distresses (cracks, potholes, rutting) during visual surveys. The measurement scale is from 0 to 100, with 0 indicating worst and 100 indicating new/excellent pavement. PCI is used by agencies to identify roads that need maintenance and/or rehabilitation. Figure 7.4 shows the DMATS road network by PCI, and Figure 7.5 shows the percentage of DMATS roads by PCI. PCI is calculated only by the Iowa and Wisconsin DOTs; the Illinois DOT does not collect PCI data.

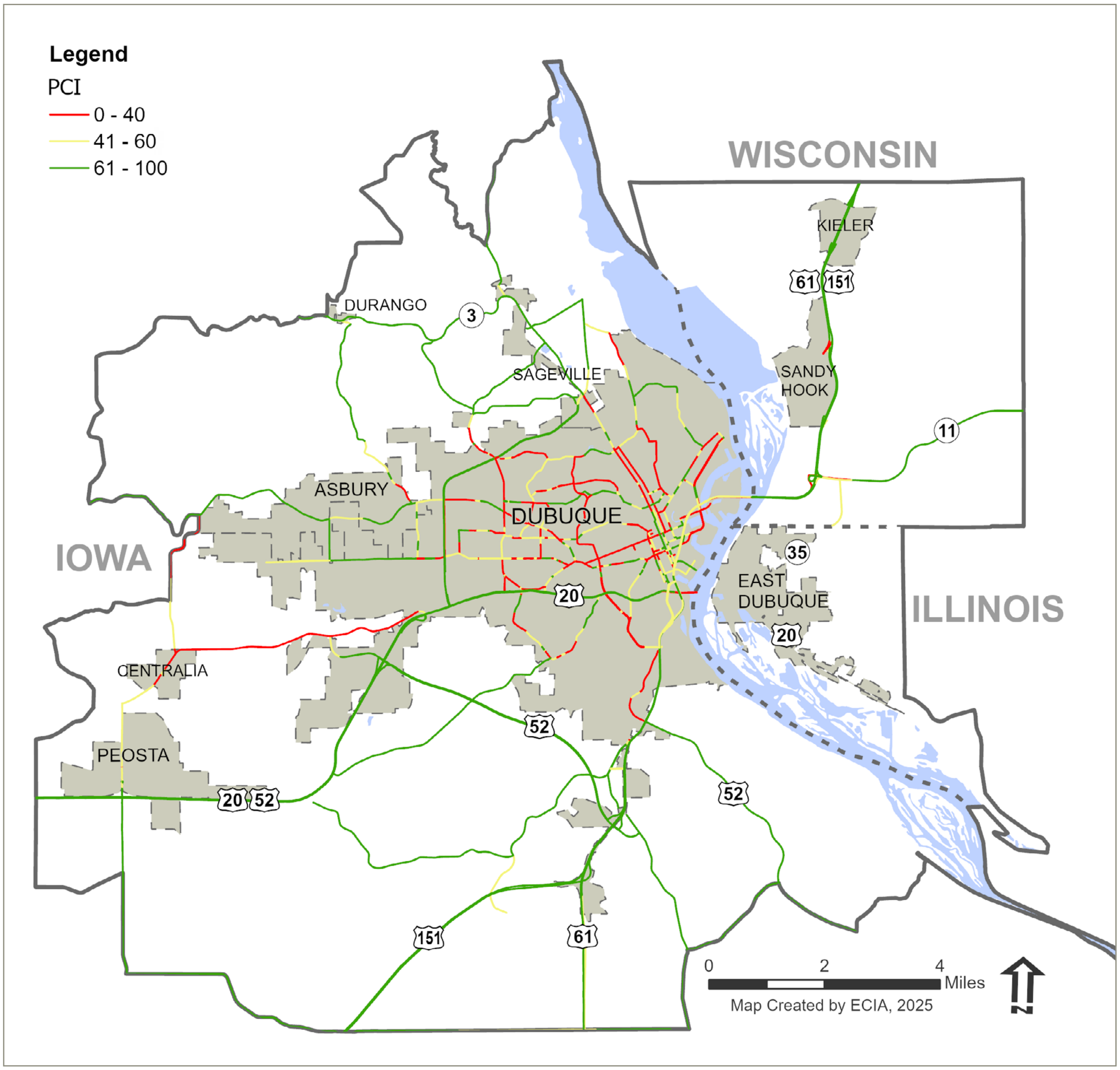

FIGURE 7.4

DMATS PCI in Iowa and Wisconsin

Source: Iowa DOT, Wisconsin DOT

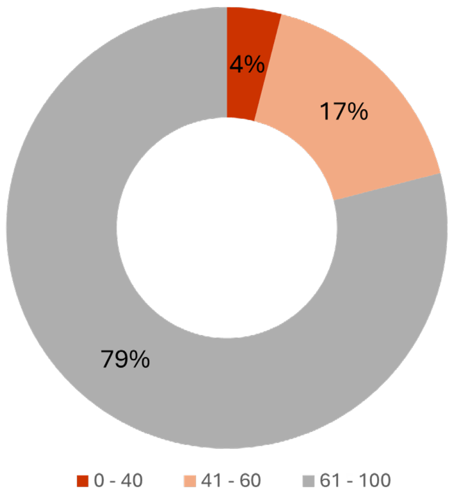

FIGURE 7.5

Percentage of DMATS Roads by PCI
Source: Iowa DOT, Wisconsin DOT

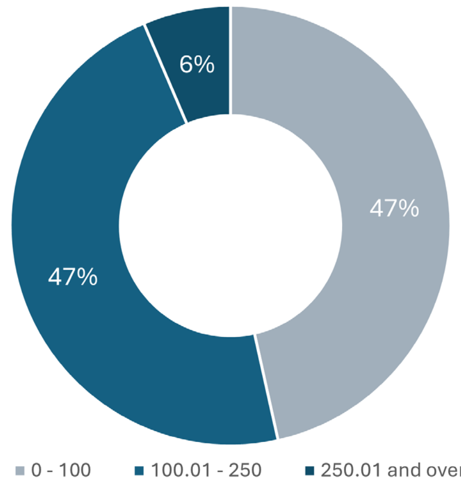

FIGURE 7.6

Percentage of DMATS Roads by IRI
Source: Iowa DOT, Wisconsin DOT

International Roughness Index

International Roughness Index (IRI) is a global standard for measuring road surface roughness. IRI is measured using a continuous profile along the road, which is then analyzed to summarize pavement surface deviations that can impact vehicle suspension movement. IRI is useful for assessing pavement ride quality, with a higher IRI indicating rougher road surfaces. IRI differs from PCI in the ways detailed in Table 7.3 below. Decision-makers who only look at IRI may ignore a road that feels smooth today but is structurally rotting underneath. Figure 7.6 presents the percentage of DMATS roads categorized by IRI. Figure 7.7 displays a map of the IRI roadway network within the DMATS area. Figure 7.8 provides a photo example of a roadway with a elevated IRI and PCI values.

TABLE 7.3

PCI & IRI Comparison

FEATURE	PAVEMENT CONDITION INDEX	INTERNATIONAL ROUGHNESS INDEX
What it measures	**Structural integrity**: The physical health of the road (cracks, potholes).	**Ride quality**: How "bumpy" or smooth the road feels to a vehicle
How it's collected	Visual inspections that look at the pavement surface.	Continuous profile that "looks ahead" to mea-sure vertical vibrations.
The Score	**0 to 100**: Higher score is better.	**Inches per mile:** A lower score is better. It measures how much a car will bounce over a distance.

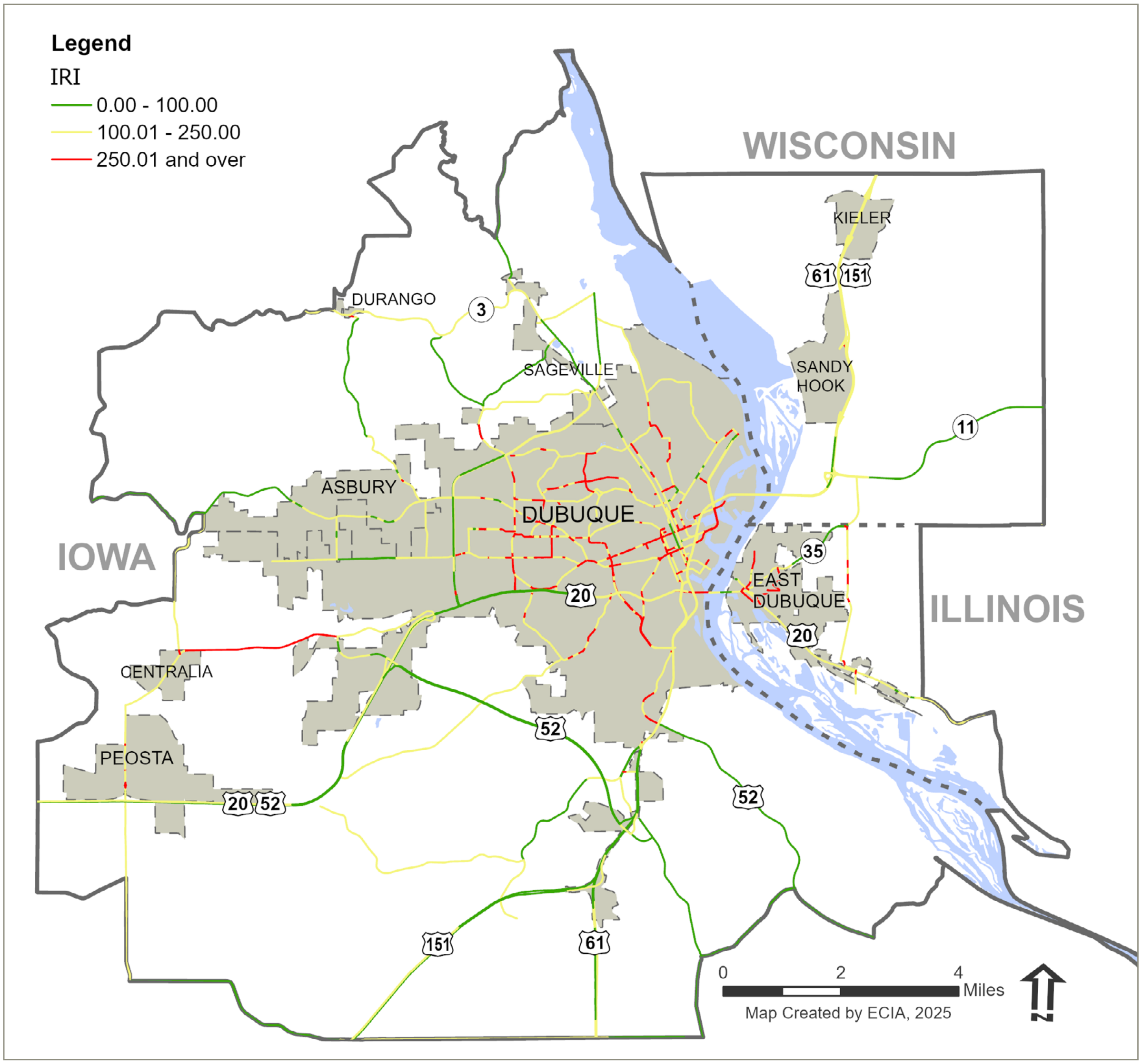

FIGURE 7.7

DMATS IRI in Iowa and Wisconsin

Source: Iowa DOT, Wisconsin DOT

FIGURE 7.8

Old Highway Road in Dubuque County

Source: Dubuque County

Bridges

Especially in a tri-state region, bridges are vital to ensure the efficient movement of both people and goods. This section goes over measures of bridge conditions from the Federal Highway Administration's National Bridge Inventory to analyze the suitability of the DMATS region's bridges.

Posted and Closed

Some bridges in the DMATS region limit the kind of traffic that goes through them. Posted bridges have signs that state the maximum allowable weight for a vehicle to travel on them, while closed bridges are inaccessible to vehicles. Figure 7.9 shows the posted and closed bridges in the DMATS area.

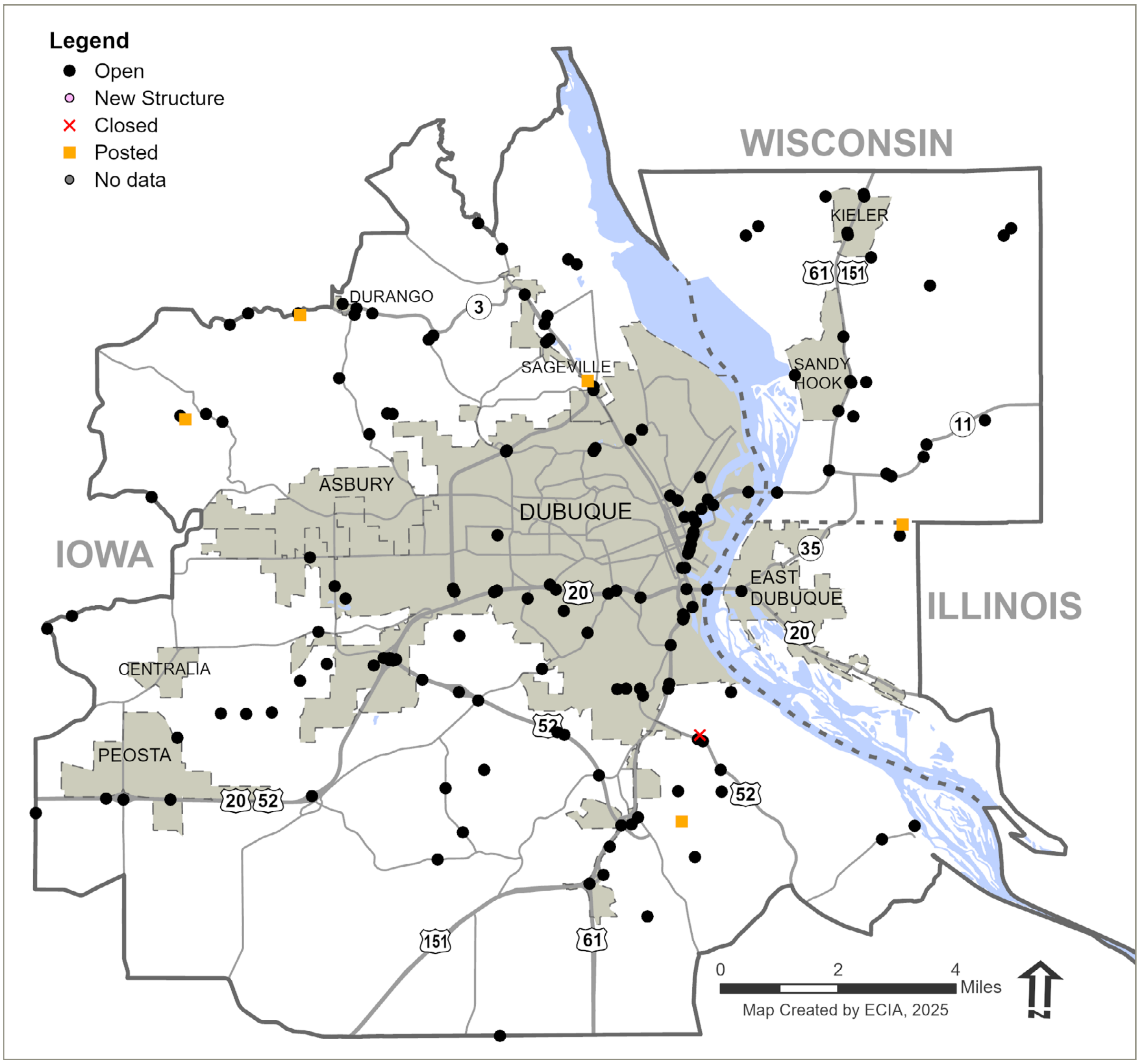

FIGURE 7.9

DMATS Posted and Closed Bridges

Source: FHWA, National Bridge Inventory

Bridge Condition

The Federal Highway Administration uses a classification system to place every bridge into one of three categories: Good, Fair, and Poor. The classification system is based on 4 condition ratings scored from 1 to 7, and the bridge is classified based on the lowest rating. If the lowest rating is greater than or equal to 7, the bridge is classified as Good; if the lowest rating is 5 or 6, it is classified as Fair; and if the lowest rating is 4 or below, the bridge is classified as Poor. Figure 7.10 shows the bridges in the DMATS area by bridge condition.

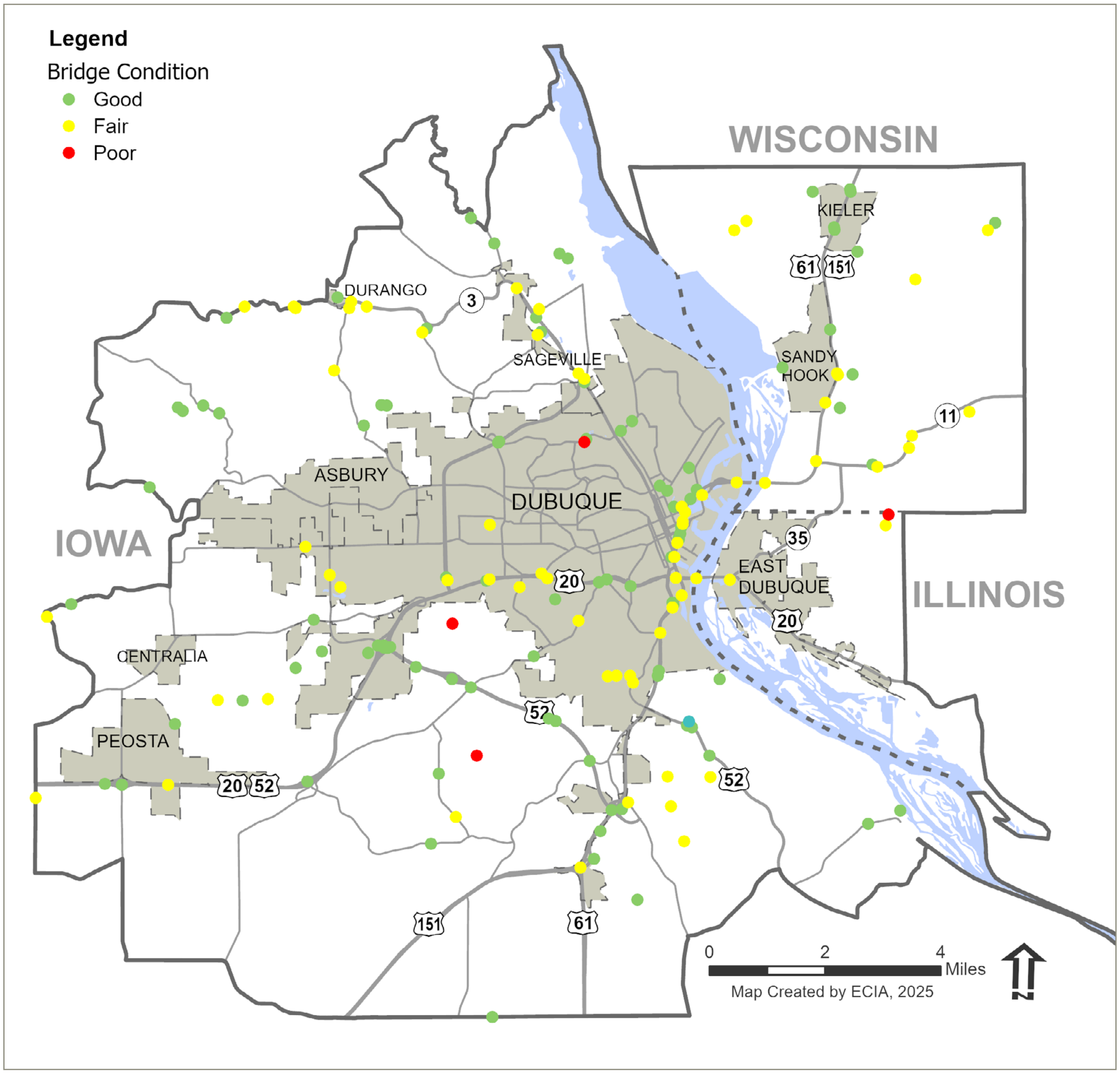

Figure 7.10
DMATS Bridge Condition
Source: FHWA, National Bridge Inventory

ITS Infrastructure

DMATS has worked with partners to invest in the region's Intelligent Transportation Systems (ITS) infrastructure. ITS integrates advanced technologies into transportation infrastructure, including cameras and other sensors that monitor traffic conditions. Figure 7.11 provides the location of the camera network in the DMATS area.

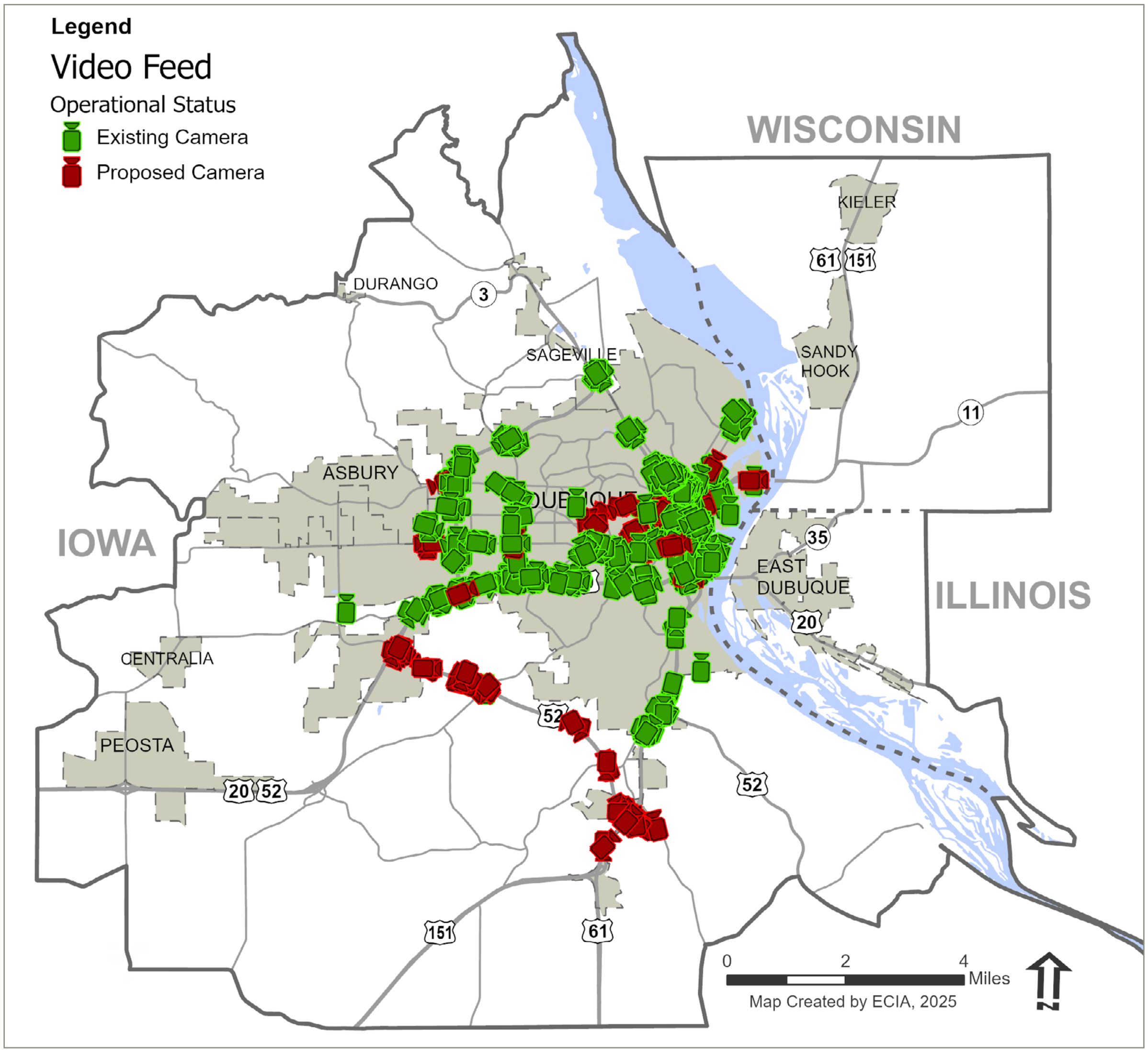

FIGURE 7.11

DMATS Camera Network

Source: City of Dubuque GIS

These cameras and other sensors then connect to a network of fiber optic cables and wireless communication devices that deliver data to a central operations center where the data is processed and put to use. The City of Dubuque has constructed a fiber optic network along the region's major corridors and the downtown area. The City has also installed fiber optic conduit and advanced ITS components into all new or reconstructed traffic signal controllers throughout the city. The City has installed fiber optic conduits under all new roadways to accommodate future fiber. Figure 7.12 shows the City's fiber optic network.

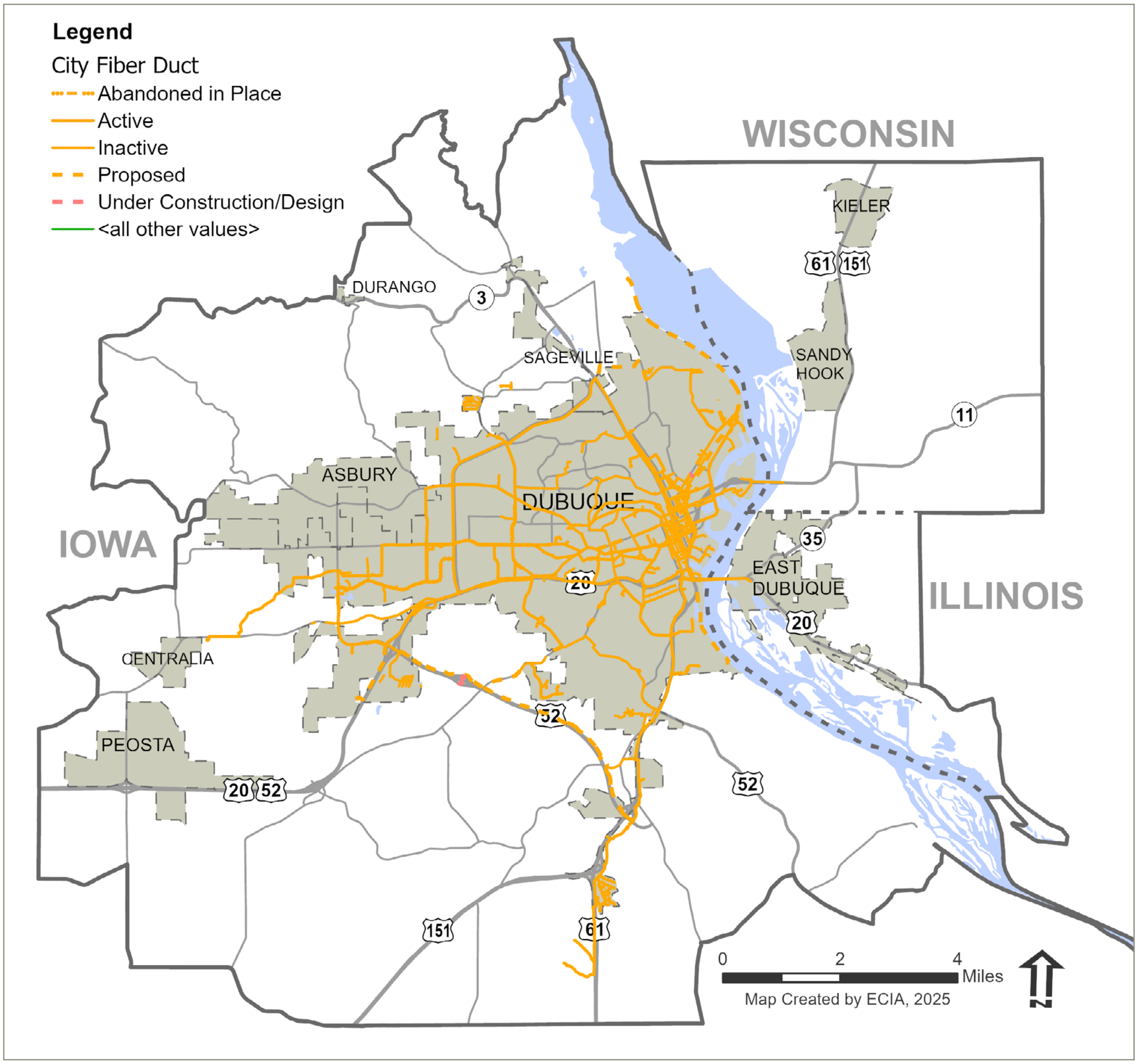

FIGURE 7.12

DMATS Fiber Network

Source: City of Dubuque GIS

The City of Dubuque has invested in a robust Traffic Operations System that uses advanced communication technologies along with state of the art traffic control equipment that allows management of the operations via a Traffic Operations Center (TOC) located at City Hall.

Within the region, communities have utilized ITS for other applications including traffic counts for project planning, traffic signal timing and coordination, and motorist notifications through dynamic message sign (DMS) boards.

STREETS Project

The Smart Traffic Routing with Efficient and Effective Traffic Systems or STREETS project represents the future of the DMATS area's traffic management efforts. Dubuque has been a leader in the use of ITS technology to manage and operate its traffic signal network. The implementation of these technologies has resulted in reduced delay on some of the area's most heavily traveled corridors. The goals of the STREETS project are to serve as a framework for other small urban areas through:

- Reducing wear and tear on major corridors
- Reducing congestion
- Improving travel times
- Improving safety
- Reducing emissions
- Enhanced system monitoring capabilities

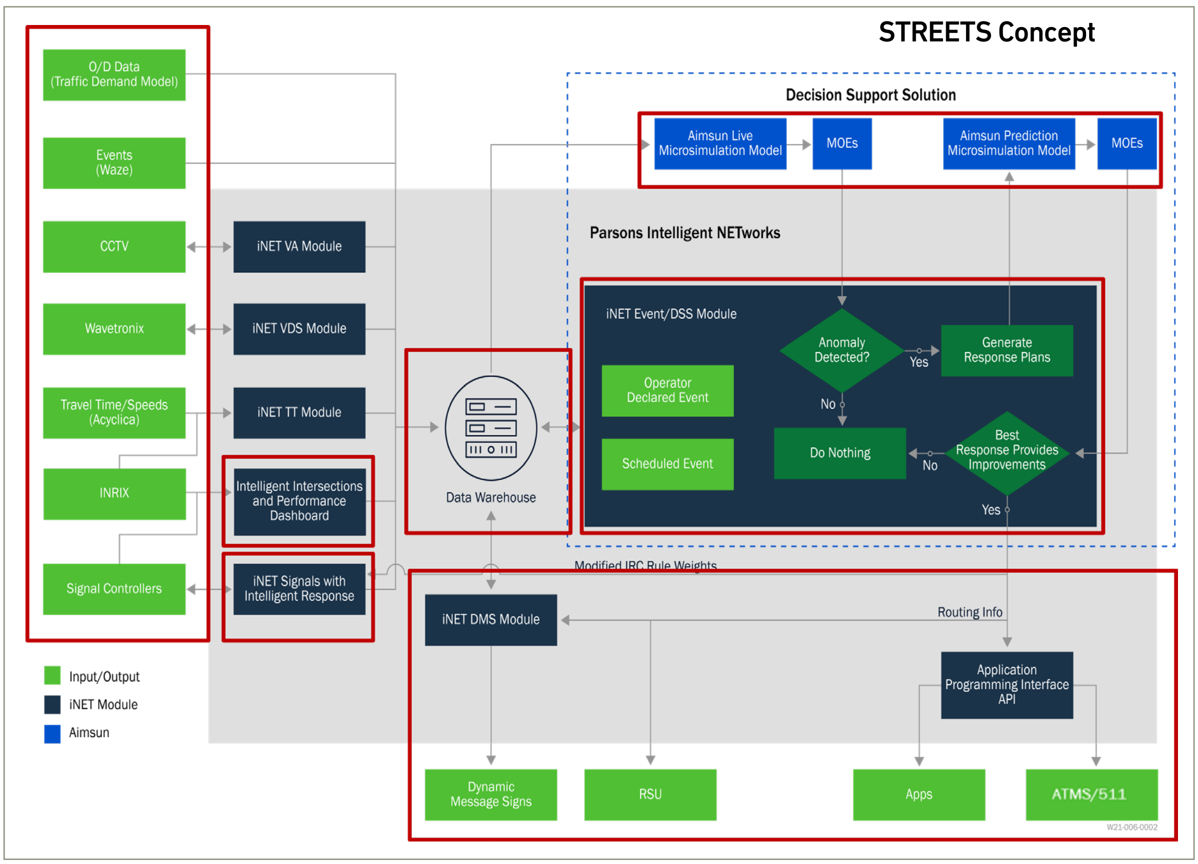

FIGURE 7.13

STREETS Concept

The infrastructure of the STREETS project is composed of

- A first-of-its-kind, fully-automated traffic control program
- Utilization of AI-based video analytics to collect real time traffic conditions
- Simulation of future traffic conditions (based on real time modeling)
- Automatic adjustment of signal timing for maximum efficiency during unusual events or traffic conditions
- Dissemination of travel times along the major routes in the region to support dynamic routing.

This infrastructure allows the transportation network to dynamically respond to events and congestion detected by the microsimulation model and proactively adjust signal timing based on predicted traffic flow data, while disseminating congestion and alternate route information for motorists. The ultimate deployment will cover 15 corridors with 72 primary signalized intersections and an additional 48 secondary signalized intersections within the City of Dubuque. Figure 7.14 shows the intersections that will be covered by the STREETS project.

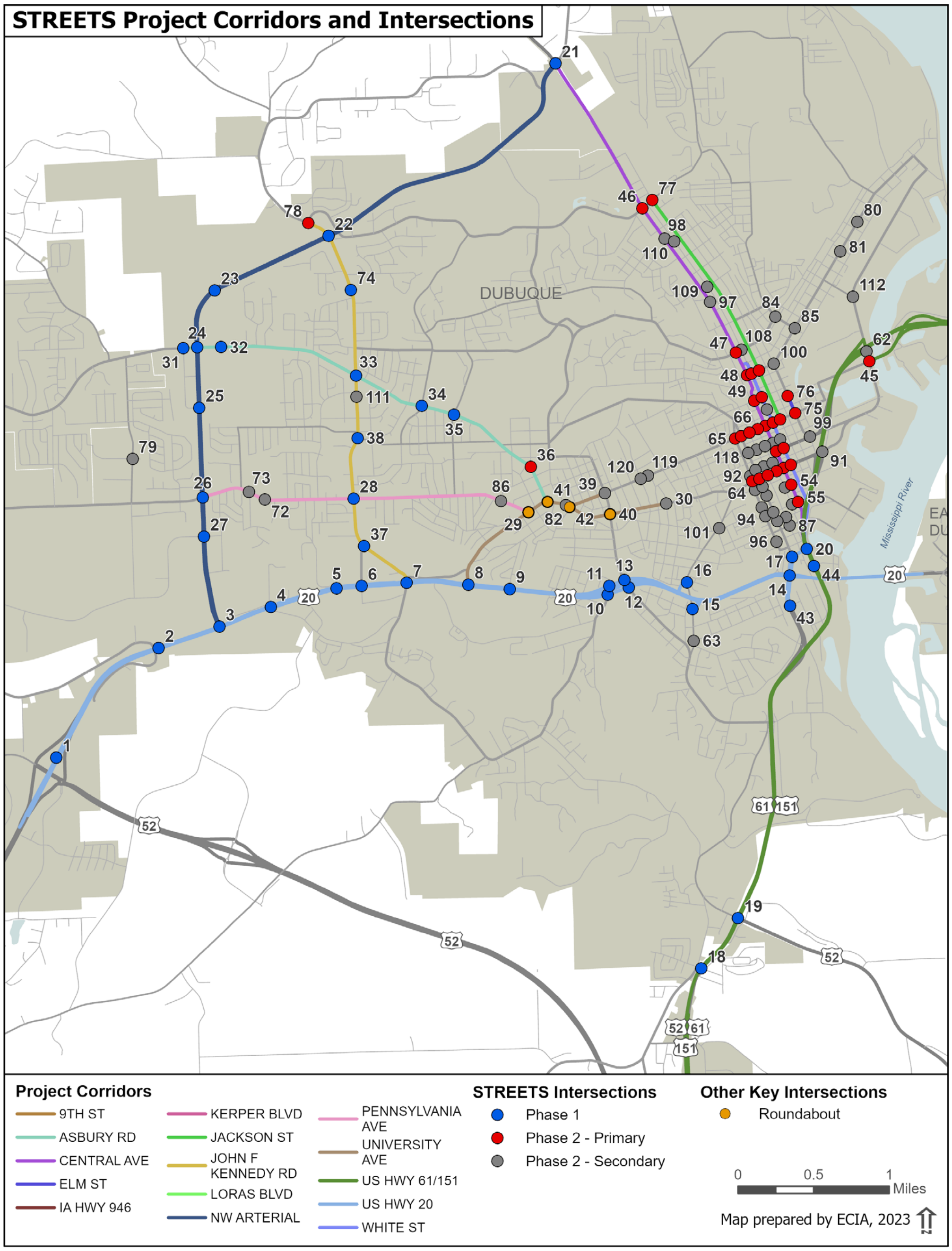

FIGURE 7.14

STREETS Project Intersections

Source: DMATS

Metro Dubuque Traffic Data Aggregation for Connected Vehicles

One of the limitations of the STREETS project was its ability to communicate information to drivers, as an increasing number are relying on in-vehicle navigation platforms such as Google Maps and Waze for routing purposes. These platforms would not be using the information within the STREETS project for routing purposes, greatly reducing the potential impact of the project.

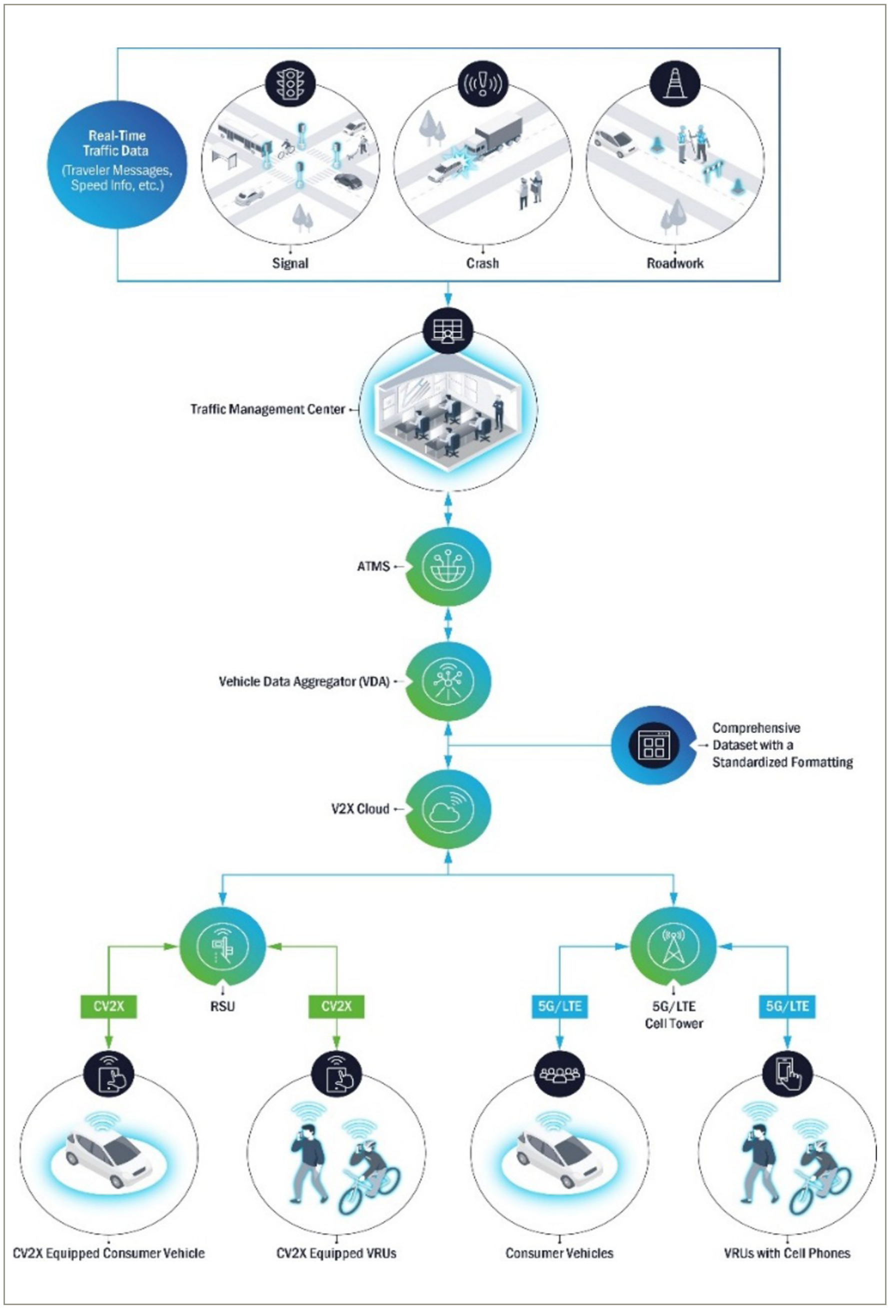

FIGURE 7.15

SMART Grant Concept

Source: ECIA

In October 2023 DMATS applied for a US Department of Transportation SMART Grant that would help support the ultimate goal of the STREETS project. The objective of this initiative was to deliver near real-time transportation information directly to vehicles over the cellular network.

To support this effort, DMATS partnered with Parsons and Harman, a Samsung subsidiary, to develop an open and standardized dataset for integration and distribution into infotainment systems. The project included the development of a prototype interface capable of communicating incidents, planned events, and signal timings directly to the vehicle. Figure 7.15 illustrates the concept and Figure 7.16 provides an example of the interface.

DMATS is currently seeking funding for Phase 2 of the project, which would include more detailed information and allow for integration into third-party applications.

Conclusion

The DMATS roadway and bridge network plays a vital role in supporting mobility, connectivity, and economic activity throughout the tri-state region. As infrastructure ages and travel demands evolve, continued investment in roadway preservation, bridge maintenance, and system operations will be essential to maintaining reliable transportation service. The region's commitment to Intelligent Transportation Systems and connected vehicle technologies positions DMATS to improve transportation efficiency and responsiveness in the years ahead. Strategic investments in both infrastructure and technology will help ensure the transportation network continues to meet the needs of residents, businesses, and visitors through 2055.

FIGURE 7.16
SMART Travel Interface in practice