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**INTEGRATED CORRIDOR MANAGEMENT –
DES MOINES METRO AREA**

DES MOINES METROPOLITAN AREA
INTEGRATED CORRIDOR MANAGEMENT (ICM)

Program-Level Concept of Operations
June 24, 2019

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1 Introduction

This document details the Concept of Operations (ConOps) for the Des Moines Metropolitan Area Integrated Corridor Management (ICM) Program. The need for the ICM concept originated from the desire to address current and anticipated instances of congestion along transportation corridors within the Des Moines Metropolitan Area. In recent years, traffic congestion and its associated impacts have been increasing—a trend that is expected to continue. To proactively and cost effectively address congestion, the Iowa Department of Transportation, in cooperation with regional stakeholders, is considering ICM strategies to improve transportation safety, mobility, and reliability while emplacing the need for sustainable, environmentally friendly solutions.

1.1 ICM PROGRAM SCOPE AND PURPOSE

The Des Moines Metropolitan Area ICM program is a regional initiative being led by the Iowa Department of Transportation in close coordination and support by local and regional stakeholders to identify, develop, and implement innovative, multi-modal and multi-jurisdictional strategies to better manage traffic congestion and more effectively move people and goods through corridors within the Des Moines Metropolitan Area. The program focuses on strategies that support the management and operation of transportation networks as a cohesive system rather than stand-alone improvements that are traditionally construction-focused expansion projects. The intent of a program-level approach is to provide a framework or structure from which future individual projects can reference thereby creating a more holistic and consistent deployment.

As part of the ICM effort, stakeholders and the public have been engaged in a series of activities starting in October 2018. The following is a list of the activities undergone as part of this effort and which provided input for this document:

- Stakeholder Kick-off Meeting (October 2018)
- Stakeholder Visioning Workshop (November 2018)
- Public Scoping Meeting (January 2019)
- Stakeholder Concept of Operations Workshop (March 2019)

A series of technical reports and analyses have been developed to support these activities and include existing and future conditions assessment, strategy development, performance measure development, and evaluation and prioritization of strategies.

Subsequent to this program-level ConOps, the ICM program will begin a Phase 2 effort which will identify and plan project-level implementations. Several future project-level implementations will require more focused project-level ConOps that will go into more detail on the specific corridor/area and selected strategies or countermeasures. As previously described, each will refer to the program-level ConOps for consistency.

1.2 ICM PROGRAM AREA

The Des Moines Metropolitan Area ICM program is a regional effort focusing on the freeway corridors within Des Moines and the surrounding communities. As a corridor focus, the study encompasses all roadways in the vicinity of the freeway as well as all available modes of travel. The study area is shown in Figure 1.

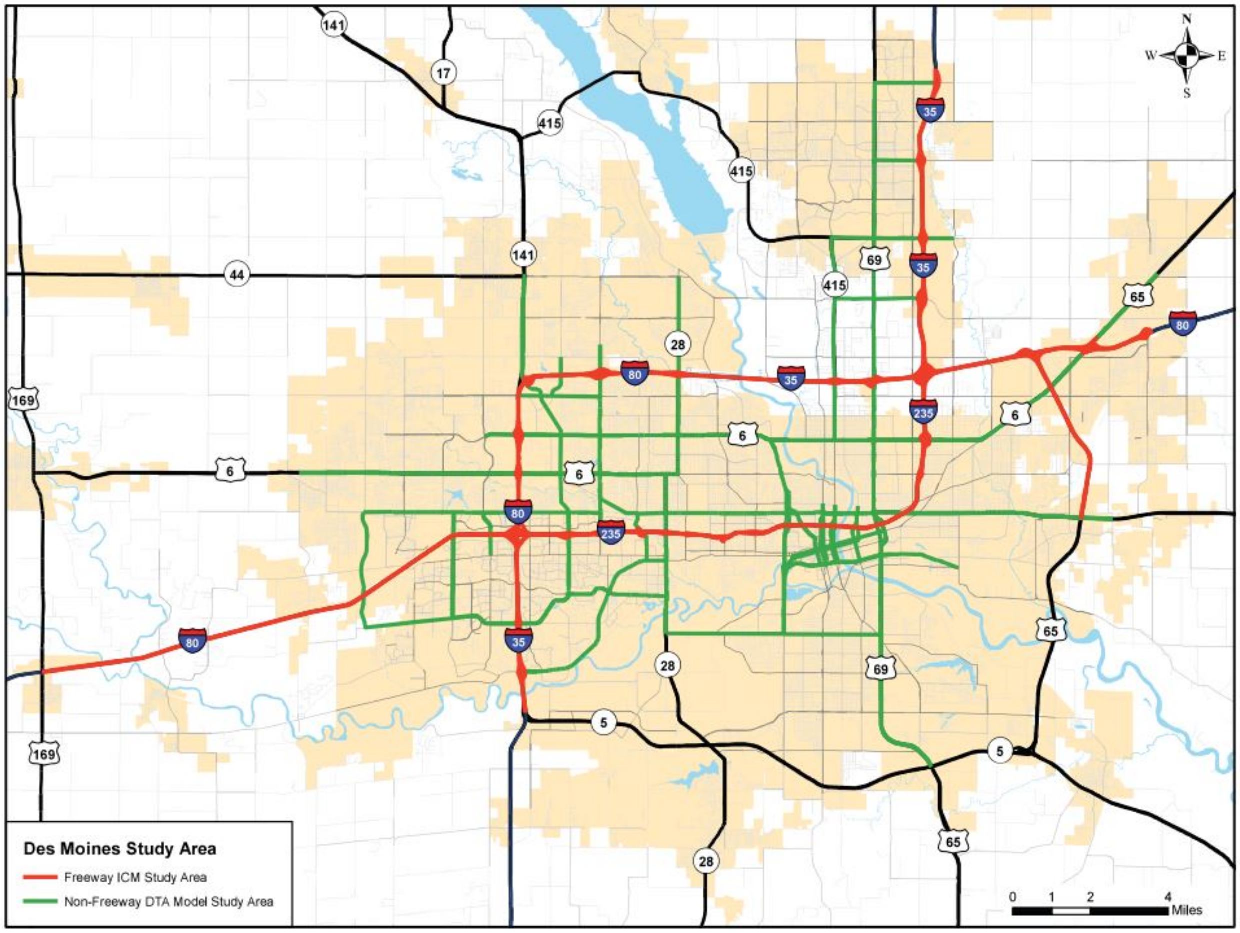


Figure 1: Des Moines Metropolitan Area ICM Program Area

2 Document Purpose and Understanding

The Des Moines Metropolitan Area ICM Program-Level ConOps provides a high-level overview of the region's ICM Program so that all stakeholders, regardless of their background, can easily understand where in the program framework they fit and what general responsibilities they have in ICM activities relative to fulfilling the regional ICM vision. The ConOps is written in a non-technical manner so that each stakeholder can understand what is being built and has the ability to provide feedback at this stage of program development. In this manner, the ConOps fosters an environment where stakeholders can collaborate to exchange ideas and gain consensus on how to proceed with implementing ICM strategies. This helps identify operational needs early in the program's development and reduces the need to revisit planning-level decisions as the system is being designed or implemented, which may result in costly schedule delays.

2.1 WHAT IS A CONCEPT OF OPERATIONS?

While the ConOps serves as a process for bringing together stakeholders and sharing information, its primary purpose is to document how the ICM system will operate from the viewpoint of multiple stakeholders. In addition, it will document the developed consensus regarding vision, goals, objectives, operational philosophies, operational system characteristics, system constraints and limitations, institutional issues, and external interfaces. This helps to clarify needs at each level early in the program's development and reduces future risk as the program is being implemented, saving budget overruns and schedule delays.

Ultimately, this program-level ConOps in combination with subsequently developed project-level ConOps will answer the who, what, when, where, why, and how questions about new or modified systems in an accessible manner for all users:

- Who? — Identifies the various people who interact with the system.
- What? — Identifies the known system components/elements and high-level capabilities required. Note this is with respect to all elements of the system—whether human or technology (hardware/software).
- When? — Identifies the activities and tasks of the system, including any required time sequence (precedence, concurrence), and operations under various conditions.
- Where? — Describes the physical and geographic location and environment.
- Why? — Explains the reasoning behind specific sequences or partitioning of tasks (e.g., policies, skill sets).
- How? — Wraps together all the above to explain how a system is to be used, operated, and maintained. This is not to be confused with prescribing how to implement the concept or the system design or detailing a system specification.

It is important to note that the ConOps is fundamentally about the process used to develop it, which is reliant upon stakeholder interaction. The documentation of the outcomes of that process in a ConOps must reflect the stakeholder input. Also, the ConOps is not static and will need to be updated as new information arises during the lifecycle of the project.

2.1.1 Program-Level Concept of Operations

The ConOps description provided above is a typical approach that is tailored to specific projects. In the case of the Des Moines Metropolitan Area ICM Program, the approach taken was to develop an overarching program-level ConOps prior to any specific projects in order to establish the structure for all future efforts. This document serves as the program-level ConOps—describing how individual ICM strategies will work together to meet the high-level ICM vision from a strategic and holistic perspective but does not provide detail regarding specific deployments at specific locations. The program-level document will serve as a framework for future projects and describes how the ICM program will be managed. The desired operation of individual ICM projects will be developed in separate ConOps documents when those projects are initiated.

The program-level ConOps described in this document focuses on the overall goals and objectives of the ICM and provides an area-wide perspective of the operating environment for the Des Moines Metropolitan Area ICM. A comprehensive menu of available strategies is identified to address stakeholder and user needs irrespective of location. Specific operational needs for each strategy, whether hardware or personnel, are identified in general terms along with high-level roles and responsibilities for planning, implementing, operating, and maintaining features and functions. This document provides the fundamental approach common to all ICM efforts and serves as a central resource to individual efforts.

2.1.2 Program-Level and Project-Level Concept of Operations Relationship

As described above, this program-level ConOps serves as the overarching strategy document for ICM within the Des Moines Metropolitan Region. As such, the program-level ConOps will serve as the springboard for additional systems engineering activities including development of more detailed project-level ConOps as well as individual systems' technical requirements, design and operations. This document should be considered a companion document that provides the high-level understanding to begin these processes.

The program-level ConOps identifies and describes all applicable ICM strategies identified to date from which stakeholders may consider as they develop solutions to congestion-related issues within their respective jurisdictions. Project champions should first reference this document to determine how their local needs can be addressed by the ICM program and, building from this body of knowledge, develop a separate standalone ConOps document with more detailed information pertinent to the individual project. As individual ICM projects are identified, a one-to-many relationship will form where this program-level ICM ConOps will serve to inform the development of many individual project-level ICM ConOps.

2.2 DEVELOPMENT PROCESS AND APPROACH

The development of this document relied heavily on two sources—an industry accepted systems engineering approach and a regional stakeholder involvement. The systems engineering approach provides the purpose and structure for developing a ConOps document within the context of a lifecycle perspective. The approach was initially developed within the field of information systems/information technology but can be applied to any complex system or field and has been adapted to transportation projects.

Stakeholder involvement is essential in the development of the ConOps as consensus is needed related to goals, objectives, and responsibilities of the project and its members.

2.2.1 Systems Engineering Context

The Des Moines Metropolitan Area ICM ConOps was developed using a disciplined systems engineering approach. Systems engineering is a method to facilitate the development, maintenance, refinement, and retirement of dynamic, large-scale systems of systems comprising both technological components (machines, information systems, etc.) and human components (users, stakeholders, etc.). Despite the apparent simplicity of the definition of systems engineering, the methods it uses are robust enough to manage the most sophisticated system applications.

The steps involved in the systems engineering lifecycle are best illustrated through a "vee model" or "V-model." This model places the relevant procedures in a step-wise, temporally relevant shape (Figure 2) with time moving left to right. As can be seen in the diagram, the systems engineering flowchart provides continuity and checkpoints between planning, development, and implementation. Each step references back to an earlier effort to verify or confirm that prior requirements are still being satisfied and carried forward.

Within the systems engineering approach, the ConOps effort serves as a transition from feasibility or concept exploration to developing requirements and moving into the first stages of design. The ConOps is typically one of the earlier stages of the systems engineering model and serves as the principal guidance document for future steps within the design process. Prior to the ConOps, effort is typically focused on needs assessment, concept selection, feasibility, and general planning.

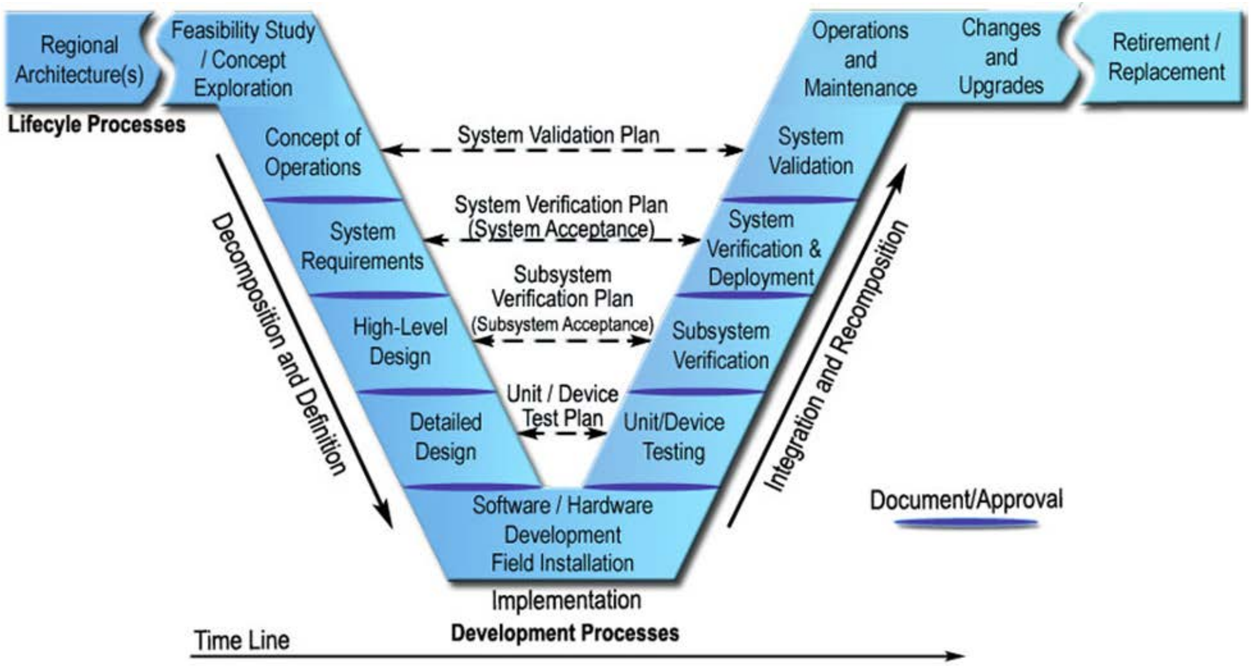


Figure 2: Systems Engineering Lifecycle V-model

Source: FHWA "Systems Engineering for ITS," Publication No. FHWA-HOP-07-069, EDL-14340, January 2000

The Federal Highway Administration (FHWA) has actively adopted the systems engineering approach for intelligent transportation systems (ITS) projects. The FHWA requirements are defined by the Final Rule on ITS Architecture and Standards (23 CFR Part 940) and state that "All ITS projects funded with highway trust funds shall be based on a systems engineering analysis" (940.11). This ConOps lays the framework for satisfying the FHWA requirement and future systems engineering activities.

2.2.2 Stakeholder Outreach

Stakeholder involvement is key to developing consensus around the ConOps and future systems engineering efforts. As part of the ConOps process, particular focus was given to engaging stakeholders in each of the steps as they were developed. A Stakeholder and Public Engagement Plan was developed and outlines specific steps, methods, and timeframes for outreach with the goal to actively identify and engage key stakeholder audiences and the general public throughout the ICM development process.

A summary of the specific steps taken or planned include the following, organized by audience type:

Primary Stakeholders:

- Jurisdictional Collaboration Site (electronic file sharing)
- Kick-off Meeting (1) at the Metropolitan Planning Organization (MPO)
- MPO Technical Meetings (as appropriate)
- Stakeholder Coordination Meetings (as appropriate)
- Visioning Workshop (1)
- ConOps Workshop (1)

- Phase 1 Implementation Meeting (1)
- Phase 2 Prioritization Meeting (1)

General Public:

- Website and electronic updates
- Social media
- Press releases (as appropriate)
- Public Scoping Meeting (1)
- Public Information Meeting (1)
- Public comment form (via website)

2.3 AUDIENCE

As previously described, the ConOps document serves as an important step between project planning and design and is the principal guidance document for future steps within the systems engineering process. As such, the target audience for the ConOps document is varied and broad in terms of background, function, and role. Individuals, or groups, referring to this document may have a role in planning, designing, constructing, operating, or maintaining the system. In addition, there may likely be affected parties impacted by the system who are indirectly involved and may need to be considered or reference the document.

The following groups or categories of audience members have been identified for this document:

- Elected officials
- Transportation agencies
- Metropolitan planning organizations
- Law enforcement
- Emergency responders (fire, medical)
- Transit providers
- Engineering firms
- Professional organizations
- Commercial vehicle operators and organizations
- Road users/general public

Within each of the above groups or categories, there are multiple types of audiences such as policy makers, managers, engineers or designers, operators, maintenance workers, construction workers, manufacturers or suppliers, and others. While this list is fairly exhaustive, it is important to consider all potential users to capture input or consider perspective in the early stages of the systems engineering process. Specific stakeholders who play a more active role in the program development are listed in Section 5.5. In general, those include:

- Iowa Department of Transportation
- Des Moines Area Metropolitan Planning Organization
- Federal Highway Administration - Iowa Division
- Greater Des Moines Partnership
- Des Moines Area Regional Transit (DART)
- All local area municipalities (City, County, Town)
- All local area emergency response providers

This list of audiences and stakeholders is intentionally broad for the program-level ConOps as it serves as the basis for all future projects. As project-level efforts are initiated, the scope of stakeholders can be reassessed based on the proposed improvements and associated impact and may be a smaller subset of those included in this document.

2.4 DOCUMENT INTENDED USE

The purpose of the ConOps is to provide a high-level overview of the Des Moines Metropolitan Area ICM program from visioning to potential strategies. As mentioned previously, the primary purpose of this document is to serve as the "parent" ConOps for future ICM projects and to provide the basic framework or understanding common to most ICM projects regardless of where they are implemented. Project staff responsible for developing future ICM projects may leverage this document to quickly understand the overarching ICM program and to better understand where in the ICM framework future projects fit. While this document provides comprehensive legacy information, project staff will be responsible for updating this document with pertinent project details as they endeavor through the project development and systems engineering processes. Project staff can either edit the document directly or provide project details as a separate addendum to this ConOps (recommended).

By reading this document, interested parties will be able to:

- Identify and understand regional needs that can be addressed through ICM concepts
- Understand the consensus view of ICM purpose and intent
- Determine the geographic and physical extent of the ICM program.
- Identify all stakeholders with a potential role in ICM and the associated responsibilities
- Understand the various strategies recommended and their application
- Identify and understand ICM-related operational and support environment

2.5 CONTENTS AND ORGANIZATION

This document generally follows the high-level outline structure that has been developed for systems engineering efforts. A brief description of each section is provided below.

Section 3: ICM Understanding provides an overview of Integrated Corridor Management and its components and processes. It provides a high-level introduction for those unfamiliar with the concepts and details those aspects which will be carried forward for the Des Moines Metropolitan Area.

Section 4: Reference Documents lists the resources used in the development of this document and serves as a source that readers may use to obtain additional details on aspects of the project. This can include documentation of any current practices/operations, strategic plans, business planning documents, concept of operations for related systems, requirements for related systems, studies to identify operational needs, and system development meeting minutes.

Section 5: Situational Background covers how the current transportation network (or the individual elements) operates, what limitations users experience, and what needs have been identified. It will ultimately provide the underlying argument in support for the ICM program and how it can meet identified goals.

Section 6: ICM Operational Description focuses on the operational characteristics of the region/corridors in terms of vision and goals. It sets the focus for the proposed system and what is desired by the stakeholders. The operational description can be framed around how each stakeholder can play a part in integrating themselves into the successful operation of the ICM system. This includes details on user activities, order of user operations, operational process procedures, and organizational/personnel structures.

Section 7: ICM Operational Concept identifies and describes the entirety of the ICM strategies or concepts that are included in the Des Moines Metropolitan Area ICM Program. Each concept is described at a high level so as to facilitate broad understanding by all stakeholders prior to consideration and/or selection by project champions for individual ICM projects. General roles and responsibilities for operating strategies is also provided.

Section 8: Operational Environment discusses the physical operational environment, such as facilities, equipment, computing hardware, software, and other items necessary to operate the ICM system. Since the program-level ConOps will highlight all selected strategies that may be used in future projects, this section is overarching and less detailed than a project-level ConOps which will be more focused on the specific implementation.

Section 9: Support Environment discusses other non-physical assets that may be leveraged in support of ICM planning and operations, such as standard operating procedures, policies, funding, legislation, education and training, memorandum of understanding, maintenance procedures, personnel, etc.

3 ICM Understanding

The basic premise behind the proposed Integrated Corridor Management System is that Des Moines Metropolitan Area transportation networks and their associated transportation management systems can be operated in a more "integrated" manner through the use of currently available technologies. It is anticipated that by "linking" the adjacent networks into an integrated system—in essence, creating a "system of systems"—the benefits currently provided by the individual network-specific transportation management systems will be further enhanced.

The ICM concept provides a framework for multi-modal, multi-jurisdictional coordination to deliver a safer, more reliable, and more convenient transportation system for all users and in a more cost-effective manner compared to traditional capacity expansion projects. The ICM approach is based on the notion of proactively managing and operating the regional transportation system as an integrated system rather than as individual roadway networks. As traffic volumes grow and as incidents and construction activities occur, managing the Des Moines Metropolitan Area surface transportation system holistically will allow the DOT and other local and regional agencies to more effectively manage transportation demand using available capacity where it exists, either by leveraging capacity on adjacent or parallel networks and/or by promoting the use of transit to move greater numbers of people using less vehicles. Furthermore, the Iowa DOT desires to use ICM strategies cooperatively to proactively manage traffic under all types of traffic conditions to deliver improved levels of safety, efficiency, reliability, productively, and quality of life for all users.

3.1 WHY IS INTEGRATED CORRIDOR MANAGEMENT IMPORTANT/NEEDED?

Transportation corridors that frequently experience congestion often have available capacity in some of the modes or facilities within the corridor. The available capacity can be used to more effectively balance transportation demand among the facilities and modes within the corridor. The ICM operational philosophy attempts to integrate these individual transportation facilities and resources that comprise a corridor or numerous interconnected corridors to maximize use of available capacity (i.e., pavement or vehicles) and to increase person throughput within and through the corridor. The basic premise behind ICM is to operate individual transportation networks (both roadways and multi-occupant forms of transportation) in a more integrated, cohesive manner rather than the traditional approach that applies operational improvements independently and without consideration of how they can work together to improve corridor operations. The ICM philosophy was developed and begun to flourish within the United States, in part, from the growing need to reduce congestion, and improve safety and mobility along problematic corridors. Today, and with the help of technological advancements, transportation practitioners are using ICM more frequently to proactively manage transportation demand to reduce congestion before it occurs rather than reacting to it. Consequently, the ICM approach reduces or eliminates the adverse impacts congestion causes to safety, mobility, and economic productivity. Like several forward-thinking departments of transportation (DOT), the Iowa DOT recognizes that operating individual networks independently is an inefficient method of allocating transportation demand across available roadway capacity. By integrating transportation facilities and resources, the Iowa DOT and local partner agencies will optimize transportation efficiency on a near real-time basis working to balance demand across the entire network and, in doing so, maximizing the benefits of existing transportation investment.

3.1.1 Potential Benefits

ICM can deliver a safer, more reliable, and more convenient transportation system for all users in a more cost-effective manner compared to traditional capacity expansion projects. As traffic volumes grow and as incidents, weather, and construction activities occur, actively managing transportation networks will allow the Iowa DOT and other local and regional partners to more effectively manage transportation demand using available capacity where it exists, either by optimizing freeway operations, leveraging available capacity on adjacent or parallel facilities and/or by promoting the use of transit or new forms of mobility to move greater numbers of people using fewer vehicles. While the benefits of ICM will vary depending on corridor characteristics and the application of specific operational strategies, it can be expected to benefit transportation in the following ways:

- **Improved safety and emergency response** – ICM strategies can reduce primary and secondary crashes improving safety for motorists, pedestrians, emergency responders, and construction workers. Furthermore, by reducing congestion and vehicle delay, emergency responders can provide more timely response and treatment to injured persons when incidents do occur.
- **Improved accessibility and mobility** – ICM strategies can improve first and last mile connections between modes which in turn can improve transportation accessibility for all users, and more specifically the elderly and disadvantaged populations.
- **Reduced or shifted demand** – At the heart of ICM is the ability to balance transportation demand among networks where excess capacity exists. Additionally, ICM offers the ability to reduce or eliminate demand altogether which helps to sustain mobility and traffic flow improvements.
- **Enhanced traveler choice and decision-making** – ICM strategies can improve access to timely, accurate, and useful travel information to promote driver choice as to which facility or mode to use, empowering users to be in control of their individual trips. As such, users may elect to take routes with less delay, shift modes, and/or shift the timing of their trips which helps to rebalance demand to other modes or times of day that can better service excess demand.
- **Increased return on and use of existing investment** – ICM helps maximize use of existing services and infrastructure, increasing the public's return on investment. A goal of ICM is to maximize use of existing transportation investment to reduce more expensive infrastructure projects that add physical capacity to the network.
- **Improved transportation efficiency and productivity** – By reducing congestion and providing drivers with choices on how they can reach their destinations, drivers including freight vehicle operators can arrive to their destinations more quickly.

- **Institutional cooperation** – Since ICM strategies often overlap jurisdictional boundaries, they have potential to bring together and improve collaboration among transportation agencies. This can improve information and data sharing and result in greater efficiencies in traffic management across jurisdictional boundaries than if agencies remain focused on operations within their jurisdictions.
- **Reduced environmental impact** – ICM can reduce stop-and-go driving behavior and in turn improve vehicle fuel efficiency and reduce the amount of emissions released into the atmosphere.
- **Improved customer experience and perception** – ICM strategies can improve the customer experience through the aforementioned benefits. This in turn can improve the public's perception of transportation agencies ultimately leading to greater support and funding for strategies.

3.1.2 Coordination with On-going Activity

Effort to develop the Des Moines ICM Program-Level ConOps was coordinated with and builds on recently developed and ongoing regional planning studies. Existing and ongoing studies are valuable sources of information because they provide insight into existing conditions and regional needs. This allows for a more comprehensive understanding of conditions and introduces project efficiencies in that prior understanding can be brought forward in a more cost-effective manner. In an effort to develop an in depth understanding of regional conditions and needs, the following planning efforts were identified and reviewed during this study:

- Des Moines Area Metropolitan Planning Organization Congestion Management Process (January 2016)
- Mobilizing Tomorrow: A Transportation Plan for a Greener Greater Des Moines (Last Amended November 2016)
- Technical Memorandum Compendium – Interstate 235 Ramp Management Feasibility Study (April 2014 - DRAFT)
- The Tomorrow Plan: Partnering for a Greener Greater Des Moines (November 2013)

4 Referenced Documents

The following resources have been referenced in development of this document:

- DART Technology Advancements
- Des Moines Rail Transload Feasibility Study, Des Moines Area Metropolitan Planning Organization, March 2019
- Congestion Management Process, Des Moines Area Metropolitan Planning Organization, January 2016
- Freight Barriers, Des Moines Area Metropolitan Planning Organization, March 2017
- Commuting in the Metro, Des Moines Area Metropolitan Planning Organization, July 2016
- The Tomorrow Plan: Partnering for a Greener Greater Des Moines, November 2013
- Mobilizing Tomorrow: A Transportation Plan for a Greener Greater Des Moines, November 2014
- Interstate 235 Ramp Management Feasibility Study, Iowa Department of Transportation, April 2014
- Des Moines Area Regional Intelligent Transportation Systems (ITS) Architecture Update, Des Moines Area Metropolitan Planning Organization, August 2009
- Transportation Systems Management and Operations (TSMO) Traveler Information Service Layer Plan, Iowa Department of Transportation, June 2017
- Transportation Systems Management and Operations (TSMO) Traffic Incident Management Service Layer Plan, Iowa Department of Transportation, January 2018

- Transportation Systems Management and Operations (TSMO) Intelligent Transportation Systems (ITS) and Communications Systems Service Layer Plan, Iowa Department of Transportation, January 2018
- Transportation Systems Management and Operations (TSMO) Work Zone Management Service Layer, Iowa Department of Transportation, June 2018
- Iowa Transportation Systems Management and Operations (TSMO) Strategic Plan, Iowa Department of Transportation, February 2016
- Iowa Transportation Systems Management and Operations (TSMO) Program Plan, Iowa Department of Transportation, February 2016
- Integrated Corridor Management Plan: Existing Conditions Report, Iowa Department of Transportation
- Integrated Corridor Management Plan: Vision, Goals, Objectives and Performance Measures Report, Iowa Department of Transportation
- Integrated Corridor Management Plan: Range of Potential ICM Strategies Report, Iowa Department of Transportation
- Integrated Corridor Management Plan: Phase 1 Evaluation Process, Iowa Department of Transportation
- 2016 Interstate Congestion Report, Iowa Department of Transportation
- 2018-2022 Iowa Transportation Improvement Program, Iowa Department of Transportation, June 2017

5 Situational Background

The Des Moines Metropolitan Planning Organization estimates that the greater Des Moines' population will change dramatically over the next 35 years. The population is expected to increase by 56 percent from 480,000 in 2010 to roughly 750,000 by 2050. In fact, from 2010 to 2014, the population growth in greater Des Moines was estimated to be roughly 40,000. During this same period, employment growth increased by roughly 24,000 jobs. By 2050, this number is expected to grow by an additional 119,000, bringing the total rise in employment from 2010 to 2050 to roughly 143,000 total jobs.

In recent years, congestion was not a significant issue in the greater Des Moines area. In fact, the Des Moines Metropolitan Planning Organization's *Mobilizing Tomorrow: A Transportation Plan for a Green Greater Des Moines* (published in 2014) states "…the region's roadway network observes very low levels of congestion today, and forecasts indicate it will maintain a low level of congestion into the future." However, recent analyses may indicate that congestion is growing, perhaps faster than anticipated.

In 2010, 27 miles (or 2 percent) of the MPO's 1,480 miles of streets operated at LOS E or F. Without any future improvements to the street system, the travel demand model forecasts that 132 miles (or 9 percent) of the road network will operate at LOS E or F by 2050. Table 1 shows the forecasted LOS changes for streets in the Des Moines area from 2010 to 2050.

Table 1: LOS Changes from 2010 to 2050 Under Existing Conditions

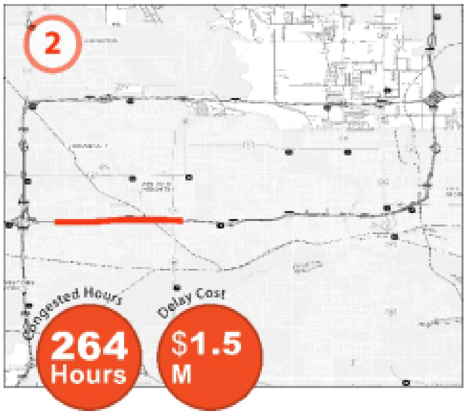
	2010		2050	
	Miles	Percent	Miles	Percent
LOS A	968	65%	549	37%
LOS B	293	20%	298	20%
LOS C	148	10%	344	23%
LOS D	44	3%	151	10%
LOS E	18	1%	87	6%
LOS F	9	1%	45	3%
Total	1480		1474	

Source: Mobilizing Tomorrow Plan Appendix B: State of the Transportation System (November 2014)

However, a more recent examination of congestion along interstate corridors indicates that congestion may be a growing concern. In 2017, the Iowa DOT released its Interstate Congestion Report providing the top 10 most congested routes using 2016 data—three of which are located in Des Moines (more than any other metro location). While the majority of congestion in Iowa is typically due to non-recurring sources, the report identifies I-235 as one of the locations that does have recurring congestion with recurring congestion accounting for 40 percent of the excess delay on I-235. Summaries of the three locations as documented in the DOT's Interstate Congestion Report are provided in Figure 3.

Furthermore, in 2016 the Des Moines Metropolitan Area had 20 of the state's top 50 congested road segments—all 20 segments on I-235. Details about these roadway segments, including annual number of congested hours, appear in Table 2. Note that 8 segments on I-235 experienced an increase in hours of congestion in just one year, from 2015 to 2016. Figure 3 indicates that there was a quadrupling of hours of congestion in the Des Moines area from 2013 to 2017. These trends may indicate that this is a very critical time for mobility in the Des Moines area with an opportunity to make improvements before these trends accelerate and congestion becomes a more significant problem.

I-235 Des Moines EB | Exit 1B (Valley West) and Exit 4 (63rd St) | 3.2 miles



Annual Congested Hours	» Increased progressively from 164 hours in 2013
Highest Monthly and Weekday Congested Hours	» Consistently by month and weekday, except Friday
Highest Congested by Time of Day	» 6 am to 9 am

I-235 Des Moines WB | Martin Luther King Jr Pkwy interchange and Exit 4 (63rd St) | 2.7 miles

Annual Congested Hours	» Slight increase from past two years
Highest Monthly and Weekday Congested Hours	» Consistent by month and weekday, except Friday
Highest Congested by Time of Day	» 3 pm to 6 pm

I-235 Des Moines WB | 3rd Street to Cottage Grove | 1.4 miles

Annual Congested Hours	» Consistent with previous years
Highest Monthly and Weekday Congested Hours	» Winter (Dec-Feb), with Tuesday-Thursday being the highest days
Highest Congested by Time of Day	» 3 pm to 6 pm

Figure 3: Summary of Des Moines Area Congested Routes Appearing in the Statewide List of Top 10 Congested Routes

Table 2: Des Moines Area Congested Roadway Segments Appearing in the Iowa Statewide List of Top 50 Segments

Route	Direction	Intersection	Length (Miles)	2015 Congestion (Hours)	2016 Congestion (Hours)	2016 Statewide Rank	2016 Percent Increase
I-235	EB	73rd St/Exit 3	0.46	233	264	11	13.2%
I-235	WB	56th St	0.50	225	260	12	15.6%
I-235	EB	22nd St/Exit 2	0.62	209	245	14	17.3%
I-235	WB	42nd St	0.50	208	231	15	11.0%
I-235	WB	56th St	0.24	190	225	16	18.7%
I-235	EB	73rd St/Exit 3	0.34	212	214	19	0.9%
I-235	WB	IA-28/63rd St/Exit 4	0.24	171	199	21	16.0%
I-235	EB	22nd St/Exit 2	0.27	177	198	22	12.3%
I-235	EB	Valley West Dr/Exit 1	0.68	172	193	23	12.2%
I-235	WB	42nd St	0.34	180	185	25	3.0%
I-235	EB	IA-28/63rd St/Exit 4	0.24	198	182	26	-8.2%
I-235	WB	31st St	0.54	168	177	27	5.4%
I-235	WB	31st St	0.36	153	161	29	4.9%
I-235	EB	IA-28/63rd St/Exit 4	0.58	151	149	33	-1.6%
I-235	EB	Valley West Dr/Exit1	0.09	138	148	34	7.4%
I-235	EB	50th St	0.50	124	131	38	5.4%
I-235	WB	Keosauqua Way	0.31	138	128	40	-7.5%
I-235	WB	7th St	0.28	128	124	44	-3.3%
I-235	WB	Cottage Grove Ave	0.29	132	120	48	-9.4%
I-235	WB	IA-28/63rd St/Exit 4	0.47	130	118	50	-9.5%

Source: 2016 Interstate Congestion Report (Iowa DOT)

5.1 EXISTING CONDITIONS ANALYSIS

As an initial step in the ICM strategy development process the project team developed an existing conditions assessment for the transportation system in the study area. Findings from this assessment are documented in a December 2018 Existing Conditions Report. The existing conditions assessment was derived from a quantitative analysis of historical data related to safety, mobility, and reliability of the Des Moines ICM study area. Data used in the analysis were made available by the Iowa DOT, and data providers with which the Iowa DOT has agreements.

The existing conditions assessment found that the study area exhibits safety, mobility, and reliability challenges. Crash rates on key roadways in the Des Moines Metropolitan Area routinely exceed statewide averages, though many segments with high crash frequencies are predominantly experiencing property damage only crashes. Reliability analysis shows the east-west portion of I-235 and the north-south portion of I-35/I-80 experience the most time periods with speeds of 45 mph or below, but most other freeway segments rated in the moderate range for multiple travel time-based performance measures. With a trend of decreasing reliability at the system level, the full length of I-35/I-80 and I-235 could benefit from reliability-enhancing strategies. Further, the mobility analysis looked at traffic volumes as an indicator of slow speeds and likely breakdowns and found that much of the core freeway loop is operating at LOS D for worst-case peak conditions. However, using traffic volumes as the LOS measure can bias the LOS calculations toward uncongested LOS and miss potential LOS E/F segments since sensor count data does not reflect true demand volume. With heavy volumes creating pressure on the system, the analysis of source congestion shows that crashes and incidents add to recurring peak congestion by being concentrated during the peaks.

The results of these data analyses are corridor and segment level metrics that were used to help shape the vision, goals, and objectives of the ICM. Results are briefly described in greater detail below.

5.1.1 Mobility Analysis

Mobility was evaluated by comparing actual vehicle travel speeds to a threshold speed for the facility type. Congestion, in this analysis, is any period of time in which actual speeds are less than 45 mph on freeways and less than 60 percent of free-flow speed on arterials. Analysis of the hours of congestion in 2013 and 2017 identified increasing levels of slow roadway speeds regardless of source of congestion (see Figure 4). Large growth in congested hours over that period is evident when comparing the two figures.

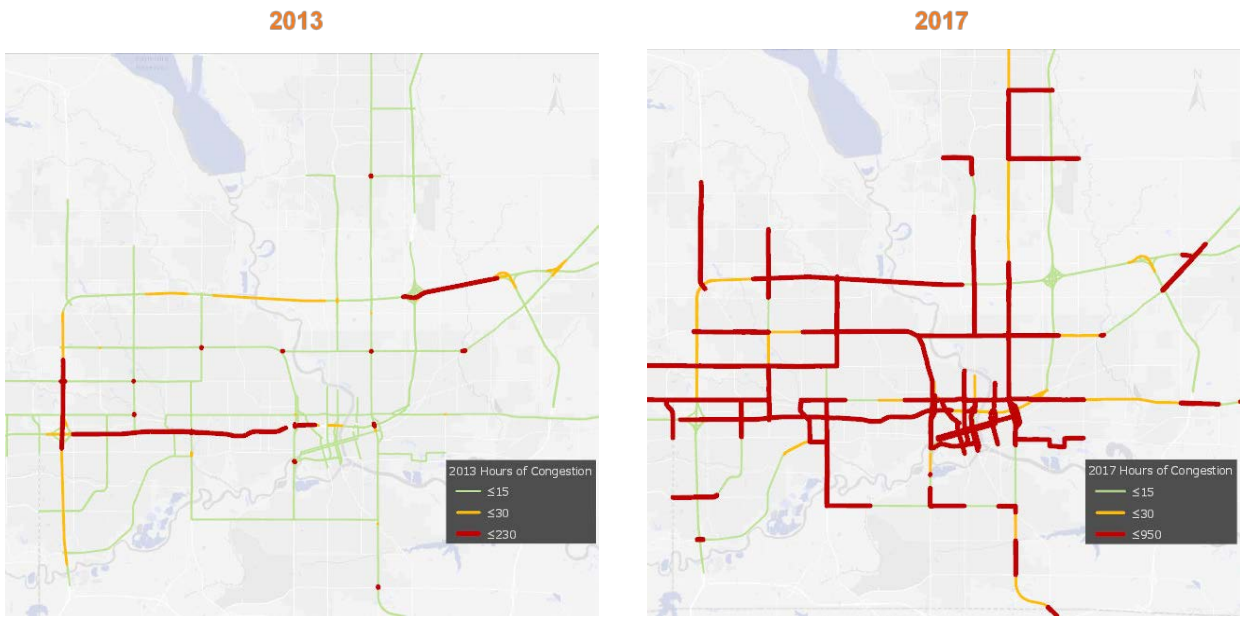


Figure 4: Hours of Congestion, 2013 and 2017

To further analyze regional mobility, the project team conducted a volume-based bottleneck analysis. This analysis indicated that much of the freeway system on both I-35/I-80 and I-235 are exhibiting LOS D as a worst-case condition (See Figure 5). The Highway Capacity Manual describes LOS D as restricted flow and regular delays, a description that lines up well with reliability findings. The recurring delays on these corridors are exacerbated by other sources of non-recurring congestion that lead to more significant breakdowns. One source known to have significant effects statewide is adverse weather.

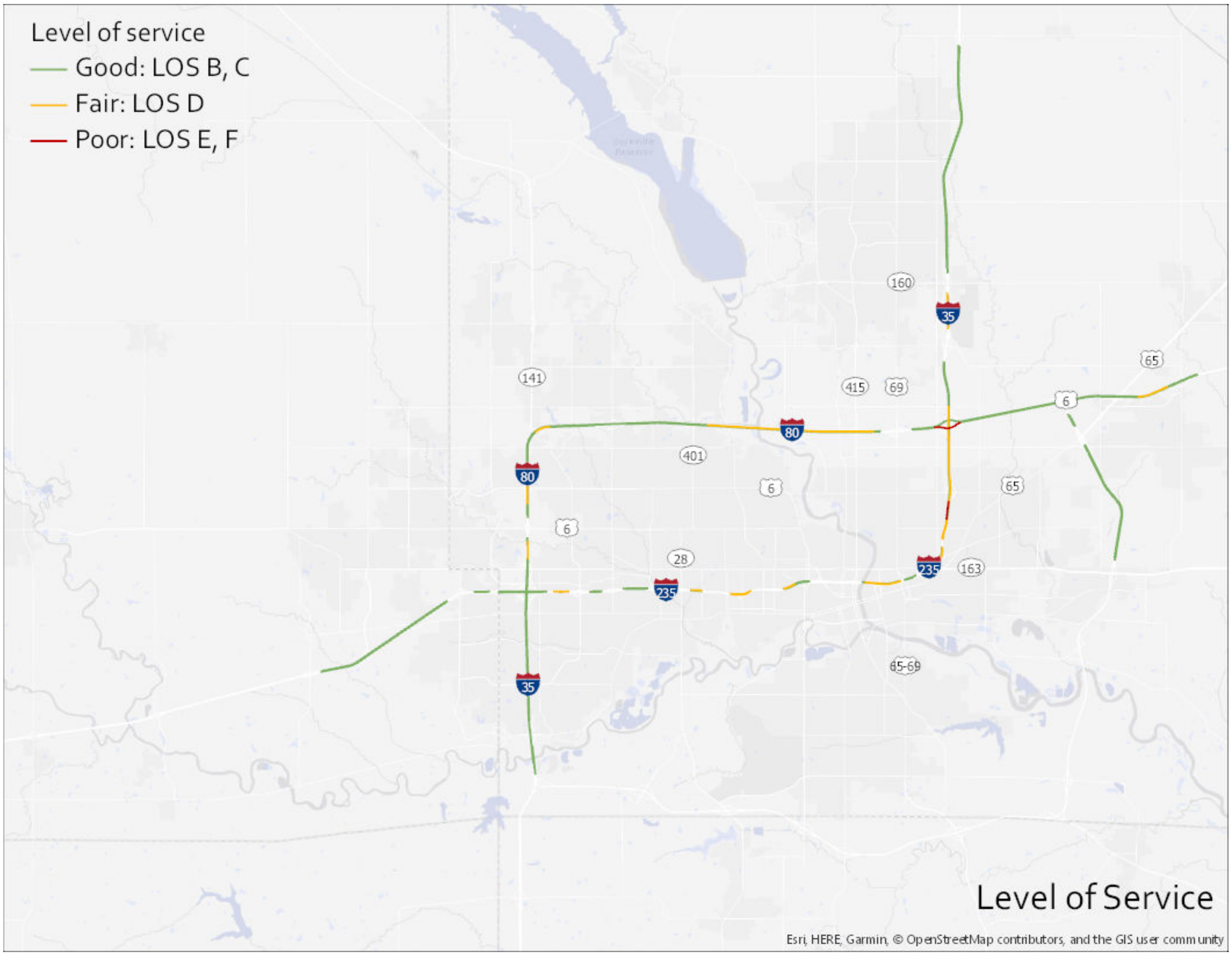


Figure 5: 2016-2017 Worst Case Peak Hour Level of Service at Sensor Locations
[Gaps represent segments not observed by sensors]

5.1.2 Crash Analysis

Between 2013 and 2017, there were 24,680 crashes on the freeways and major roads in the study area. In this same period 460 people were killed or suffered major injuries. Crash trends show an increase in the annual number of crashes that have occurred during this period. In addition, there is a significant increase in the number of crashes on the major roads between 2014 and 2015 and sustained through 2017 that deserves more research.

As expected there are differences in the characteristics of crashes between those on the freeways and those on major roads. However, regardless of location, crashes were most frequently attributed to following too closely, driving too fast for conditions, and failure to yield right of way. Managing traffic flow may reduce the risk of crashes with these contributing factors.

The average crash rate for much of the system is relatively high compared to statewide average rates. Figure 6, shows the crash rate (crashes per 100 million vehicle miles traveled [MVMT]) on the freeway and major roads compared to average crash rates for comparable facilities. The segments were categorized as follows:

- Good – The segment crash rate is less than 85 percent of the statewide average
- Fair – The segment crash rate is between 85 percent and 115 percent of the statewide average
- Poor – The segment crash rate is greater than 115 percent of the statewide average

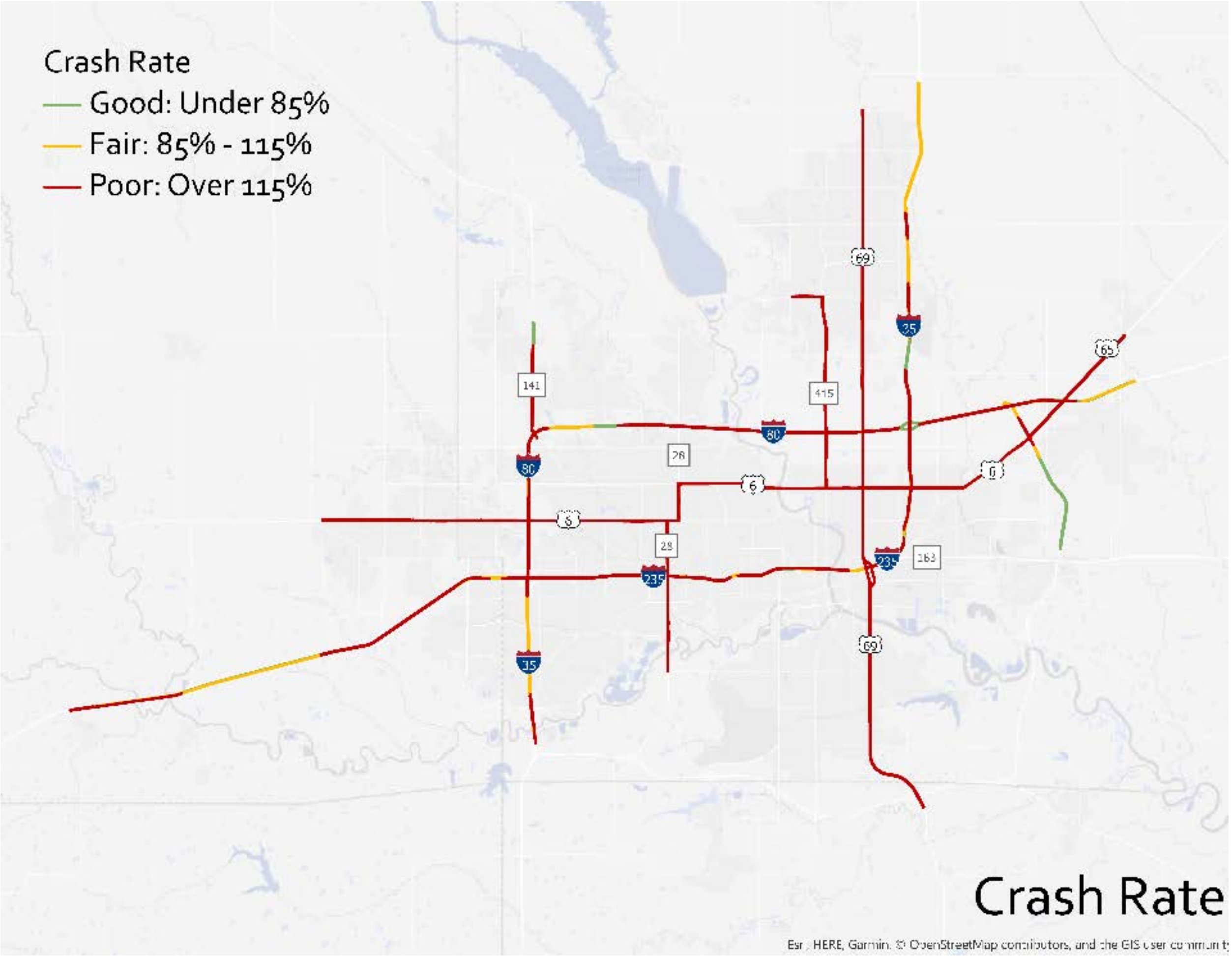


Figure 6: Crash Rate Comparison to Statewide Average Rates by Facility Type

Similarly, Figure 7 shows the locations with statistically significant higher crash density than expected. The crash hot spots were calculated using Getis-Ord GI* statistic (known as GI*) to identify localized clusters or pockets of crashes with densities well above or below typical values for the studied system. Each segment was categorized as cold spots, hot spots, or not significant with a degree of confidence ranging from 90 to 99 percent.

Hot spots include I-235 between the southwest junction and approximately Pennsylvania Avenue; I-35/I-80 from the southwest junction north to approximately the Hickman Interchange; and near the northeast junction. The crash cost index shows that the severity of crashes in many of these locations is relatively low. However, there are exceptions particularly near the northeast junction of I-235 and I-35/I-80. These segments reflect higher crash rates and may become priorities for solutions.

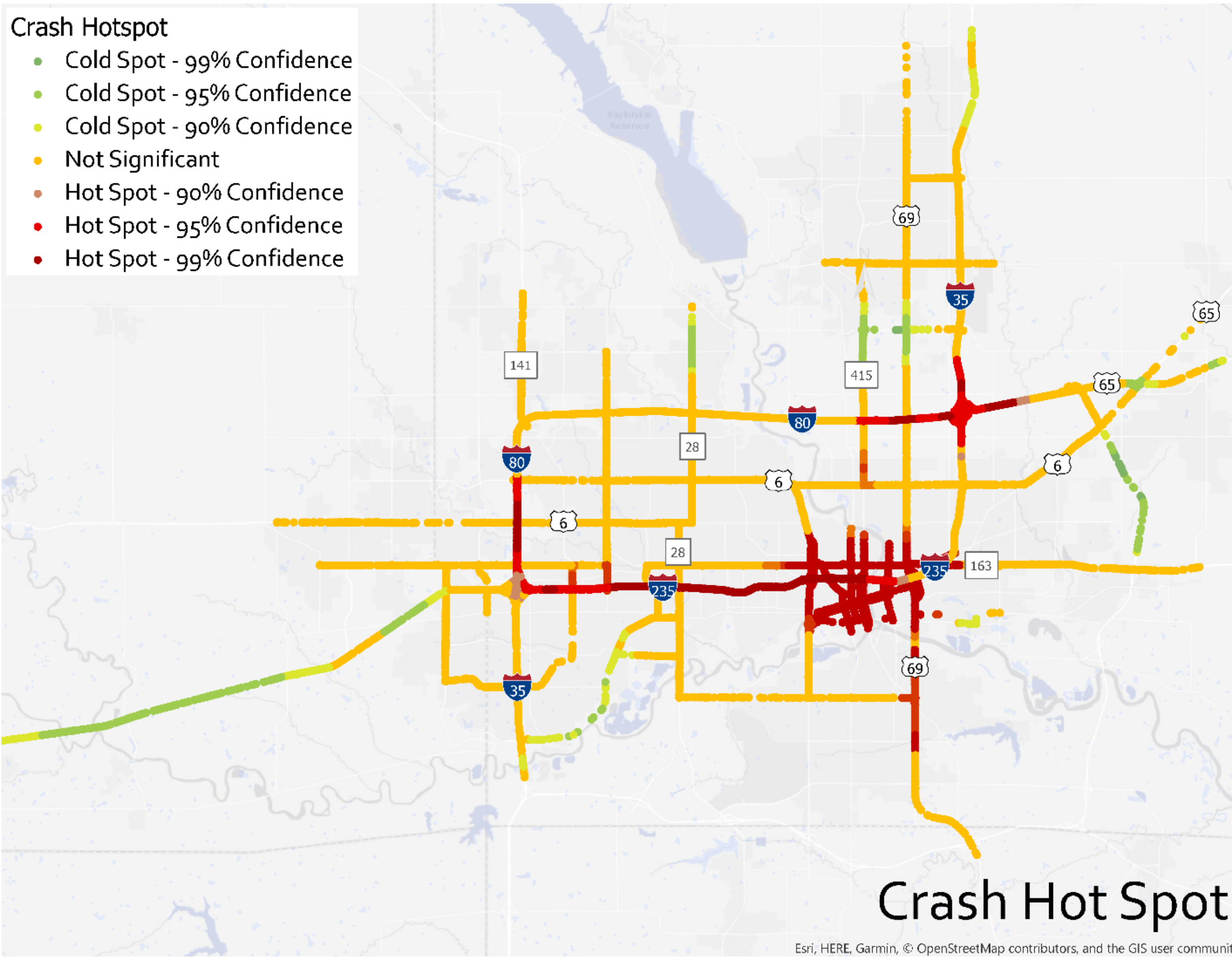


Figure 7: Crash Hot Spot Map – Freeway and Major Roads

5.2 CORRIDOR BOUNDARIES AND NETWORKS

The Des Moines ICM project area, including ICM corridors are shown in Figure 8. The limits of the project area are:

- I-235 southwest junction to northeast junction with I-35/I-80
- I-80 US Hwy 169 (Desoto) to 1st Avenue (Bondurant/Altoona)
- I-35 – Iowa 5 (West Des Moines) to 36th Street (Ankeny)
- US 65 – I-80 to Iowa 163 (Pleasant Hill)

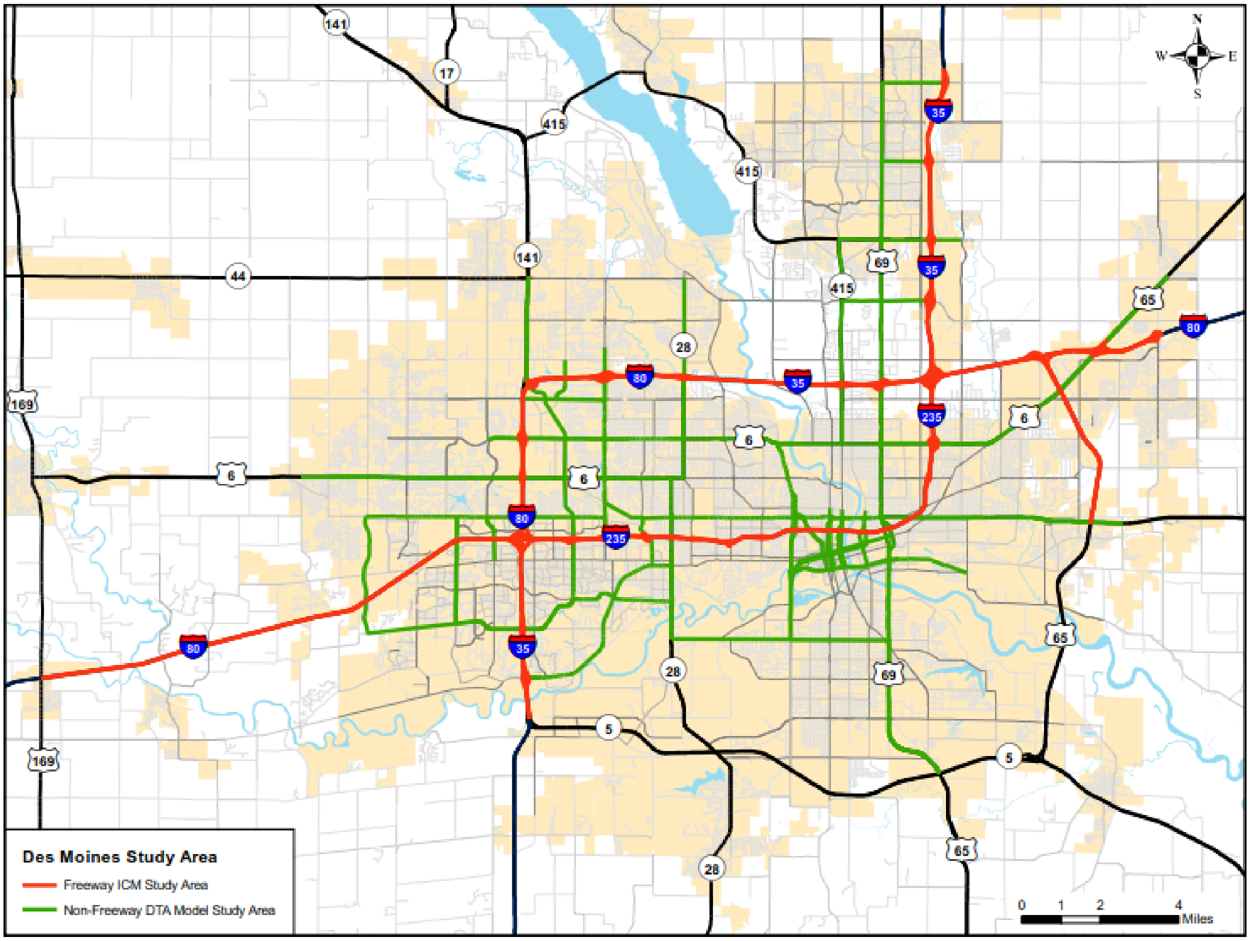


Figure 8: Des Moines ICM Study Area Interstate and Arterial Corridors

5.2.1 Networks

The Des Moines ICM concept will leverage capacity on available transportation networks to the extent possible and practical when incidents and congestion occur. Networks will be operated holistically to move vehicles and people around incidents and congestion in a seamless and efficient fashion. To that end, the ICM system will provide motorists with real-time travel information that they can use to make a choice between individual networks empowering them to make educated decisions about how they travel.

The Des Moines ICM program is focused on both interstate and surface streets throughout the entire region. In addition, it will leverage available transit capacity along these routes to move greater numbers of people using less vehicles.

- Interstate Network – The existing interstate network includes I-235, I-80, and I-35. This network is shown in Figure 8 as red routes.
- Arterial Network – The existing arterial network includes a number of east-west and north-south arterials that connect to the interstate network. This network is shown in Figure 8 as green routes.
- Transit Network – The existing transit network consists of services and routes provided by the Des Moines Regional Area Transit.

5.3 RANGE OF STAKEHOLDERS

In terms of ICM program development, the core “stakeholder” group includes those agencies that have a role in the installation, operation or maintenance of infrastructure (i.e., traffic management technologies, pavement, communications, and other equipment that may be used to improve operations along transportation networks). This includes any agency that may collect, contribute, convey, process, or distribute information or data in support of the ICM vision, goals, and objectives.

The Iowa Department of Transportation is the lead agency for the Des Moines Metropolitan Area ICM program. The external stakeholders, those outside the Iowa DOT that will be impacted by ICM projects, are municipal or responder organizations within the Des Moines Metropolitan Area. Specially, the following stakeholder organizations have been identified within the core group:

- State/Regional/Federal Transportation Management
  - Iowa Department of Transportation
  - Des Moines Area Metropolitan Planning Organization
  - Federal Highway Administration - Iowa Division
  - Greater Des Moines Partnership
- Local Municipality Publics Works/Engineering/Planning
  - City of Altoona
  - City of Ankeny
  - City of Bondurant
  - City of Clive
  - City of Des Moines
  - City of Grimes
  - City of Johnston
  - City of Pleasant Hill
  - City of Urbandale
  - City of Waukee
  - City of West Des Moines
  - City of Windsor Heights
  - Dallas County
  - Polk County
  - Warren County
- Emergency Response
  - Polk County Emergency Management
  - City of Des Moines Police
  - City of Des Moines Fire
  - Dallas County Sheriff’s Office
  - Dallas County Emergency Medical Services
  - Iowa State Patrol
  - Madison County Sheriff’s Office
  - Polk County Sheriff’s Office
  - Warren County Sheriff’s Office

- Public Transportation
  - DART
  - Iowa Interstate Railroad
- Other Regional Transportation Operating Agencies
  - Iowa DOT Highway Helper
  - Iowa Motor Truck Association

As specific projects develop within the Iowa ICM program, there may be a need to include additional external stakeholders that are not included in the above core list. These can include private sector groups that are impacted or provide services such as towing/recovery groups, construction professionals, or private media services. These stakeholders will be specific to the individual project and will be identified in the project-level ConOps.

6 ICM Operational Description

The Des Moines Metropolitan Area Integrated Corridor Management (ICM) program was initiated to develop operational strategies for both near-term and long-term timeframes to enhance safety, mobility, and travel time reliability, and reduce the environmental impacts of travel in the corridor. To help guide the development of these strategies, stakeholders in the region have collaborated to identify needs and define a project vision, goals, objectives, and performance measures. This report also provides a summary of the steps used to determine these guiding principles.

6.1 STAKEHOLDER NEEDS

To guide the development of an ICM vision, goals, objectives, and performance measures a list of key ICM factors was developed. A preliminary list of factors was provided to stakeholders that reflected priorities documented in other transportation planning activities (e.g., Des Moines Area Metropolitan Planning Organization's *Mobilizing Tomorrow: A Transportation Plan for a Greener Greater Des Moines*, and Iowa Transportation Systems Management and Operations (TSMO) Program Plan Version 1.0). Through a voting process, workshop participants were provided the opportunity to prioritize these key ICM factors to reflect stakeholder needs to then help define the vision, goals, objectives, and performance measures for the Des Moines ICM program. Provided below is a prioritized list of these needs and key considerations:

- Safety
  - ICM strategies must address speeding. Speeding is an increasing problem that is significantly impacting safety.
  - Safety issues have a significant impact on mobility.
- Mobility
  - ICM strategies must address mobility for all travelers.
- Reliability
  - Reliability is significantly impacted by safety and mobility issues.
  - Addressing reliability issues must also consider transit services.
- Integration
  - Integration must address first mile/last mile issues.
  - Integration must support multi-modal travel and consider regional connections.

- System Preservation
  - ICM strategies must address fiscal considerations. Expansion of technologies, services or infrastructure should not happen until they can be properly operated and maintained.
  - Core assets must remain in a state of good repair, regardless of whether it is the roadway network, field devices, vehicles, or any other infrastructure components.
- System Management
  - System management must address the entire transportation network and cross jurisdictional boundaries.
  - System is multi-jurisdictional and multi-modal.
- Accessibility
  - Accessibility means all travelers arrive safely and efficiently at their destination regardless of mode.
  - Accessibility also means providing affordable travel options for all travelers.
- Regional Economic Vitality
  - ICM strategies help foster a healthy regional economy.

Stakeholders were also given the opportunity to identify things that must be included in the Des Moines ICM project vision. The following statements were provided during the Visioning Workshop to help guide the definition of the Des Moines ICM vision:

- The success of the Des Moines ICM project will be predicated on active and sustained engagement of stakeholders. Engagement over time will also evolve to include additional stakeholders and partners.
- ICM solutions need to focus on providing predictable and reliable travel in the Des Moines metropolitan area.
- ICM solutions should support the advancement of a vital economy.
- It is necessary to be proactive in identifying potential funding sources, perhaps those that include contributions from multiple jurisdictions.
- ICM strategies need to be cost effective and maximize operational benefits.
- ICM strategies must be sustainable in the context of current management and maintenance programs.
- ICM solutions must maintain and preserve the built and natural environment.
- ICM solutions need to focus on emerging trends such as connected vehicles (CV) and automated vehicles (AV).
- Consideration must be given to how ICM strategies will impact all transportation system users.
- ICM solutions need to address commuter options such as telecommuting, and not just during adverse weather conditions.
- ICM solutions need to foster interconnection of systems, and be flexible and adaptable to changing conditions.

6.2 VISION

In November 2018, the Iowa DOT facilitated a stakeholder ICM visioning workshop to explain the project purpose and to solicit feedback on the future direction of the Des Moines Metropolitan Area ICM program. During this workshop, the project team facilitated discussion with stakeholders through an examination of existing conditions, and interactive exercises to identify where and how ICM strategies could potentially be implemented to address stated challenges. Based on the stakeholder input received, the project team developed the following vision for ICM within the Des Moines Metropolitan Area:

> The Des Moines metropolitan area will benefit from a safe, efficient, reliable, and sustainable transportation system that supports economic growth and promotes equitable transportation services and a healthy community. ICM strategies will assist the state and area communities to proactively manage multi-modal transportation systems in a safe and efficient manner using proven technologies and operational strategies while maximizing the use of existing infrastructure and services. ICM will offer travelers more opportunities to make convenient trips to meet social and economic needs.

The Des Moines ICM project vision statement articulates a shared purpose for the regional stakeholders to work toward. It is oriented toward high-level outcomes and reflects the needs of the range of stakeholders involved in the project. This helps to ensure that it reflects the overall visions and missions of the individual agencies. Key principles guiding the development of the Des Moines ICM vision statement are that it:

- Is future oriented
- Leads to a better future
- Represents stakeholder values
- Sets standards of excellence
- Is rooted in the purpose and direction of the region
- Inspires stakeholder enthusiasm, collaboration and commitment
- Reflects unique aspects of the region
- Is ambitious

6.3 ICM PROGRAM GOALS

Goals that have been identified for the Des Moines ICM project are broad aspirations or outcomes for the region and directly relate to factors important to stakeholders (e.g., safety, mobility, and system preservation). Table 3 lists the goals that have been identified for this effort.

Table 3: Des Moines Metropolitan Area ICM Goals

Factors	Goals
Safety	Reduce fatalities and serious injuries on public roads in the region.
Mobility	Provide options to travelers that minimize time spent traveling.
Reliability	Improve efficiency and predictability of travel in the region.
Integration and Connectivity	Provide transportation that allows travelers to make efficient and seamless multi-modal trips throughout the region.
Accessibility	Improve traveler’s overall ability to reach key destinations such as jobs, schools, libraries, health care, shopping, and entertainment.

Factors	Goals
Regional Economic Vitality	Use the regional transportation system to foster a thriving, competitive regional economy.
System Preservation	Maintain transportation infrastructure in a state of good repair.
Systems Management	Improve the efficiency of the surface transportation system.

6.4 ICM OBJECTIVES

Objectives for the Des Moines ICM project support specific goals and provide additional details, or strategies, on how the goal will be achieved. Table 4 provides an overview of the objectives that have been identified for the Des Moines ICM program.

Table 4: Des Moines Metropolitan Area ICM Objectives

Factors	Objectives
Safety	• Reduce number of traffic fatalities. • Reduce number of serious injuries in traffic crashes. • Reduce pedestrian and bicycle fatalities.
Mobility	• Reduce congestion in key commuter corridors. • Reduce congestion in key freight corridors. • Provide choices and travel options for transportation system users. • Provide transit service connecting major activity centers within the Des Moines metropolitan area. • Provide more dedicated bicycle facilities. • Provide more sidewalks for pedestrians. • Reduce single occupancy vehicle (SOV) trips.
Reliability	• Reduce the variability of travel time on key commuter routes and modes. • Improve average on-time performance for transit services.
Integration and Connectivity	• Improve multi-modal connections between bicycle, pedestrian, transit, and private vehicle travel. • Improve system connectivity through improved multimodal connections and reduced network gaps.
Accessibility	• Provide transit service throughout the Des Moines metropolitan area. • Improve proximity to multi-modal transportation. • Improve ADA accessibility. • Improve service for traditionally underserved populations.
Regional Economic Vitality	• Facilitate the efficient and safe movement of freight and goods.

Factors	Objectives
System Preservation	• Preserve and maintain pavement. • Preserve and maintain bridges. • Preserve and maintain bicycle trail systems. • Preserve and maintain sidewalks. • Support urban development projects with necessary transportation investments.
Systems Management	• Implement metro-wide demand management strategies. • Implement employer-based demand management programs at major employers. • Implement ITS technologies along priority commuter and freight corridors. • Implement advanced operational strategies along priority commuter and freight corridors.

7 ICM Operational Concept

The ICM Operational Concept is a high-level description of how agencies, through the various elements they own and operate, interconnect to form an integrated "system of systems." This understanding focuses on the specific transportation functions that agencies need to collectively perform and their roles and responsibilities with respect to deploying, operating and maintaining ICM elements. The ICM operational concept focuses on key ICM strategies and operating agencies' roles and responsibilities in implementing and operating those strategies. Key agencies can be defined as those that have a major role in transportation operations, which are both providers and receivers of information.

The Des Moines Metropolitan Area ICM program will combine existing advanced transportation technologies and practices with new, innovative and cost-effective solutions to enable the safe, effective movement of people and goods along regional transportation networks (roadways and modes). The basic premise behind the ICM concept is to operate individual transportation networks in a more coordinated and integrated manner, thereby increasing overall throughput and enhancing safety and mobility during normal and incident conditions. It is anticipated that integrating available transportation networks will allow these networks to service demand better than if individual networks were operated in a standalone fashion—as many of these networks are operated today. In this regard, when one network becomes over saturated (because of recurring or non-recurring conditions), another under-saturated network may be used to help service demand and help to restore traffic flow on the saturated network by distributing demand more evenly across the corridor.

Because the Des Moines ICM concept covers nearly the entire region and consists of many individual transportation facilities, the ICM Operational Concept is reliant upon the application of multiple integrated and coordinated combinations of ICM strategies that can address observed problems occurring at specific locations. This section presents the "toolbox" of options available to practitioners seeking to address transportation needs and issues. The application of various strategies, all working together, will be important to optimize operations within individual corridors. High-level agency roles and responsibilities are described to provide context on how institutional integration will occur. This understanding will be expanded upon during individual project planning stages when individual or groups of strategies are considered for implementation.

7.1 EVENT MANAGEMENT

Event management is the collective group of strategies used to help agencies or regions manage traffic flow during disruptions. While some of these disruptions are unplanned, such as those caused by weather or traffic incidents, event management also encompasses managing planned events—such as work zones, special events, and freight operations and management. It is important for agencies to address these issues efficiently to minimize the impact to transportation and to maintain safety for motorists and workers. Moreover, proper planning will also provide benefits such as increased economic productivity and reduced costs.

7.1.1 Traffic Incident Management

The ICM system will manage unexpected traffic incidents so that the impact to the transportation network and traveler safety is minimized. This concept includes incident detection capabilities through roadside surveillance devices (e.g., CCTV cameras and traffic sensors) and through regional coordination with other traffic management, maintenance and construction management, and emergency management centers. If incidents occur in proximity to rail lines and might affect rail operations, coordination with rail operators is also needed. This concept supports traffic operations personnel in developing an appropriate response in coordination with other response personnel to confirmed traffic incidents. The response may include traffic control strategy modifications or resource coordination between centers.

In the Des Moines region, the ICM program will integrate the traffic incident management community (particularly local law enforcement, emergency medical services, fire and rescue, towing and recovery, and medical examiners) in traffic management practices to foster better relationships and break down barriers to real-time decision-making, event management, and information sharing. The full breadth of traffic management and emergency management agencies will meet regularly to identify traffic incident management issues and develop strategies and inter-agency agreements needed to improve incident identification and reduce response and clearance times to improve safety and restore operations.

In support of this concept, regional agencies will perform the following functions:

- Collect and distribute traffic and crash data and respond to requests for these data
- Exchange data with other traffic centers and allow control of select field devices upon mutual agreement
- Monitor traffic data for incidents
- Provide incident response actions and status
- Investigate and develop specific strategies to improve incident detection and reduce response and clearance times

Roles and Responsibilities:

- **Emergency Response Agencies:**
    - Provide tactical decision support, resource coordination and communications integration in support of local management of incidents.
    - Receive information on incidents from the public and partner agencies.
    - Respond to incidents and provide incident details/request for additional resources to dispatch upon arrival.
    - Provide real-time information on the current conditions at the incident scene including information on freight loads and hazard materials.

- Secure the incident scene and conduct traffic control until highway helpers arrive (law enforcement).
- Participate in ongoing incident management training and regional planning efforts.
- Assist in the development of pre-planned emergency alternate route plans.

- **Traffic Management Agencies:**
  - Identify incidents and disseminate incident event information to other agencies (populate ATMS software with specific incident information).
  - Dispatch and track highway helper vehicles to assist in emergency response and traffic control.
  - Provide real-time information on incidents and alternate routes including route restrictions to the public and partner agencies.
  - Operate and maintain CCTV cameras to assist with incident verification. Implement additional CCTV cameras at locations where gaps exist in coverage.
  - Coordinate incident response with ISP, sheriff's departments, maintenance and other agencies
  - Lead development of pre-planned emergency alternate route plans.
  - Modify traffic signal timing to facilitate traffic flow when emergency alternate routes are implemented.
  - Provide incident information on 511, social media outlets and DMS.
  - Provide information on snow plow operations including routes recently plowed.
  - Coordinate planning for incidents with emergency response agencies including pre-planning activities and facilitation of after action reviews.
  - Coordinate with maintenance to implement incident response, assist in clean up and repair of damage equipment.
  - Participate in on-going incident management training and regional planning efforts.
- **Emergency Management Agencies:**
  - Coordinate response with Traffic Management Agencies and Emergency Response Agencies for large scale events.
- **Highway Helpers:**
  - Provide on-site traffic control.
  - Provide motorists assistance and clear minor incidents from roadway lanes.
  - Provide incident details to the Iowa Department of Transportation and partner agencies as appropriate.
  - Participate in ongoing incident management training and regional planning efforts.
- **Transit Management Agencies:**
  - Notify dispatch of incidents and provide incident details to traffic management agencies.
  - Modify transit routes to avoid incidents, as appropriate.

7.1.2 Planned Special Event Management

Planned special events can create significant changes in traffic operations because of large numbers of spectators or participants at a single venue or because of temporary roadway closures for special use. These can include sporting events, concerts, festivals, and conventions occurring at permanent multi-use venues. They also include less frequent public events such as parades, firework displays, bicycle races, sporting games, motorcycle rallies, seasonal festivals, and milestone celebrations at temporary venues.

The ICM program will include strategies to manage such large events through advanced operations planning, stakeholder coordination and partnerships, developing a multi-agency transportation management plan, raising awareness of general public and event patrons of potential travel impacts, and coordinating agency services and resource sharing. Operational phases of planned special event management can include: Program Planning, Event Operations Planning, Implementation Activities, Day of Event Activities, and Post-Event Activities. Within these phases, participation is needed by event planners, transportation agencies, law enforcement, emergency responders, and communications staff.

Roles and Responsibilities:

- **Emergency Response Agencies:**
  - Receive information on special events from special event venues and coordinate emergency response actions and activities.
  - Assist in the development of pre-planned event management plans.
  - Provide tactical decision support, resource coordination and communications integration during the planned event.
  - Monitor traffic operations and provide feedback to traffic operators.
- **Traffic Management Agencies:**
  - Lead development of pre-planned event management plans.
  - Enter special event information in ATMS software with specific information on any roadway closures.
  - Operate and use applicable CCTV cameras to assist with traffic management near the planned event.
  - Provide real-time traffic information including route restrictions to the public and partner agencies.
  - Modify traffic signal timing to facilitate traffic flow during event.
- **Highway Helpers:**
  - Limited involvement.
- **Transit Management Agencies:**
  - Participate in advanced planning activities.
  - Modify transit routes as necessary to avoid or assist special event, as appropriate.

7.1.3 Work Zone Management

The ICM concept includes tools and processes to help manage work zones—areas of the roadway where maintenance, construction, and utility work activities occur—and maintaining traffic flow and safety through the work zone. This strategy consists of efforts within an individual agency/stakeholder and efforts across agencies/stakeholders depending on the size of the work zone and its impact. As a foundational effort, work zone activity will be the subject of a coordination process so agencies and their partners are aware of the scope of various work zone activities and can coordinate on needed responses. Work zone activity will be evaluated during the coordination process to determine the potential impact on traffic operations and whether limitations are needed on time-of-day, work duration, or work area.

Real-time management of work zones can be accomplished using existing or temporary ITS field devices. Traffic conditions immediately upstream and through work zones will be monitored using CCTV cameras and controlled primarily using dynamic message signs (DMS) but will be supported by other strategies including queue warning, lane management, advisory speeds and ramp meters. To mitigate the impacts of construction on traffic flow and safety, the regional ICM program will provide users with enhanced traveler information so they can make educated decisions on when and how to travel including which routes to use to avoid work zones and get to their destinations more quickly. The ICM will provide this information before users reach work zone queues to change driving behavior prior to the queue. This will help to reduce secondary incidents and reduce stop and go driving behavior through work zones. The ICM program will also include technologies to improve safety and operations along adjacent roadways that are expected to deteriorate with passive diversion as well as technologies that will improve emergency access through work zones.

As part of work zone management, the Iowa DOT and its partner agencies will coordinate to develop viable alternate routes. This coordination will include ensuring that selected routes can accommodate increased traffic volumes and that traveler information is provided to inform travelers of expected delays and guide them back to routes they diverted from.

Roles and Responsibilities:

- **Traffic Management Agencies:**
  - Develop a coordination process that allows for evaluation of work zone activities and requires consensus on scope (time-of-day, duration, area).
  - Maintain and disseminate to partner agencies (i.e., transit, law enforcement, emergency management, media outlets, etc.) maintenance and construction work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits.
  - Implement, operate and maintain fixed and portable roadway ITS devices including intelligent work zone devices that support work zone management, CCTV cameras, dynamic message signs, and traffic sensors.
  - Disseminate work zone speeds, delays, and closures to motorists prior to entering the work zones.
  - Post work zone information to 511 and social media outlets.
  - Monitor the operational status of roadway ITS devices used for work zone management and report failures and malfunctions to maintenance.
  - Coordinate maintenance and construction activities with other traffic and emergency response and emergency management agencies.
  - Coordinate with highway helpers to provide motorist assistance and clear disabled vehicles within and approaching work zones.

- **Construction Professionals (Contractors/Designers/Utility Companies):**
  - Develop work zones that minimize impacts to traffic operations and safety to the extent possible.
  - Participate in the work zone coordination process.
  - For utility companies or their contractors, apply for applicable permits through the appropriate governing agency.
  - Notify agencies of any changes in work zone or issues that are observed during the work activity that impact traffic operations and safety.
- **Emergency Response Agencies:**
  - Assist Traffic Management Agencies with detour and alternate route planning.
  - Provide as needed extra enforcement within and immediately upstream of work zones.
  - Provide incident details to traffic management agencies.
  - Provide comments and suggested changes to proposed construction and maintenance work schedules and activities.
- **Transit Management Agencies:**
  - Notify dispatch of incidents within or near work zones and provide incident details to traffic management agencies.
  - Provide comments and suggested changes to proposed construction and maintenance work schedules and activities.
  - Modify transit routes to avoid work zones, as appropriate.

7.1.4 Weather Responsive Traffic Management

Weather traffic management includes strategies that use mobile road weather data (using field devices and vehicles) for traveler information, traffic control, and winter maintenance activities. There are three types of road weather management strategies that may be employed in response to environmental threats: advisory, control, and treatment strategies. Advisory strategies provide information on prevailing and predicted conditions to both transportation managers and motorists. Control strategies alter the state of roadway devices to permit or restrict traffic flow and regulate roadway capacity. Treatment strategies supply resources to roadways to minimize or eliminate weather impacts. Many treatment strategies involve coordination of traffic, maintenance, and emergency management agencies. These mitigation strategies are employed in response to various weather threats including fog, high winds, snow, rain, ice, flooding, and tornadoes.

Roles and Responsibilities:

- **Iowa DOT:**
  - Implement, operate, and maintain environmental sensor stations (ESS) to provide real-time and historic atmospheric and pavement condition information.
  - Incorporate ESS data in the maintenance decision support system to support winter maintenance decision-making.
  - Provide data to weather forecasters to improve the quality of weather forecasts used for maintenance decision-making.
  - Provide weather related information to the 511 system for dissemination to travelers.

7.1.5 Freight Operations Management

The ICM program will manage and improve freight operations through activities in planning, infrastructure, and enforcement. Freight operational strategies involve movement of cargo via the surface roadway network as well as rail systems and other modes.

For roadway-based freight, the strategies include gateway facilitation, driver identification and validation, compliance facilitation, weigh-in-motion, freight status information, and network status information. As a foundational effort, over-dimensional freight activity will be controlled through a permitting process so agencies and their partners can evaluate the potential impact on traffic operations and whether limitations are needed on time-of-day, route, or escorting. Successful implementation of this concept will result in reduced impacts to traffic operations on the surface network. For freight operators, it could result in increased efficiency and productivity, improved reliability of commercial vehicle service, and improved shipment and service integrity.

This concept may, with the proliferation of connected vehicle roadside and on-board equipment, include commercial vehicle signal priority at signalized intersections along arterials and ramps that are critical to freight mobility.

For rail-based freight, the strategies include coordination on train planning (route and schedules), at-grade crossings and traffic control, dwell times and locations, and any construction activity that may impact other stakeholders.

Roles and Responsibilities:

- **Iowa DOT:**
    - Plan and develop freight routes that can accommodate key commercial interests and industry needs.
    - Identify detour routes that can support legal loads without physical or political restrictions.
    - Maintain system for permitting over-dimensional freight movement and evaluate impacts to traffic operations. Issue permits in a timely manner with any required restrictions on time-of-day, route, or escorting. This includes adding restrictions to the permitting process to prohibit over-dimensional loads during peak hours. Deploy, operate, and maintain technologies required to collect and exchange information with commercial vehicles operating on freeway and ramp facilities.
    - Provide both pre-trip and en-route travel planning, routing, and commercial vehicle-related traveler information, which includes information such as freight routes, route restrictions, high-profile vehicle advisories, inspection stations, truck parking locations and current status and oversize/overweight permit information.
    - Report potential commercial vehicle violations to appropriate law enforcement agencies.
    - Evaluate and coordinate at-grade rail crossings for improvements and traffic control.
    - Provide rail operators with information on roadway construction or maintenance activities occurring near rail lines.
    - Include rail operators in planning and operations activities associated with incident management and any rerouting.

- **County and Municipal Traffic Management Agencies:**
  - Deploy, operate and maintain technologies required to collect and exchange information with commercial vehicles operating on arterials.
  - Provide current and forecasted traffic information, road and weather conditions, and other road network status on arterial freight routes. This includes information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions) in effect.
  - Evaluate and coordinate at-grade rail crossings for improvements and traffic control.
  - Provide rail operators with information on roadway construction or maintenance activities occurring near rail lines.
- **Intermodal Freight Operators:**
  - Provide freeway and arterial traffic management agencies with freight plans that may possibly impact traffic. This may include requests for special treatment at traffic signals or dynamic lane management systems.
  - Apply for over-dimensional permits if required due to anticipated loads (i.e., over height/weight), vehicles speeds, or unusual routing.
- **Rail Operators:**
  - Provide agencies with train planning (route and schedule) that may impact adjacent roadway operations.
  - Provide agencies with information on rail activities (construction, maintenance, or dwell times) that will impact adjacent roadways and at-grade intersections.
  - Evaluate and coordinate at-grade rail crossings for improvements and traffic control.

7.2 FREEWAY TRAFFIC MANAGEMENT

Freeway traffic management involves effectively using policies, strategies, and actions to address impacts to traffic caused by intensity, timing, and location of travel. With the increased use of vehicles on roadways caused by population growth, increase in number of licensed drivers and auto ownership, changes in urban land use, etc., freeway traffic management provides practical and cost-effective means to address potential problems without the need to increase capacity or reconstruct existing facilities.

7.2.1 Regional Traffic Management

The ICM system will allow regional traffic management agencies to collect, archive, and share information and device control to support regional traffic management strategies. Regional traffic management strategies include inter-jurisdictional, real-time data collection, system monitoring, and device management. Each of these systems and functions have significant benefits to individual agencies as it allows active monitoring of traffic operations, archival of data for trend analysis, and remote operation of field devices. In addition, while each jurisdiction may have individual components of the above, this strategy will allow the sharing of information and/or control by other agencies to facilitate a regional approach to data and operations.

This concept includes traffic detection equipment (i.e., sensors), dynamic message signs and other surveillance/dissemination equipment (i.e., cameras), and center to field communications to exchange information between roadway field elements and Traffic Management Centers. The derived data can be used locally such as when traffic detectors are connected to a dynamic message sign to automatically post messages such as the presence of queues, or remotely (e.g., when a CCTV system sends back video to a Traffic Management Center). The data generated by this concept enable traffic managers to monitor traffic and road conditions, identify and verify incidents, detect failed or malfunction equipment, and collect data for use in performance measurement, traffic strategy development, and long range planning. The collected data will also be analyzed and made available to users via traveler information outlets such as dynamic message signs, and the DOT's 511 website.

Sharing data and/or device control between agencies will allow a more coordinated response to corridor operations, such as coordinated traffic signal control between freeway ramp terminals and arterial traffic signal control within a corridor. The nature of optimization and extent of information and control sharing will be determined through working arrangements between jurisdictions. Several levels of coordination may be supported from sharing information through sharing device control between traffic management centers.

As connected vehicles gain penetration into vehicle fleets, the manner in which the region will collect and disseminate traveler information may change. If and when this happens, this concept may evolve to use probe data obtained from connected vehicles within the transportation network to support traffic operations, including incident detection and the implementation of localized operational strategies. Traffic data will be collected from connected vehicles, possibly allowing a shift from state funded detection technologies to privately owned technologies, and allowing more cost-efficient system management and operations.

Roles Responsibilities:

- **Iowa DOT:**
  - Deploy, operate and maintain technologies that collect and/or verify current field conditions such as traffic volumes, vehicle speed/density, and other operational characteristics.
  - Maintain and operate a data management platform that stores historic and forecasted traffic information, road and weather conditions, closures, special events, and other road network status. This includes information on incidents, including expected severity, location, time, and nature of incident.
  - Collect and store traffic sensor data for transportation planning and performance monitoring uses.
  - Disseminate road network condition and incident information to the public, the media, and other partner agencies such as emergency response and law enforcement.
  - Provide device control of ITS field equipment to partner agencies per established agreements.
  - Analyze data received from other operational centers (e.g., traffic flow, incidents, transit capacity and schedule adherence along with environmental and weather conditions) and devise a set of operational strategies to maintain balance in the region or corridor between traffic demand and safe transport for people and goods.
  - Develop and provide detour, route restriction, and other routing information based on collected and received current traffic, incident, emergency, and roadway conditions.
  - Initiate requests for control of other agency owned/operated field devices control as needed and based on established agreements.
  - Monitor the operational status of field equipment and report failures and malfunctions to maintenance for repair.

- **County and Municipal Traffic Management Agencies:**
  - Deploy, operate and maintain technologies that collect and/or verify current field conditions such as traffic volumes, vehicle speed/density, and other operational characteristics.
  - Maintain and operate a data management platform that stores historic and forecasted traffic information, road and weather conditions, closures, special events, and other road network status. This includes information on incidents, including expected severity, location, time and nature of incident.
  - Collect and store traffic sensor data for transportation planning and performance monitoring uses.
  - Disseminate road network condition and incident information to the public, the media, and other partner agencies such as emergency response and law enforcement.
  - Provide device control of ITS field equipment to partner agencies per established agreements.
  - Analyze data received from other operational centers (e.g., traffic flow, incidents, transit capacity and schedule adherence along with environmental and weather conditions) and devise a set of operational strategies to maintain balance in the region or corridor between traffic demand and safe transport for people and goods.
  - Develop and provide detour, route restriction, and other routing information based on collected and received current traffic, incident, emergency, and roadway conditions.
  - Initiate requests for control of other agency owned/operated field devices control as needed and based on established agreements.
  - Monitor the operational status of field equipment and report failures and malfunctions to maintenance for repair.

7.2.2 Ramp Management

The ICM program will improve the operation of freeways, arterials and/or the ramps that connect them through roadside technologies and/or geometric improvements located on the ramp or near the ramp/arterial intersection. Ramp Management strategies including traditional ramp metering, adaptive ramp metering, ramp terminal geometric improvements and special use ramp designations will balance freeway demand and capacity, maintain optimal freeway operation by reducing incidents that produce traffic delays, improve safety on adjacent freeways or arterial streets, or give special treatment to a special class of vehicles.

Ramp metering is the application of a traffic control device at the on-ramp of a freeway to control the rate at which traffic is added to the mainline. Metering the on-ramp breaks up any platooning of ramp traffic which may occur such as when the traffic signal at the upstream crossroad is green. By controlling the on-ramp traffic, it is possible to reduce the number of conflicts at the merge or weave areas and improve traffic flow on the mainline. Ramp metering generally uses data from traffic sensors on the mainline and the ramp to determine the appropriate rate of release. Metering systems usually include detection that monitors queuing on the ramp to adjust meter rates to minimize the likelihood that vehicles backup into the crossroad.

Ramp metering and adaptive ramp metering provide central monitoring and control, communications, and field equipment to meter the rate at which vehicles enter a freeway from a ramp. All types of metering are covered by the concept including pre-timed/fixed time, time-based, responsive, and adaptive metering strategies. Pre-timed and time-based metering strategies are based upon historical data whereas adaptive ramp metering is based on anticipating traffic conditions in the very near future using real-time data from traffic sensors that measure traffic flow and queues.

Limited ramp terminal geometric improvements including transit queue jumps will be explored to use excess ramp capacity to temporarily and safely store vehicles on the ramp rather than having queues extend backward onto the adjacent freeway facility. Geometric improvements will also be explored on the adjacent arterial to better service demand exiting and entering adjacent freeway facilities and to improve traffic flow on both the arterial and freeway facility.

Roles Responsibilities:

- **Iowa DOT:**
  - Deploy, operate, and maintain field equipment used to meter traffic on ramps. The equipment includes static and dynamic signs to provide guidance and information to drivers at and approaching a meter, including information for any special bypass lanes.
  - Configure and update parameters for ramp meters and other systems equipment associated with ramp metering operations.
  - Monitor ramp operations and coordinate response strategies with county and municipal traffic management agencies.
  - Implement geometric improvements along specific ramps to manage demand exiting the freeway.
  - Monitor ramp operations using CCTV camera and detection on mainline freeways and ramps.
- **County and Municipal Traffic Management Agencies:**
  - Monitor operations on the arterial near freeway entrance and exit ramps and coordinate response strategies with the Iowa DOT.
  - Implement geometric improvements at specific spot locations along arterials to manage excessive demand entering/existing freeway ramps.
  - Coordinate ramp/arterial signal operations with adjacent signals located on the arterial.z

7.2.3 Active Freeway Traffic Management

The ICM system will be used to dynamically manage recurrent and non-recurrent congestion on interstate corridors within the project boundaries based on prevailing traffic conditions. The system will be managed/operated holistically to maximize interstate performance using, to the extent possible, combinations of new, innovative, and cost-effective strategies including, but not limited to, dynamic part-time shoulder use, dynamic advisory speeds, dynamic lane use control, and queue warning. These techniques will manage vehicles on the freeway mainline and, while related to other response techniques, will not directly involve rerouting. As such, the primary responsibility will remain within Iowa DOT and not include other partner agencies.

Roles Responsibilities:

- **Iowa DOT:**
  - Actively monitor the interstate road network using roadway sensors (i.e., detection devices, cameras, etc.) or third-party data sources.
  - Operate active traffic management field equipment (e.g., lane use signs, dynamic advisory speed signs).

- Activate/Deactivate lane management field equipment to change lane configuration in response incidents, traffic demand, special vehicle use or other conditions necessitating a response to dynamic conditions impacting traffic flow.
- Provide incident information to drivers at points upstream of congestion using dynamic message signs (side mount and over the road).
- Design, implement, operate and maintain connected vehicle roadside equipment (i.e., roadside communication units) to disseminate incident alerts, information, lane use controls and advisory speeds directly to vehicle on-board communication systems.
- Coordinate with Iowa State Patrol on requests for traffic enforcement of lane control violations or vehicles that exceed speed limits. This may be a simple request for increased enforcement presence or to prosecute violators.
- Monitor the speeds of vehicles and calculate/disseminate optimal advisory speeds by lane.

7.3 ARTERIAL TRAFFIC MANAGEMENT

Arterial traffic operations involve many conflicting factors due to the need for direct access to land use (business and residential), regional connectivity, local circulation, and multimodal users. Additionally, just like freeways, arterial systems face high demand that can lead to significant delays and congestion. Moreover, these conditions can be exacerbated by ineffective operation and maintenance of traffic signals, which can contribute to many hours of unnecessary traffic delays, congestion, fuel consumption and air pollution. Through the use of strategies such as traffic signal management, dynamic parking management, and adaptive traffic signal control, arterial traffic management can be used to effectively and successfully manage traffic on arterial roadways.

7.3.1 Parking Management

The ICM system will support communication and coordination among equipped parking facilities and with traffic management systems. This concept also shares information to support multimodal travel planning, including dynamic parking reservation capabilities. Information including parking availability, system status, and operating strategies are shared to enable local parking facility management in support of ICM and other transportation strategies.

Under this concept parking operators will collect and distribute static and dynamic parking information about individual parking lots. Static information includes hours of operation, rates, lot location, lot entrance locations, lot capacity, lot type, and lot constraints. Dynamic parking information includes real-time parking status and occupancy information. Parking information will be disseminated to pre-trip and en-route travelers to enable dynamic wayfinding to available parking.

More advanced implementation of this concept may eventually allow regional traffic management agencies to reduce travel demand within an area or corridor by coordinating with parking management agencies to implement dynamically priced parking to limit demand for parking during special events, specific days or at certain times of day.

Near term implementation of parking management strategies will rely on dynamic message signs and traveler information outlets (e.g., 511 and media broadcasts). Long-term implementation of parking management strategies may evolve to include vehicle-to-infrastructure communications.

Roles and Responsibilities:

- **Transportation Management Agencies:**
  - Coordinate with parking operators on strategies to implement when travel impacts are anticipated. This may include recommendations for dynamic adjustments to parking fees and restrictions.
  - Implement, operate, and maintain dynamic message signs for dissemination of traffic and parking information (parking lot status, number of parking spots available, etc.). In the future, this may include connected vehicle roadside field equipment to communicate similar types of information to connected vehicles via short range communications.
  - Monitor field equipment and report malfunctions and failures to maintenance in a timely manner.
- **Parking Facility Operators:**
  - Maintain and disseminate static parking lot data, including location, the capacity of the parking lot, (i.e., the maximum number of spaces available), pricing information, lot type (open lot, garage, covered, private, public), lot constraints, electric vehicle charging stations, and hours of operation.
  - Maintain and disseminate dynamic parking lot data, including changes to hours of operations, pricing, and current parking availability.
  - Operate and maintain an interface that travelers may make reservations for parking spaces as part of travelers' pre-trip travel planning. This includes accepting requests to reserve parking from external entities.
  - Provide parking management data to traffic management agencies as part of demand management programs. This could include changes to hours of operation, pricing, and current parking availability.
  - Share historical parking lot usage data with transportation management agencies to support demand management and long-term transportation planning.
- **Event Promoters**
  - Send event information to parking facility operators.

7.3.2 Traffic Signal Control

Local municipal traffic engineering or public works departments will be responsible for monitoring ICM arterial corridors including ramp/arterial intersections to assess signal performance and determine if poor signal operation or other conditions are contributing to arterial congestion. Municipalities will be responsible for the installation, operation and maintenance of traffic signal equipment such as traffic signal controllers, signal heads, detection and communications.

Local municipalities will be responsible for reporting signal faults and failures to other potentially impacted local municipalities as well as the Iowa Department of Transportation (if conditions occur that may affect freeway mainline or ramp operations or conditions).

Local municipalities will share video images and video from video detection systems with partner agencies, as mutually agreed to, at specific locations where events may cause traffic disruption on other agency owned and operated roadways.

More advanced arterial signal control can include coordinated traffic signal systems up to and including adaptive control. Coordinated signal control involves communication between adjacent traffic signals on a corridor and a system of timing plans that synchronizes the progression of traffic to reduce excessive stops and delays. Adaptive signal control is a more advanced technique that, with additional detection and software, can modify timing plans in real time and "adapt" to changes in traffic patterns.

Roles and Responsibilities:

- **Iowa Department of Transportation:**
  - Evaluate and include traffic signal products on an approved product list for use by Iowa DOT projects and other stakeholders.
  - Create statewide procurement agreements for traffic signal equipment that allows purchasing by other stakeholders.
- **Traffic Management Agencies:**
  - Deploy, operate and maintain traffic signal equipment.
  - Periodically configure traffic signal systems including modifying traffic timing parameters (cycle length, splits, offset, phase sequence, etc.).
  - Monitor traffic signal control status and detect/report traffic signal malfunctions and failures.
  - Share traffic camera images/video of events impacting traffic signal operations with other traffic management agencies.
  - Develop timing plans that promote coordinated progression along the arterial network.
  - Provide data on traffic signal operations with adjacent entities to improve progression and throughput on corridors.

7.4 TRAVELER INFORMATION

Traveler information, including traffic conditions, advisories, public transportation information, parking information, incident information, and weather information will be disseminated to travelers both pre-trip and en-route through a variety of channels. The ICM system will provide the capability to create, populate and access a historical database that includes traffic data to create a variety of reports on the performance of ICM corridors. Historical data will be merged with real-time information to predict the impact of travel conditions and incidents and to develop strategies to adjust system operations.

Traveler information will be provided to travelers pre-trip through 511 or media outlets and/or displayed to en-route travelers through dynamic or variable message signs (or connected vehicle roadside infrastructure in the future). Travel time information strategies have proven to be an effective means of communicating with drivers on congested or unreliable corridors and for agencies to manage these corridors to more evenly distribute the travel demand stress on major corridors to alternative routes.

7.4.1 Alerts and Advisories

This concept provides drivers information including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories at specific equipped locations on the road network using dynamic message signs. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This concept also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit

Management, Emergency Management, and Transportation Information Centers. In the future, dissemination of these alerts and advisories may be provided through vehicle-to-infrastructure technologies.

Roles and Responsibilities:

- **Iowa Department of Transportation:**
  - Deploy, operate and maintain a 511 system that allows the collection, dissemination, and archival of travel data. The system shall be accessible via phone, internet, and mobile applications and display information on current traffic conditions (closures, incidents, traffic speeds).
  - Deploy, operate and maintain dynamic message signs and connected vehicle roadside equipment.
  - Provide current and forecasted traffic information, road and weather conditions, and other road network status to the 511 system and other interested parties including, other traffic, emergency, maintenance management agencies. Information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements) in effect is included.
  - Provide direct access interfaces for media outlets to obtain camera video feed for use in reporting to the public.
- **Traffic Management Agencies:**
  - Deploy, operate and maintain dynamic message signs and connected vehicle roadside equipment.
  - Provide current and forecasted traffic information, road and weather conditions, and other road network status to the 511 system and other interested parties including, other traffic, emergency, maintenance management agencies. Information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements) in effect is included.
- **Media Outlets**
  - Provide up-to-date information from the collective 511 system to subscribers via television, radio, and social media outlets.

7.4.2 Route Guidance

The ICM system will provide users with information they can use to alter trips in response to current conditions. While similar to the alerts and advisory strategies, this strategy requires additional coordination between agencies as it often results in changes in travel patterns outside a single jurisdiction. Types of information needed for this strategy include:

- Information on detours, road closures, and recommended routes.
- Travel time changes associated with detour routing.
- Available alternate modes such as transit service. Includes information on transfer options, reduce fares and other marketing information to encourage mode shift.
- Parking information including locations, availability, and fees.

Roles and Responsibilities:

- **Iowa Department of Transportation:**
  - Develop alternate route plans for diversion scenarios in conjunction with partner agencies.
  - Deploy, operate and maintain dynamic message signs and connected vehicle roadside equipment.
  - Provide public with information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements).
  - Coordinate with partner agencies, transit providers, and parking operators to determine appropriate available resources.
- **Transit Providers**
  - Develop transit route changes and/or pricing policies for use during major incidents and/or rerouting.
  - Provide up-to-date information to the Iowa DOT and other transportation agencies on the availability of transit services during events or incidents.
- **Parking Operators**
  - Provide up-to-date information to the Iowa DOT and other transportation agencies on the availability of parking during events or incidents.

7.5 INFRASTRUCTURE ENHANCEMENT/MANAGEMENT

Infrastructure enhancement and management aims to improve corridor conditions through developing TSMO functions in conjunction with new infrastructure additions, such as park-and-ride lots, acceleration/deceleration lanes, cycle tracks, and crash investigation sites. These developments are further supplemented by techniques and low-cost solutions to bottlenecks, geometric design of streets, and rail to ultimately help improve incident management, corridor flow, and overall safety. Strategies within this group are not meant to be major investments in infrastructure improvements such as traditional roadway widening, new interchange ramps, or significant intersection modifications.

Roles & Responsibilities:

- **Iowa Department of Transportation:**
  - Identify freeway bottleneck locations where additional capacity is needed to mitigate temporary queuing.
  - Identify freeway ramp locations where traffic control or merge/diverge conditions result in excessive queuing and delay.
  - Develop projects that reduce or eliminate freeway and ramp bottlenecks.
  - Identify and develop projects that improve incident response, such as median barrier gates or staging areas.
- **Traffic Management Agencies:**
  - Identify local roads that operate at or near capacity, where additional capacity may be leveraged to temporarily increase throughput.
  - Develop projects that maximize intersection traffic operations by removing queuing, delay, and bottleneck conditions.

- **Transit Providers:**
  - Identify park-and-ride lots that are operating at or near capacity as well as those that have excess capacity. Determine strategies to manage parking usage through increased advertising, enhanced user amenities, and increased parking capacity.
  - Coordinate with the Iowa DOT and other transportation agencies on new park-and-ride locations, expanded availability, and changes to transit usage.
  - Provide the Iowa DOT and other transportation agencies information on bottlenecks, intersection queuing, and other operational issues that impact transit travel time and schedules.

7.6 TRAVEL DEMAND MANAGEMENT

Travel demand management is a set of strategies aimed at maximizing traveler choices, such as work location, routes, timing, and mode. Although travel demand management was traditionally seen as a means of providing alternatives to single occupancy commuter travel to save energy, improve air quality, and reduce peak period congestion, it has now expanded to include optimizing general transportation system performance for commuting and non-commuting trips and recurring and nonrecurring events.

The ICM system will enhance existing travel demand management programs to provide travelers with additional choices as to how and when they can travel. TDM programs will be used to promote understanding of available travel options and provide incentives for the public to use more efficient forms.

By providing additional choices, travelers will gain flexibility when planning trips to avoid single-occupancy trips in the peak periods. This will reduce the severity of peak travel periods by reducing the number of vehicles on the road and spreading the demand over longer periods of time so that existing capacity can effectively service overall total demand.

The ICM program will implement TDM strategies aimed at:

- Providing enhanced information about alternative forms of transportation. This includes partnering with regional employers to not only promote publicly available forms of transportation such as transit, bike sharing, and car/vanpooling but to encourage employer-side strategies such as flexible work hours and telecommuting.
- Marketing business benefits to employers through multi-agency collaboration through transportation management associations and other collaborative groups. TDM strategies not only have transportation benefits, but they can also make employers more competitive in attracting talent by allowing employees the option to achieve better work-life balances. Also, because strategies allow employees to avoid congested periods, TDM can improve employee morale and productivity.
- Aligning available transportation services with new and efficient forms of travel to encourage natural mode shift. TDM programs will help with first and last mile issues impacting the attractiveness of transit. By addressing these gaps, TDM will increase the attractiveness of transit thereby increasing person throughput using less vehicles.
- Offer incentives for transit and other non-vehicle modes of travel and for travel outside hours of peak demand.
- Enact disincentives for driving, by leveraging changes to parking prices, tolls, and congestion pricing.

Roles and Responsibilities:

- **Transit Management Agencies:**
  - Coordinate various outreach initiatives that support employer TDM programs and regional commuter services.
  - Manage and participate in the development and implementation of TDM initiatives.
  - Coordinate with transportation management agencies to identify best route locations and timeframes to assist in congestion reduction.
  - Enhance opportunities for first and last mile connections through coordinated efforts with ride-sharing and personal drop off areas and programs for bike, scooter, and other personal transportation modes.
- **Transportation Management Agencies:**
  - Provide accurate, timely and reliable traveler information on current status of transportation facilities to influence travel behavior.
  - Provide information on other modes of travel, such as transit, to encourage mode shift.
  - Improve accessibility of travel information by providing information via methods that travelers use the most.
  - Provide transit operators with data related to congested corridors that may be potential TDM routes.
  - Dedicate new or available capacity to TDM-focused modes of travel, such as bus or bike lanes.

7.7 PUBLIC TRANSPORTATION MANAGEMENT

Public transportation management seeks to successfully integrate and manage public transportation within the urban transportation system. To incentivize users to take public transportation when they have a choice, strategies commonly involve discounted tickets, transfer connection protection, seamless transfers between modes, and other fare strategies. Moreover, when there is increased traffic demand, public transportation management seeks to make public transportation a consistent and sometimes faster alternative to driving through the use of express bus service, bus rapid transit, signal priority for transit vehicles, and designated transit lanes. Travelers can access on-demand information, real-time data, and predictive analysis on travel information to decide whether public transportation is the best option for their needs through mobility on demand strategies.

The Des Moines ICM system will integrate public transportation into ICM corridors to improve transit operations and enhance corridor performance. The goal of this integration is to enhance transit operations, promote transit use, and increase person throughput throughout the ICM corridor by effectively using available transit capacity (i.e., empty seats).

To realize the ICM vision, transit management agencies will manage transit vehicle fleets and coordinate operations with other modes and transportation services much like they do today, but will take the additional step of integrating their services to improve overall corridor performance. Transit operators will be responsible for transit fleet management, maintenance operations, and scheduling activities. Operators will actively monitor, control and modify transit fleet routes and schedules on a day-to-day basis (dynamic scheduling). The modification will take account of abnormal situations such as vehicle breakdown, vehicle delay, detours around work zones or incidents, and other causes of route or schedule deviations. Transit management agencies will be responsible for collecting relevant transit operational data within the ICM corridor and subsequently relaying pertinent operational information to their dispatchers who will then report this information in a timely manner to partner agencies (e.g., traffic management, emergency response and management) as appropriate. Based on anticipated impacts transit agencies will adjust transit services based on pre-determined response plans.

At freeway or ramp locations where transit service is frequently subject to delays caused as a result of recurring congestion, transit and traffic management agencies will collectively work to determine the feasibility of improvements such as ramp queue jumps or intermittent transit lanes. If implemented, local jurisdictions will adjust traffic signal operations at intersections under their jurisdiction to give priority to transit vehicles operating along signalized arterials. Similarly, the Iowa Department of Transportation will analyze the feasibility of implementing and using dedicated transit lanes on freeways during peak periods to enhance transit reliability.

7.7.1 Transit Priority Treatments

The Des Moines Metropolitan Area ICM program will incorporate transit priority treatments to enhance the efficiency of transit operations and incentivize transit use over less efficient forms of travel. This includes equipping traffic signals and transit vehicles that operate along high volume corridors with transit signal priority to reduce transit delay at traffic signals. It will also incorporate roadway improvements such as bus rapid transit and intermittent bus lanes to separate transit vehicles from congestion caused by other vehicle classes.

Priority treatments will be prioritized at locations along arterials, ramps, and freeways where recurring congestion frequently and adversely impacts transit operations and/or locations where existing capacity may be leveraged to allow transit vehicles to bypass queues to improve operational performance.

Roles and Responsibilities:

- **Transit Management Agencies:**
    - Analyze transit vehicle schedule performance to determine the need for priority along certain routes or at certain intersections. Send manual requests for priority along routes or at intersections (when needed).
    - Plan, design, implement, operate and maintain transit signal priority equipment installed on transit vehicles.
    - Monitor transit vehicle operational performance to determine necessary changes.
- **Traffic Management Agencies:**
    - Plan, design, implement, operate and maintain transit signal priority equipment within traffic signal controllers.
    - Plan, design, and implement lane control field equipment for intermittent transit lanes.
    - Remotely monitor and control transit-oriented equipment and systems.
    - Monitor traffic conditions and demand along freeways and ramps and report incidents and/or congestion to transit management agencies.
    - Notify enforcement agencies of current enforceable lane restrictions (i.e., location, duration, and type of restrictions in place (exclusive use by transit vehicles).

- **Law Enforcement:**
  - Enforce driver compliance with transit-oriented roadway restrictions based on information provided by the traffic management agency.

7.7.2 Transit Incentives/Pricing Strategies

The ICM program will include transit incentives and fare strategies to leverage available transit capacity (i.e., empty seats) to reduce vehicle travel demand. The goal is to encourage single occupant vehicle drivers to use transit or other modes to relieve congestion during incidents or peak periods.

DART has been working with local employers since 1974 to take advantage of employer programs. They offer a transit benefit program to provide bus passes at a reduced cost to the employees along with tax incentives for the company. As part of the ICM program these programs would be maintained and enhanced with the aim of reducing congestion and maximizing use of available transit capacity within ICM corridors.

Roles and Responsibilities:

- **Transit Management Agencies:**
  - Coordinate with local employers to promote and implement transit incentives.
  - Coordinate with transportation management agencies to identify best route locations and timeframes to assist in congestion reduction.
- **Traffic Management Agencies:**
  - Promote transit incentives/pricing strategies using available tools.
  - Provide transit operators with data related to congested corridors that may be potential transit routes.

7.7.3 On-Demand Services

The Des Moines ICM will incorporate on-demand/flexible transit and mobility services to supplement transit coverage/services and to provide first and last mile connectivity between existing transit services and user destinations. Strategies such as dynamic transit capacity assignment, on-demand transit and mobility on demand will better serve the mobility needs of transit users including the elderly and disadvantaged populations. This concept may include tailoring transit services to individual user needs.

Roles and Responsibilities:

- **Transit Management Agencies:**
  - Plan, implement and operate a user interface to support requests for dynamic, demand responsive trip requests.
  - Manage transit vehicle fleet and operators to provide on-demand flexible services.

8 Operational Environment

The physical operational environment associated with the Des Moines Metropolitan Area ICM program includes all facilities, equipment, computing hardware, software, personnel, operational procedures, and support necessary to operate the ICM system. The program-level ConOps focuses on the major assets that are generally thought to be fundamental for delivering most if not all ICM strategies. To that end, the Operational Environment description provided is intended to be overarching and described in less detail than the description corresponding to the project-level ConOps which will be narrowly focused on the environmental characteristics inherent to individual IMC strategies. This section will support understanding needed to develop the Operational Environment description of future project-level ConOps.

8.1 EXISTING ITS FIELD ELEMENTS

Field elements represent the backbone of intelligent infrastructure and allow for the collection, analysis, and dissemination of information related to the transportation network. Field devices may operate independently and automatically, or be governed by center-based software, personnel, or interface with vehicles or other field elements.

A full inventory of existing ITS field elements was not conducted as part of this document effort, but a list of available devices was compiled from available resources. Those devices currently deployed along the ICM corridors within the Des Moines Metropolitan Area include:

- Communication networks
- Closed circuit television (CCTV) cameras
- Fixed dynamic message signs (DMS)
- Portable changeable message signs (PCMS)
- Traffic signals system and related roadside equipment
- Environmental/Road weather sensor stations
- Traffic detection
- Friction sensors

8.1.1 Communication Networks

Communication networks are essential to connect and transmit data between devices and data centers. The communication network links the field devices to the data user for operations, management, and storage. There are several different methods for establishing communication links, each with their own advantages and disadvantages. Within the ICM corridors, Iowa DOT and partner agencies use a combination of the following common methods:

- Fiber Optics
- Wireless Radio
- Cellular
- Copper Wire

Per the Iowa DOT TSMO Service Layer Plan 3 document, the Des Moines metropolitan area has approximately 30 miles of fiber optic cable owned and operated by Iowa DOT for the dedicated use of transportation. In addition, there are over 85 miles of shared fiber under agreement with other agencies and considered indefeasible right of use (IRU) for the Iowa DOT. The use of fiber is currently the highest-rated transmission method as it provides large bandwidth, high reliability, and is more secure than other methods. Since installation of fiber is relatively expensive and maintenance requires specially trained technicians, the use of fiber optic cable is typically limited to longer runs along major facilities. Where possible, the practice of sharing fiber through inter-governmental agreements should be continued and expanded.

Wireless radios are beneficial for shorter distances where a single device, or a series of devices, need to connect to a backhaul transmission line. Within the Des Moines metropolitan area, Iowa DOT does not have any wireless radios. Wireless radios are easy to install and do not require much ground disturbance.

However, the transmission distance and bandwidth depend on the transmission frequency, some of which may require to be licensed with the Federal Communications Commission (FCC).

Cellular communication with devices is typically through third-party providers and requires a recurring cost. Cellular is typically only used in rural applications and there are no known applications of cellular communication within the Des Moines ICM corridors.

Copper wire is one of the earliest forms of communication with field devices and still widely used. Copper wire locations within the ICM corridors are primarily associated with traffic signals and associated equipment. Due to the localized nature of copper wire, specific locations were not assessed.

8.1.2 Cameras

CCTV cameras are used to monitor traffic in real-time and provide useful visual information to staff involved in operations, maintenance, and law enforcement. Per the Iowa DOT TSMO Service Layer Plan 3 document, the agency has approximately 96 cameras in the Des Moines metropolitan area most of which are located along the freeway system. There are a select number of cameras co-located at and associated with road weather information systems (RWIS), weigh-in-motion (WIM) sensors, and intersection conflict warning systems (ICWS).

In addition to Iowa DOT, local agencies have installed CCTV cameras at signalized intersections. These cameras provide the agencies with the ability to remotely view roadway and weather conditions to assist in road weather management decision-making and operations at traffic signals where most delay and conflicts arise.

Those cameras owned and operated by Iowa DOT (Figure 9) are connected directly to the traffic management center (TMC) where operators have full control over the pan, tilt, and zoom functions of the devices. While the TMC retains primary control of the cameras, other local agencies can access and control the cameras via a direct link or a secured internet option.

Live video feeds are also shared with local media for media broadcasts and with the general public through the State’s 511 traveler information website.

While the primary benefits of these CCTV cameras are for monitoring and operational decision-making, they also serve other purposes as well. The CCTV cameras will be used to remotely monitor and verify that active features such as dynamic message signs (DMS), traffic signals, and ramp meters are functioning properly and to confirm any concerns received through the public or partner agencies. Similarly, CCTV cameras will be used to monitor critical infrastructure and may provide a mechanism to measure performance if visual in nature.

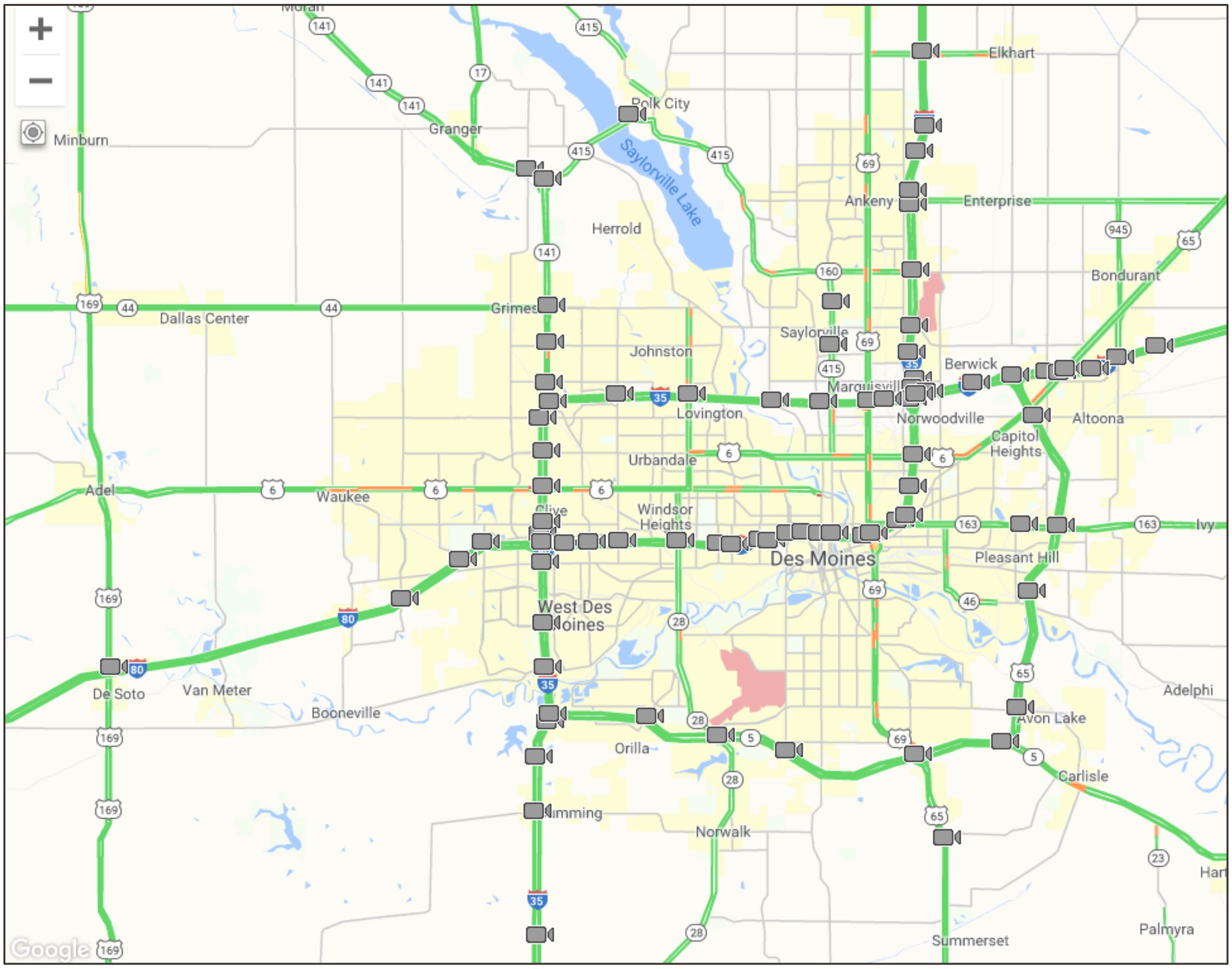


Figure 9: Des Metropolitan Area CCTV Camera Locations

8.1.3 Dynamic Message Signs (DMS)

Dynamic message signs are electronic signs that can display short messages, typically text-based, to inform travelers about upcoming roadway conditions. These messages are posted and managed in real time by agency staff and only activated when warranted. Primary messages for DMS include information related to incidents, roadwork, weather, travel time, etc.

DMS allow the most direct communication with the traveling public and provide information and/or instruction directly from the transportation agency. While other sources of information are becoming more commonplace with the prevalence of cell phones and third-party applications, DMS are still useful for the higher function routes such as freeways. Installation costs for DMS remain high due to the cost involved in the structure/support, power source, and communication lines.

The two primary types of DMS are overhead and side-mounted, referring to their physical location relative to the roadway. Currently, Iowa DOT has 28 DMS in the Des Moines metropolitan area with 19 DMS overhead and 9 side-mounted. Most existing DMS are monochrome (amber in color) and typically allow three lines of text. In recent years, DMS technology has evolved into color and full matrix capabilities allowing a wider range of messages including colored graphics in addition to typical text.

Portable changeable message boards (PCMS) are also used by most agencies and available for temporary applications. These are commonly used in construction or maintenance work zones, extended incident management, or special events.

8.1.4 Traffic Sensors

Traffic sensors are devices placed within or adjacent to the roadway surface that detect and record the presence of vehicles. These devices are predominantly at fixed locations, although portable sensors can be used for event and work zone management. Types of devices include inductive loops installed in the pavement, video detection cameras placed above the pavement, or radar (microwave, infrared) systems placed above the pavement.

Traffic sensors provide agencies the ability to detect vehicles and determine factors such as traffic volumes, vehicle speeds, vehicle classification, and presence/occupancy. These factors can then be used in measuring system performance, planning activities, operational decisions, or incident detection and management. Depending on the type and location of the sensor, detection can be applicable to roadway segments (throughput) or intersections (turning movements). Real-time access to these sensors are available through the TMC.

Per the Iowa DOT TSMO Service Layer Plan 3 document, the agency has 97 radar detection devices installed along freeway segments within the Des Moines metropolitan area. In addition to the radar devices, there are eight other sensors installed and functioning as automatic traffic recorders (ATR) and one as part of a weigh-in-motion system. Many of the ATR are not compatible with the central software platform and are used mostly for reporting annual trends in performance measures.

Traffic sensors installed and operated by local agencies were not inventoried as part of the ICM effort. Available sensors at the local level are generally installed as part of an actuated traffic signal and limited to intersection control. These are important in terms of operational efficiency at intersections and can be used to determine corridor performance along major arterials and collector streets.

8.1.5 Traffic Signals and Controllers

Traffic signals, and associated controllers, are required at the intersection of major streets where the magnitude of conflicts between vehicles and/or other road users (pedestrian, bicycle) require active control of right of way. Signalized intersections assign right of way to roadway users in a defined pattern or cycle depending on varying factors. The most basic control is a fixed pattern which cycles through the different phases whether traffic is present or not. The addition of traffic detectors allows semi-actuated or fully-actuated control that can adjust the cycle durations or skip portions of the cycle depending on the presence of vehicles. This actuation allows various techniques to improve the efficiency at an individual intersection. The addition of communication between traffic signals can allow a coordinated system of traffic signals that improves the travel efficiency along a corridor. The most common methods of coordination are time-based clock systems, wireless radio transmission, and direct copper-wire or fiber optic connection. Adaptive traffic signal control is an advanced control mechanism that adjusts traffic signal timing parameters, such as cycle, split, and offset, in real time to adapt to changing traffic conditions. Currently, the City of West Des Moines operates adaptive signal systems and several other jurisdictions are considering adding adaptive signal systems.

A full inventory of traffic signals within each agency has not been conducted. As priority corridors are identified for near-term ICM efforts, a full inventory of signalized intersections, including associated detection and communication, will be needed along the corridor to determine available strategies and required improvements.

8.2 EXISTING TRAFFIC INCIDENT MANAGEMENT PROGRAMS/STRATEGIES

This section documents existing traffic incident management programs/strategies that can be leveraged to support ICM planning and operations.

8.2.1 Freeway Service Patrol

Freeway service patrols are programs, generally operated through a State DOT, that provide quick responses to incidents within congested urban corridors to mitigate congestion and reduce secondary risks. The drivers of freeway service patrol vehicles are trained and equipped to handle a wide variety of maintenance and emergency response issues. Primary tasks include removing debris from the roadway, providing assistance to stranded motorists (fuel, tire changes), quick clearance of vehicles, and traffic control assistance with larger incidents.

Iowa DOT currently operates a freeway service patrol in the Des Moines metropolitan area under the name Highway Helper. The Highway Helper program is a fleet of two 1-ton pickup trucks that operate on select routes during the hours of 6 a.m. and 7 p.m., Monday through Friday. The program also operates on select holidays and special events depending on the need. While management and oversight of the Iowa Highway Helper is performed by Iowa DOT, the Highway Helper drivers are external staff provided under contract.

The current routes that are routinely patrolled within the Des Moines metropolitan area are listed below:

- I-80, MP 121 to MP 141
- I-35, MP 69 to MP 94
- US 65, MP 79 to MP 84
- I-235, all

In addition to the approximately 50 miles of routine patrol, the Highway Helper program is also on-call for an additional 22 miles, mostly along I-35.

The Highway Helper trucks are in direct communication with the TMC and can be dispatched by operators as issues are detected. The public can also request assistance by calling 911. This ability to coordinate response between the Highway Helper, the TMC, and law enforcement allows for a quicker and more coordinated clearance of minor obstructions which reduces the likelihood of secondary crashes and continued congestion. The program also provides a very public-facing service that is held in high regard. In 2016, the Highway Helper program responded to over 6,700 incidents in the Des Moines area.

8.2.2 Traffic Management Center (TMC)

A traffic management center, or traffic operations center, is a central hub where information and data are collected, analyzed, and acted upon to manage traffic operations and roadway safety. Typically, a TMC is staffed by operators who have the ability to directly communicate with maintenance personnel and law enforcement which allows for a coordinated response to incidents whether they are vehicular crashes, construction work zones, inclement weather, or issues related to the roadway itself. Communicating information with the public is also important in notifying drivers whether en-route through DMS or pre-trip through 511 or social media. In small agencies, a TMC can be as simple as a single computer and phone system. In large agencies, a TMC may require an entire building with multiple workstations.

Iowa DOT operates a single, centralized TMC located in Ankeny, Iowa that provides coverage for the entire state highway system. The TMC is located within the Motor Vehicle Division building and is staffed 24 hours a day, every day. The Ankeny TMC staff have access to view and operate roadway traffic cameras which allows operators to locate, verify, and/or monitor traffic congestion and incidents. This provides additional "eyes" and support to responders in the field and increases the ability to address upstream issues.

The operators also play a critical role in communicating both internally and externally. Internally, operators can send alerts called Emergency Incident Notifications (EINS) to DOT staff notifying them of the status of incidents. In 2018, the operators sent over 20,000 of these email alerts across the state. Also, detailed incident data related to the timeline and characteristics are entered in an advanced traffic management software for future reporting and after-action analysis. Externally, operators can communicate with the public through dynamic message signs (DMS), the 511 website, and media outlets. In 2018, operators posted over 3,000 DMS messages and the 511 website was visited over 5 million times.

The TMC is a central hub for data aggregation, operational decision-making, and information dissemination. This will play an important role in future ICM efforts as the success of ICM relies heavily on real-time data and a coordinated response. As protocols are established and decision support systems are developed, the TMC operators are typically the first to assist and are available 24/7. The operators will be able to communicate to local staff and manage field equipment.

In the future, the Statewide TMC may also support local jurisdictions in traffic signal operations. The specifics of the DOT TMC traffic signal operations have not been decided at this time.

8.2.3 Traffic Incident Management Training and Planning

A vital aspect of traffic incident management is the upfront training of personnel and the planning of events or scenarios. Efficient and effective incident responses rely on knowledgeable people who can react quickly, know the resources and procedures, and can effectively communicate and coordinate with peer agencies.

The continuous training and planning for incident management can include the following:

- Classroom training
- Planning exercises
- Committees/team meetings
- After action reviews

Formal coursework in a classroom setting is typically required of all DOT workers and first responders who will regularly be involved in roadway incidents. Federally, FHWA has developed a common curriculum through the 2nd Strategic Highway Research Program (SHRP2) that is available in various formats: an extensive single program, a series of smaller classes, and web-based. These are provided through a train-the-trainer format where each state can nominate a trainer who receives direct training from FHWA and in turn provides training throughout the state. As of 2017, Iowa DOT had almost 100 individuals complete the train-the-trainers program and nearly 3,000 responders complete the SHRP2 training. This equates to approximately 10 percent of all responders. Additional progress related to this training program will help the safety of individual responders and also increase their ability to work in an incident command system (ICS).

Planning events, such as tabletop exercises, should involve all agencies and personnel effected by the scenario, whether real or fabricated. These upfront exercises help in the coordination and communication between agencies, identify areas that need additional resources, and identify missing critical components. For the Des Moines metropolitan area, a Traffic Incident Management Plan was developed among key stakeholders for a large-scale incident and last updated in 2015. Also, TIM planning efforts are undertaken annually for the Iowa State Fair held in August at the Fairgrounds and other special events. Tabletop exercises such as these are a valuable tool for ICM strategies and can help agencies refine the protocol and resources available to effectively deploy a coordinated response.

Formal committees that have established membership and common goals allow for progress in traffic incident management on a larger scale and longer time frame. Rather than planning for specific events, these committees are often focused on high-level topics such as agency agreements, policy and procedure, roles and responsibilities, and funding. Statewide, Iowa DOT has established a Statewide TIM Committee in 2016 which has held several annual TIM Conferences. Related to the Des Moines metropolitan area, local agencies have established the Polk County Multi-Disciplinary Safety Team (MDST) and Traffic Management Advisory Committee (TMAC).

After action reviews (AAR) are typically limited to major or unusual incidents and can be formal or informal. The purpose of the reviews is to learn from the successful aspects of a recent incident response and to identify ineffective or missing aspects of a response. It is important for these reviews to be timely and completed soon after the incident so that specific details are not lost.

8.2.4 Communication Interoperability

The ability to communicate across agency platforms is an essential tool in responding to and managing incidents. Communication interoperability is the ability to directly communicate to other agencies or parties involved and can apply to data as well as voice/radio. Interoperability can help enhance coordination of responders while on-scene of an incident and helps an incident command system (ICS) stay structured and informed. It can also apply to data at the TMC level and data communication between DOT and law enforcement software systems.

Typically, each agency has a standalone radio system that uses specific frequencies, channels, and protocols that are not available to the public and may not be known outside the agency. Iowa established the Iowa Statewide Interoperable Communications System Board (ISICSB) in 2007 to address the various issues of interoperability. Under this board, there are standing committees focused on governance, operations, technology, training, and user groups.

As part of a nationwide initiative, Des Moines and the majority of Iowa has full coverage under the FirstNet wireless broadband network. FirstNet is a high-speed wireless broadband network dedicated to public safety that provides a common platform with the ability to have priority use during emergencies. It operates through AT&T and utilizes Long-Term Evolution (LTE) technology.

The ability to communicate across agencies during critical incidents is paramount to sharing information and managing a response. While the FirstNet network was developed for large-scale events, the resulting training and structure will help any incident regardless of size. The features and protocols developed for communications interoperability can help ICM efforts and any effort that involves multiple agencies, multiple countermeasures, and may include an ICS response.

8.2.5 Operational Analysis Tools

The systemic identification of recurring congestion and areas prone to incidents is helpful in planning resources and developing countermeasures. An analysis of this type requires a number of reliable and accurate data sources related to crash type, crash frequency, traffic volumes, vehicle speeds, and other factors. The comparative analysis of roadway segments can provide a method for prioritization.

Iowa DOT has developed two separate methods for analyzing highway operations—the Interstate Condition Evaluation for Operations (ICE-OPS) and the Interstate Congestion Report. The first, ICE-OPS, was developed in partnership with the Office of Systems Planning. The second, the Interstate Congestion Report, was developed in partnership with the Center for Transportation Research and Education (CTRE) at Iowa State University.

The ICE-OPS reporting is a data-driven analysis based on nine criteria and performed in a spatial environment. The criteria are all operational in nature and the methodology was developed specifically for the TSMO program within the Iowa DOT. Each corridor segment is provided a score for the individual criteria which is then weighted for a composite score and ranking. The criteria are as follows:

- All bottleneck occurrences per mile
- Freight bottleneck occurrences per mile
- Traffic incident frequency
- Crash rate
- Buffer time index (PTI)
- Event center buffer mileage
- Weather sensitive corridor mileage
- Average annual daily traffic (AADT)
- Interstate Condition Evaluation (ICE) rating

The Interstate Congestion Report is a similar evaluation of operational issues along the Iowa interstate system. The criteria used in this methodology includes: congested hours, speed performance, and percent increase in typical travel time. Most of these data are still collected and analyzed, but the last formal report was prepared in 2016. The CTRE website still publishes congestion statistics and delay costs but now in an interactive format that allows further exploration.

While both methods are based on historical data and not conducive to real-time incident management, the analysis does provide traditional “hot spot” identification which allows for a more focused approach. In terms of future ICM efforts, these tools allow for developing priority locations for initial planning, development, and implementation.

8.3 TRANSIT

The Des Moines Area Regional Transit Authority (DART) provides transit services throughout the region and serves 19 member jurisdictions. The transit agency provides traditional fixed bus routes, ride sharing, and paratransit. In addition, there are over 20 park-and-ride lots throughout the region that are free to use and located adjacent to major bus routes including five of the seven express routes. By the numbers, there are 150 bus and paratransit vehicles, 112 rideshare vans, and 1780 bus stops.

Accounting for all services, DART reported 4.5 million annual ridership for FY18.

Related to future ICM efforts, there are numerous fixed bus routes that DART operates on the identified ICM corridors. West of downtown Des Moines, Interstates 35, 80, and 235 are currently used for Routes 52, 92, 93, 94, 95, and 96 to provide express bus service to/from western communities and the DART Central Station downtown. North of downtown Des Moines, Interstate 235 is currently used for Route 98 to provide express bus service to/from northern communities and the DART Central Station downtown. Many other bus routes operate on arterial streets identified as part of the ICM study and will need to be included as part of future strategies.

8.4 WEATHER MANAGEMENT

8.4.1 Environmental Sensor Stations

Iowa DOT currently uses a Road Weather Information System (RWIS) to provide real-time and historical atmospheric and pavement condition information. RWIS typically consists of a combination of atmospheric sensors (temperature, humidity, wind speed and direction, visibility, and precipitation) and a roadway sensor (surface temperature, subsurface temperature, and occasionally surface liquid chemical composition). Roadway sensors are typically selected based on the needs of the area and overall site cost. Iowa DOT often supplements weather sensors with traffic detectors and a camera at each RWIS location.

Within and near the Des Moines metropolitan area, there are eight RWIS sites operated by Iowa DOT. These sites provide localized information on air temperature, precipitation, wind speed, visibility, surface temperatures, and humidity. These are important factors that can inform future ICM strategies particularly when inclement weather impacts travel or forces road closures.

8.4.2 Decision Support System

Iowa DOT provides a map-based website for all weather-related information called Weatherview. This platform consists of two major functions: Automated Weather Observing Systems (AWOS) and Road Weather Information Systems (RWIS). The AWOS system provides weather data important for airport operations such as barometric pressure, wind speed and direction, and visibility (See green airplane icons in Figure 10 for locations). The RWIS system provides weather data important for roadway operations such as precipitation, pavement and bridge temperatures, and visibility (See blue dots in Figure 10 for locations). Each system provides current observed data as well as forecasts. A map overlay of current weather radar and National Weather Service warnings and advisories is also provided.

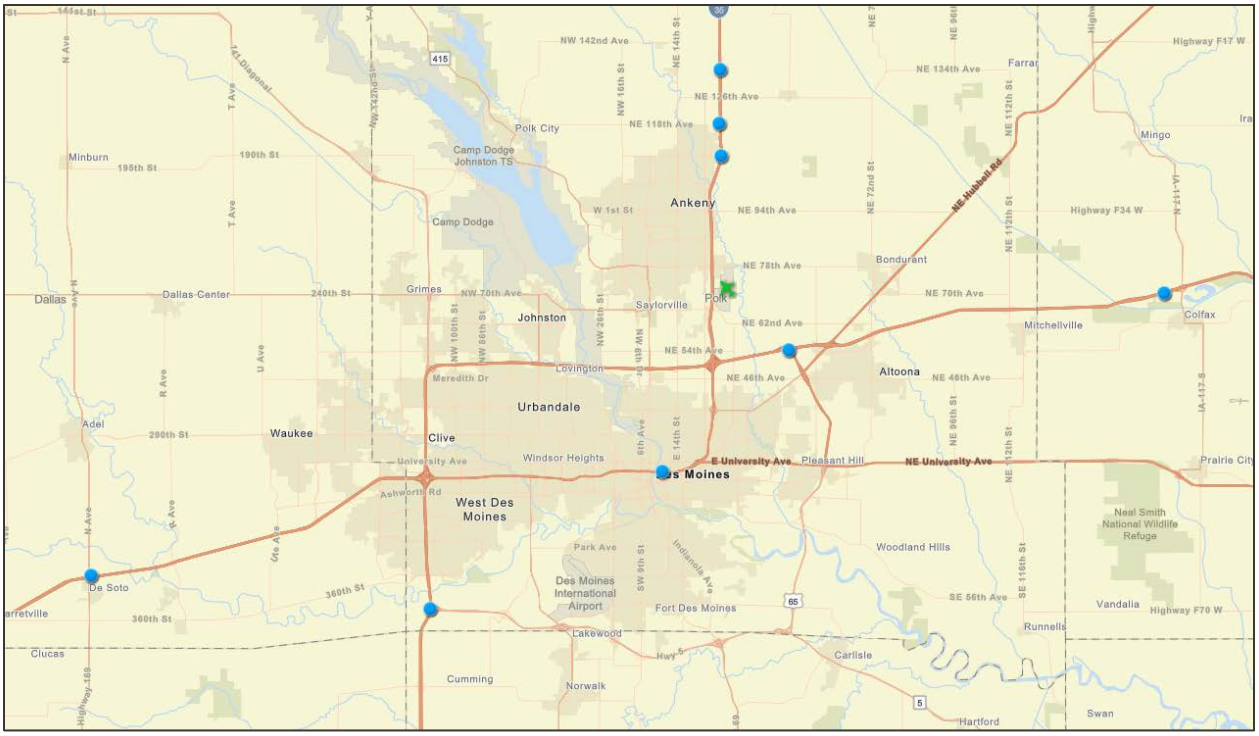


Figure 10: Iowa DOT Weatherview Map - AWOS and RWIS Locations

8.4.3 Snow Removal Equipment

Iowa DOT and local agencies maintain and operate a fleet of snow plows to remove snow and treat roadways during inclement weather. Prior to snow events or cold weather, agencies pre-treat roadways to prohibit ice and snow buildup on the roadway surface. A combination of abrasives, salt, and liquid salt brine, either individually or in combination, are used to block the formation of ice. Application of these materials requires trucks equipped with special applicators to spread material on roadways.

Information on snow plow activity is currently being transmitted from the field to the Iowa DOT and provided online for public viewing via a map-based platform called "Track a Plow." The website provides information on the number of active snow plows, snow plow locations, material application, road condition, and video camera feeds.

8.5 TRANSPORTATION DEMAND MANAGEMENT

Transportation demand management (TDM) is a set of strategies aimed at reducing peak-hour congestion through the use of alternative modes of travel or shifts in travel time. Traditionally, these methods originated as part of air quality conformance but have benefits beyond just air pollution. Early strategies related to TDM involve transit, ridesharing, vanpools, park-and-rides, and bicycling/walking. These types of strategies were not aimed at reducing the number of trips but reducing the number of vehicles on the roadway. More recent strategies involve reducing the number of trips by providing flexible work schedules, compressed work weeks, telecommuting, and changes to land use zoning.

Many of the strategies used for TDM involve transit and/or employer-provided incentives. Transit, carpool, vanpool, and modifications to work hours/location are typically coordinated through large employers in the area to encourage participation. These efforts, and supporting funding, generally fall under the oversight of a regional planning organization or transit provider.

In 2016, the Des Moines Area MPO published a Congestion Management Process which provides a collaborative approach to demand reduction, operational improvements, and capital projects. The report identifies demand reduction as the least expensive tool in managing congestion and lists the following strategies for the Des Moines area: car/vanpooling, flexible work hours, telecommuting, parking management, and land use policies. Operational improvements identified as moderately expensive include: traffic operational improvements, access management, traffic incident management, intelligent transportation systems, signal timing and interconnectedness, ramp metering, roundabouts, complete streets, and traffic signal priority. The most expensive options are related to capital projects such as lane additions or transit capital improvements. The document serves as a framework for a process and specific analysis and recommendations are not provided.

In terms of incentivizing trip reduction, DART supports employer-sponsored transit services through reduced transit fares for employees of participating businesses. The individual businesses determine the amount of subsidy and administer the program.

8.6 TRAVELER INFORMATION STRATEGIES

Traveler information strategies encompass all methods in which a transportation agency disseminates information and data to the general public. Providing accurate and timely information to travelers helps drivers make more informed decisions on route planning, both spatially and temporally, which can help improve congestion and safety on the roadway. This information can range from general advisories, such as travel time or weather events, to specific incidents, such as crashes or work zones. The communication methods are typically varied in approach and may apply better in one situation or audience compared to another. It is important to consider that not all travelers have access to each method so agencies will often have significant overlap in information systems to ensure access by a wide audience.

Iowa DOT uses many systems and methods for informing the public of traffic conditions. Each primary method is listed below with a short description.

- 511 services: Iowa DOT uses a full suite of 511 services including access via phone, website, or mobile phone app. The 511 platform provides information related to construction activity, incidents/crashes, congestion/travel speed, lane closures, and the current messaging on DMS. Access to Iowa DOT cameras is provided as high resolution still-frame images and lower resolution streaming video. Uploads of Waze reports, a crowdsourced data feed, is made possible by the widespread use of the free navigational phone app and the connected citizens program agreement. During winter weather, the 511 system also provides snow plow locations and video from onboard cameras.
  - Phone access uses the common “5-1-1” keypad access when in Iowa. For phone access to Iowa’s 511 system while out of state, users must use 800-288-1047. The phone system is fully automated with menu selections by route.
  - The website, www.511ia.org, provides a full featured map-based system that allows interactive navigation statewide. By creating a unique account, users can develop personalized routes that trigger automatic alerts. If users have limited internet bandwidth, a static map system and a text-only report is available.

    - An Iowa 511 mobile phone app is available for download for Android and iOS which provides much of the same functionality as the website.
- Dynamic message signs (DMS): Within the Des Moines metropolitan area, Iowa DOT has 28 DMS signs (See Figure 11). These electronic signs can display short messages, typically text-based, in an effort to inform travelers about upcoming roadway conditions. These messages are posted and managed in real time by agency staff and only activated when warranted. Primary messages for DMS include information related to incidents, roadwork, weather, travel time, etc. DMS allow the most direct communication with the general public and provide information and/or instruction directly from the transportation agency.
- Social media: Iowa DOT provides traveler alerts on several social media platforms including Facebook and Twitter. For each platform, there is a statewide account as well as various accounts specific to local geographies. For the Des Moines metropolitan area, there is a Central Iowa 511 Facebook account and a Des Moines 511 Twitter account.
- Agency websites: Iowa DOT has a public-facing agency website where visitors are largely directed toward online services related to driver licensing, vehicle registration, or roadway conditions (511). There are links to business functions that contain information on operational issues such as construction projects. The information provides an overview of activities that may impact travelers and is useful in context but is not as timely as other methods listed here.
- Weatherview: Iowa DOT provides a map-based website for all weather-related information as part of the Weatherview system. This platform consists of two major functions—Automated Weather Observing Systems (AWOS) for airport operations and Road Weather Information Systems (RWIS) for roadway operations. Each system provides current observed data as well as forecasts.
- Press releases: Traditional press releases are a tool available for planned events, such as work zones, or extended closures or incidents. Press releases are a more formal method of disseminating information typically through print, radio, or television.

In addition to the above Iowa DOT methods of traveler information, there are numerous other providers and avenues for roadway conditions. Traditional media sources such as radio and television provide regular updates to listeners/viewers particularly during peak commute times with a focus on commute travel times. Mobile phone apps that provide navigational directions now include real-time data on incidents and restrictions and provide alternative routes based on crowdsourced travel times. Some apps incorporate DMS messages and other data that are available through 511.

All forms of traveler information will benefit future ICM efforts as many ICM strategies rely on real-time countermeasures. Providing travelers accurate and timely information on the current condition and any anticipated changes will increase the success of ICM implementations.

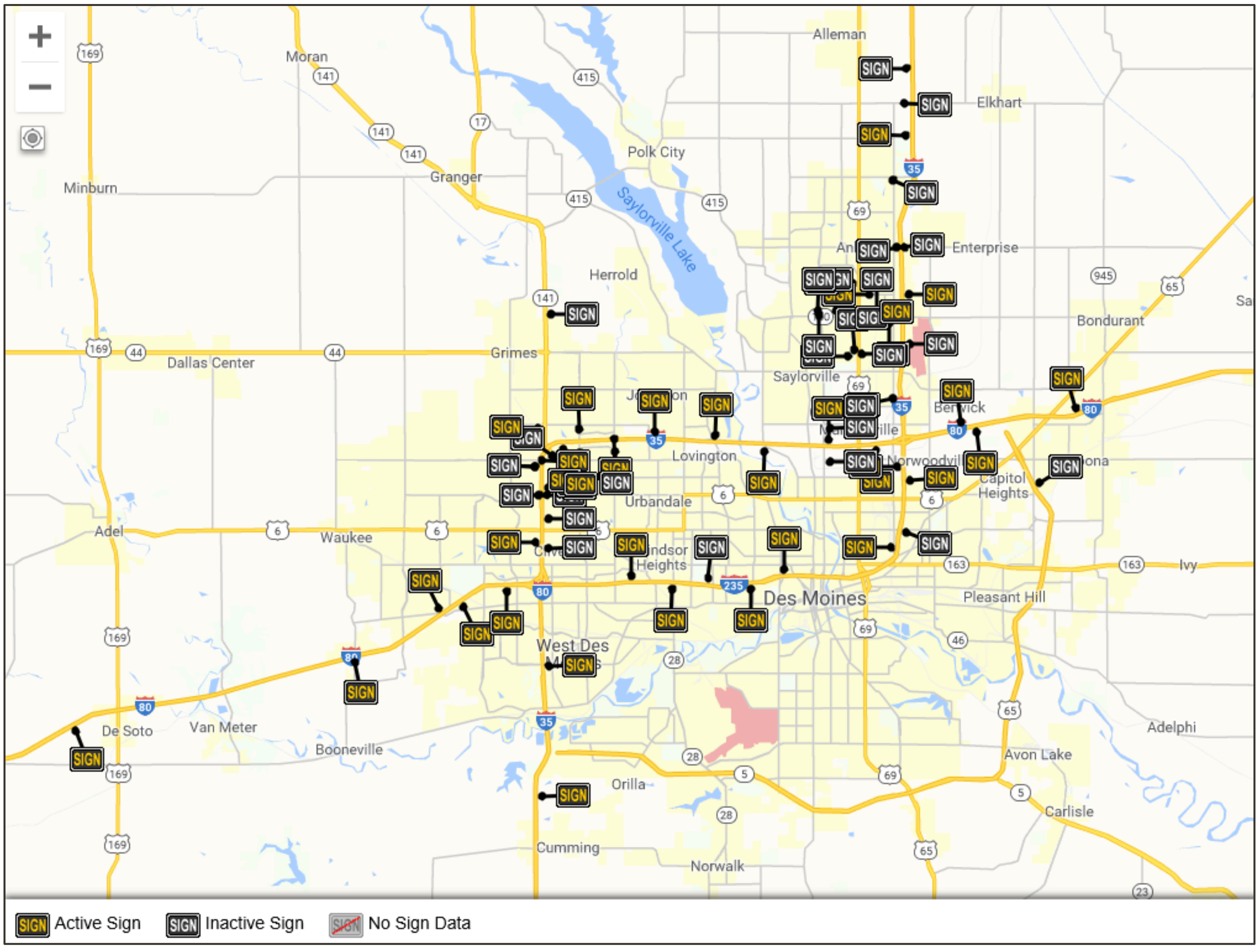


Figure 11: Des Moines Metropolitan Area DMS Locations

9 Support Environment

The support environment associated with the Des Moines Metropolitan Area ICM program includes management structures and non-physical assets that support the ICM program. The effectiveness of the Des Moines Metropolitan ICM program depends on the leadership and involvement of many stakeholders. Effective management of a large multifaceted system over a large geography involving multiple agencies requires a formal structure to govern the activities and direction of the program. The structure will consist of various levels of public-sector resources and is described in the following section. In addition, the support environment includes non-human resources such as training and educational materials, public outreach activities, national and regional ITS architecture references, and alternate route plans.

9.1 ICM PROGRAM MANAGEMENT

The Iowa DOT, in cooperation with regional ICM stakeholders, will establish a multi-agency ICM executive committee and ICM working groups to manage ICM activities and resolve issues as quickly and efficiently as possible. Each group will be structured similarly to the MPO's existing executive and technical working committees.

9.1.1 ICM Champion

The Iowa DOT will be the lead agency or champion for the ICM program. As champion, the DOT will take the lead in organizing ICM activities and will host ICM-related meetings. They will also provide administrative support, such as taking notes, and documenting/following up on any actions items. The DOT will also lead the following activities:

- Ensure that all agencies that have a role in the operation and maintenance of all networks are invited to participate in ICM planning. This includes inviting those agencies that may simply benefit from ICM that wish to stay engaged in related efforts.
- Determine initial activities to be conducted and funding for high-level programmatic activities.
- Maintain a regular communication schedule and agency points of contact.
- Approve changes to ICM direction and scope.
- Approve ICM related deliverables.

9.1.2 ICM Executive Committee

The ICM Executive Committee will be led by the Iowa DOT and will be composed of members that serve on the Des Moines Area MPO's Executive Committee. These members include:

- The MPO's three elected officers: the Chair, Vice Chair, and Secretary/Treasurer
- The immediate past chair
- Three additional members elected by the MPO Policy Committee
- At least one representative of the City of Des Moines

Currently, the MPO's Executive Committee is comprised of the following seven members' agencies:

- City of West Des Moines
- City of Des Moines
- City of Ankeny
- Polk County
- City of Clive
- Coty of Norwalk
- City of Grimes

The ICM Executive Committee will meet on the same day and immediately before (or after) scheduled MPO Executive Committee meetings. Currently, these committee meetings are scheduled to meet on the second Wednesday of each month.

The ICM Executive Committee will generally provide oversight of the ICM Program, allocating resources to support project implementation as appropriate. It serves as the ICM decision-making body acting upon the technical guidance and recommendations received from the ICM Technical Committee. The committee will be responsible for deciding which ICM strategies to implement, and finalizing each selected strategy's scope, budget, and implementation agency. It provides the final go/no-go decision on ICM strategies. In addition to these responsibilities, the ICM Executive Committee may also:

- Provide strategic direction on the ICM program
- Allocate resources to support project implementation
- Advise on issues escalated by the technical committee

- Recommend resolution of scope-related matters
- Advise on strategic partnerships

9.1.3 ICM Technical Committee

The ICM Technical Committee is responsible for ICM project monitoring and decision-making including setting priorities for ICM projects within the Des Moines Metropolitan Area. The ICM Technical Committee's role during ICM project development is to evaluate strategies suggested by or derived from input received by the steering committee, choose which ones to implement, and pass their recommendations to the ICM Executive Committee for final approval. The Committee will have appropriate representation to make decisions on behalf of all regional interests, but will be small enough to be efficient in decision-making. Likely representatives include members of the Des Moines Area MPO Transportation Technical Committee and/or other senior stakeholders or experts that are capable of providing guidance on many different issues, can facilitate and contribute to discussion, and are team-oriented. If membership is comprised of members of the Des Moines Area MPO's Transportation Technical Committee, it will likely be a subset of current members ranging from 6 to 12 total members.

Similar to the ICM Executive Committee, the ICM Technical Committee will meet on the same days and immediately before (or after) scheduled MPO Transportation Technical Committee meetings. Currently, these committee meetings are scheduled for the first Thursday of each month.

9.1.4 Technical Subcommittees

Technical subcommittees may be formed for ICM related projects with scopes pertinent to a subset of agencies represented on the technical committee. These subcommittees may be formed for projects requiring further discussion and evaluation beyond what is available at the ICM Technical Committee. Subcommittees will present project-level findings and updates to the larger Technical Committee.

9.1.5 Steering Committee

The Steering Committee represents the broadest set of ICM stakeholders. This group would be comprised of any person that has an interest in providing input on ICM-related matters. Issues and needs raised by Steering Committee members should feed into programmatic update cycles and should be reflected in future updates of this ConOps. The Steering Committee will meet less frequently than the aforementioned groups and will not be a decision-making entity. The general roles and responsibilities of this group may include:

- Provide input into the range of stakeholders that should be included in ICM outreach efforts.
- Provide input into the direction of regional ICM efforts including updating ICM vision, goals and objectives as needs change.
- Help with the identification and definition of ICM strategies.

9.2 OUTREACH & EDUCATION

9.2.1 Website

A program website has been created to provide stakeholder and public information on the ICM efforts at the following URL: https://iowadot.gov/desmoinesicm/. The program website is divided into four sections: Home, About ICM, Events & Resources, and Stay Informed. The Home tab includes the program study area map, a synopsis of program goals, a quick link to recent events/news, and an option for subscribing to ICM updates. The About ICM tab provides background understanding for those stakeholders and members of the public that do not know what ICM is. The About ICM tab also includes a schedule for ICM program start-up activities that is updated around critical schedule changes. The Events & Resources tab acts as a repository of the activities of prior key ICM meeting materials. The repository includes materials from the Concept of Operations Stakeholder Workshop, Online Public Scoping Meeting, presentation to the Des Moines Area MPO Technical Advisory Committee, and Stakeholder Visioning Workshop. The Events & Resources uses a current events section to call attention to events that are active at the time of website visit or scheduled for the near future. The final tab is Stay Informed. Users who complete the Stay Informed section are able to leave comments for the project team, sign up for future updates by email, or easily follow Iowa DOT on social platforms like Twitter and Facebook.

9.2.2 Informational Video

An informational video on the topic of ICM is currently in production and will be available to support the Des Moines ICM program in fall 2019. The goal of this video is to explain and illustrate the Iowa DOT's efforts in Integrated Corridor Management, primarily in the Des Moines metro area. The average length of the video is estimated at four to five minutes. The video will be produced with short, focused sub-topic clips in mind to allow for inclusion in presentations.

Audience: The intended audience for this video is non-technical policy makers, Highway Commission, and legislators.

Key Communication Objectives and Themes:

- Inform and inspire decision-makers to champion ICM efforts in the metropolitan area.
- Educate policy makers on what ICM strategies are and how they are selected and right-sized for a community's transportation needs.
- Educate policy makers on what Iowa DOT's efforts have been to study ICM opportunities in the Des Moines area.
- Build excitement for ICM and address why policy makers should care about this effort.
- ICM is not a completely new concept; but newer to Iowa (national map) highlighting other efforts. (there are elements of this in other areas in Iowa i.e., I-80/380)

9.2.3 Peer-to-Peer/FHWA Training

FHWA offers an ITS Peer-to-Peer Program (P2P) providing short-term technical assistance to agencies facing ITS planning, procurement, deployment, and operational challenges, including ICM, active traffic management, incident management, traffic demand management, travel information, and traffic signal control systems. P2P is an important tool for transferring ITS knowledge, resources, and experiences among public agencies and throughout the transportation industry. A broad range of organizations are eligible for P2P assistance:

- State, county, and city transportation and public works offices
- Transit agencies
- Turnpike and tollway authorities
- Metropolitan and statewide planning organizations
- Emergency and public safety organizations
- Motor carrier offices

The P2P Program tries to cover all costs associated with the assistance efforts, within the limits of the program's guidelines and the availability of funding. The P2P Program will pay for travel, accommodations, meals, incidental expenses, and similar costs associated with on-site and off-site assistance.

More information on the P2P program can be obtained by calling 617-494-2883 or e-mailing p2p@dot.gov. ITS P2P Program Guidelines are available here.

9.3 ALIGNMENT WITH ITS ARCHITECTURES

An ITS architecture is a high-level framework that describes and illustrates how existing and planned ITS elements interconnect to exchange information to collectively deliver a service or function like ICM. To this extent, an ITS architecture can be viewed as a blueprint that shows the existing and future state of ITS integration within a particular area (e.g., state, metropolitan region or project). The architecture identifies the individual pieces or ITS elements, the functions these pieces perform, and the information and data that are exchanged. An ITS architecture is developed at a high level and is not intended to serve as the detailed design of the system, but rather provides sufficient detail to develop consensus between the various agencies that have a stake in ITS activities. It also provides high-level details needed to understand what must be built. To this extent the architecture helps systems planning and development by providing high-level details to begin these and future systems' engineering activities. It achieves this by providing these stakeholders the ability to visualize where in the regional context their ITS elements fit, and with what other elements they communicate.

ITS architecture development is guided by the National ITS Architecture. The National ITS Architecture, developed and maintained by FHWA, is a common, mature framework for planning, defining, and integrating ITS elements. The National ITS Architecture reflects the contributions of a broad cross-section of the ITS community and specifically defines:

- The functions that are required of ITS to perform transportation services
- The physical entities or subsystems where these functions reside
- The information and data flows that connect these functions and physical subsystems together into an integrated system

The listing of functions, subsystems and flows contained in the National Architecture is comprehensive and is intended to serve as the underlying standardized framework from which ITS projects and their corresponding project architectures are to be developed. For this reason, any locally developed architecture, including the Des Moines Regional ITS Architecture and any subsequently developed project architectures, will reflect only a sub-set of all the possible functions, subsystems, and information flows brought forward by the National ITS Architecture.

In early 2001, the United States Department of Transportation (USDOT) announced the release of the Federal Highway Administration's (FHWA) final rule and Federal Transit Authority's (FTA) policy for applying the National ITS Architecture at the regional level. The FHWA rule/FTA policy on ITS Architecture and Standards (23 CFR Part 940) requires that all federally funded ITS projects conform to a Regional ITS Architecture and undergo a systems engineering (SE) analysis to qualify for, or remain eligible to receive financial assistance. The Des Moines Regional ITS Architecture (August 2009 Update available here) is the Regional ITS Architecture that ICM projects containing an ITS element must comply with. The definition of projects includes both standalone ITS projects and those that include ITS elements. Section 23 CFR

904.11 specifically states that a SE analysis should be developed to an extent similar to the project scope and meet the seven requirements/activities below:

1. Identify portions of the regional architecture being implemented
2. Identify participating agency roles and responsibilities
3. Identify requirement definitions
4. Analyze alternative system configurations and technology options to meet requirements
5. Identify procurement options
6. Identify applicable ITS standard and testing procedures
7. Outline procedures and resources necessary for operations and maintenance.

Since this ConOps follows a systems engineering process, it partially meets some of the above requirements—particularly items 2 and 7. However, as individual ICM projects are identified, practitioners will conduct more detailed project planning including development of project-specific ConOps documents and systems engineering analyses as appropriate. Practitioners will review/update the most recent version of the regional ITS architecture available at the time of project development to begin project development and to ensure that project-level architecture is consistent with the regional ITS architecture. Since the Regional ITS Architecture was last updated in 2009, it is recommended that practitioners update the Regional ITS Architecture and/or develop project-level ITS architectures to incorporate the latest version of the National ITS Architecture guidance.

ICM projects that are not federally funded are exempt from 23 CFR Part 940 requirements. However, it is still good practice to follow a structured approach for designing ITS systems so that risk is minimized and that quality can be built into the system regardless of funding source. This will work toward developing systems in a structured fashion where their associated benefits are maximized and allocated funding is used effectively and efficiently.

9.4 EMERGENCY ALTERNATE ROUTE PLANS

Local emergency alternate routes will be developed to accommodate diverted traffic. Primary and secondary alternative routes will be identified for I-80, I-35, and I-235 within the project area. The secondary alternative route will be used if the primary route cannot handle the amount of traffic being diverted. All proposed routes will be driven to assess their ability to accommodate diverted traffic. The following considerations will be considered when selecting routes:

- Roadway design and geometry (e.g., number of lanes, lane widths, shoulder widths, limited secondary access, etc.)
- Proximity of alternate to diverted highway
- Truck/trailer weight, height, and turning movement restrictions
- Presence of traffic control devices such as signals and stop signs
- Impacts of additional traffic on emergency response routes
- At-grade railroad crossings
- Existing signing (back to original route)