ITS OPERATIONS AND MANAGEMENT PLAN

JULY 2022
Version 1

Table of Contents

List of Figures

List of Tables

Chapter 1

Introduction

1 INTRODUCTION

Mont Belvieu is a city in Chambers and Liberty counties in the state of Texas. It is just north of Interstate 10 along State Highway 146 and FM 3360. The city is along Interstate 10 and is 30 miles east of Downtown Houston. It is the site of the largest underground storage facility for liquified petroleum gas in the US. The US LPG market pricing indicator is driven primarily by the Mont Belvieu market and reported daily by the US Energy.

The Public Works & Engineering Department of the City of Mont Belvieu is responsible for the City's Management Center Plan. As the City grows a drastically a plan is needed to assist residents and city personnel with implementing emergency planning and ways to communicate with Intelligent Traffic Systems (ITS). A 3-year approach is needed to develop and install a systematic approach for implementing ITS projects in the City of Mont Belvieu. ITS employ electronics and communications technologies on the street, and automated traffic systems, to enhance mobility and response time for all modes by increasing the efficiency and safety of the transportation infrastructure within the city.

The basic goal of this Management Center Plan is to identify a series of improvement projects to address the transportation-related functional requirements for the City of Mont Belvieu, with an objective of providing a Management Center and advanced transportation system improvements throughout the city for emergency operations. The guiding principles and many of the technical aspects have not been developed previously. This plan will serve as a foundation for a Management Center implementation along with a much-needed updated technology for ITS devices to improve egress and ingress for emergency operations related Evacuations, plant operations emergencies, and coordinating/providing guidance for interstate/Sate Highway traffic along SH 146, SH 99 and IH 10 during traffic incident and emergencies.

1.1 SUMMARY OF ITS OPERATIONS PLAN PROJECT

The Consultant Contract and project was structured into eight general tasks:
Task 1 – Determine Goals and Objectives
Task 2 – Document Existing Conditions
Task 3 – Identify Transportation Concerns and Needs
Task 4 – Determine ITS Options
Task 5 – Define Functional Requirements and System Architecture
Task 6 – Develop a Prioritized Staffing Plan
Task 7 – Develop a Prioritized ITS Operations Plan The technical activities encompassed:

- Documenting the existing conditions of ITS-related systems and networks
- Identifying deficiencies in the transportation related systems through an assessment of transportation problems and needs
- Selecting candidate projects for ITS improvements and TMC operations to address problems and needs while establishing an initial priority for each of the projects
- Confirming conformance to the Regional ITS Systems Architecture
- Defining ITS Operations Plan requirements, such as priority, cost, project phasing and staffing
- Preparing an Implementation Plan for these improvements that conforms to the Code of Federal Regulations Title 23 (23 CFR)

The results of the efforts associated with the above individual tasks are summarized in the chapters of this Operations Plan Update. A summary of each chapter follows.

1.2 CHAPTER 2 — EXISTING CONDITIONS

This chapter provides a description of the existing transportation system characteristics, physical needs, and the general system objectives. The data collection activities in this task were geared toward establishing a database for use in the remainder of the project. The data was utilized to evaluate potential system elements and increased functionality, assess communications capabilities, and needs, and consider ways of improving transportation through advanced technology and information systems that maximize the safety and efficiency of the transportation infrastructure for the community.

1.3 CHAPTER 3 — TRANSPORTATION CONCERNS AND NEEDS

This chapter identifies and confirms the transportation problems and needs of the City of Mont Belvieu as identified by the staff. Based on discussions for this plan, the desires, community needs, and emergency operations priority of system functions are still valid.

1.4 CHAPTER 4 — DETERMINE ITS PROJECT OPTIONS

This chapter builds on the results obtained from Chapter 3 and determines project options to address identified needs and goals. Projects were identified that could be logically implemented for TMC emergency operations development over the next three years.

1.5 CHAPTER 5 — HIGH LEVEL SYSTEMS ARCHITECTURE

A goal of this study was to create a system that would follow developing National Standards, particularly the National ITS Architecture. This chapter discusses system functions and identifies comparable ITS Market Packages. It then develops the High-Level Systems Architecture, using a multi-step process that identifies input and output data flow customized for the City of Mont Belvieu. Finally, the Architecture was compared to the Regional ITS Architecture developed for the Houston-Galveston Area Council for consistency. Most of the functions that could be included in the Management Center Plan were taken from the market packages associated with the National ITS Architecture.

1.6 CHAPTER 6 — STAFFING PLAN

This chapter identifies the City's Management Center Emergency Operations staffing needs through an assessment of other cities and ITS guidelines. The findings are summarized and the relative priorities for each of the problems and needs are established for recommendations.

1.7 CHAPTER 7 — PERFORMANCE MEASURES

This chapter presents the performance measures and the process for on-going monitoring and evaluation of the ITS Operations Plan and the implemented systems.

1.8 CHAPTER 8— PRIORITIZED ITS OPERATIONS PLAN

This chapter presents a prioritized ITS Operations Plan based on the work performed in all the prior tasks. This ITS Operations Plan summarizes the results of the seven tasks and provides a guide for the implementation of ITS elements over the next three to four years.

Chapter 2

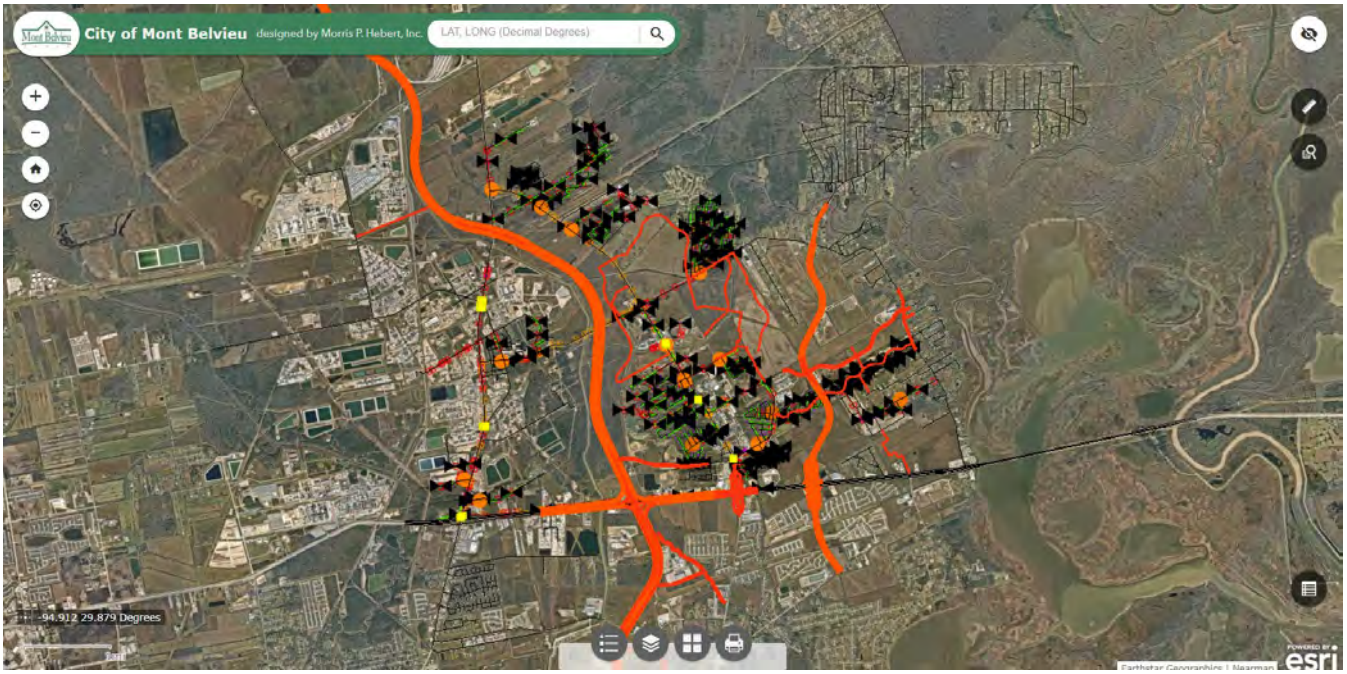
Existing Conditions

2 EXISTING CONDITIONS

2.1 OVERVIEW

This chapter provides a description of the existing transportation system characteristics, physical needs, and the general system objectives. The data collection activities in this task were geared toward establishing a database for use in the remainder of the project. The data will be utilized to evaluate potential system elements and increased functionality, assess communications capabilities, and needs, and consider ways of improving transportation through advanced technology and information systems that maximize the safety and efficiency of the transportation infrastructure. Maps were prepared showing existing city-controlled traffic signals, Fiber Communication layout, throughfare plan, City facilities and other elements of the City's transportation infrastructure. Maps and GIS data base for the City of Mont Belvieu can be found: https://www.montbelvieu.net/302/Geographic-Information-System-GIS

Figure 2.1 — Location Area



2.2 EXISTING CONDITIONS

2.2.1 PURPOSE AND INTRODUCTION

The Transportation System is a multifaceted network of components. It incorporates everything that involves moving from one place to another, whether it is people, goods, or information. This report encompasses the documentation of the existing roadway network, the existing ITS subsystems, and communication between each following a review of the City's existing transportation infrastructure and related systems. Mont Belvieu hosts numerus refineries including storage units including multiply pipelines in the city limits. As recently as October 2021, SH 146 was shut down completely during afternoon peak hours due to an underground pipeline explosion.

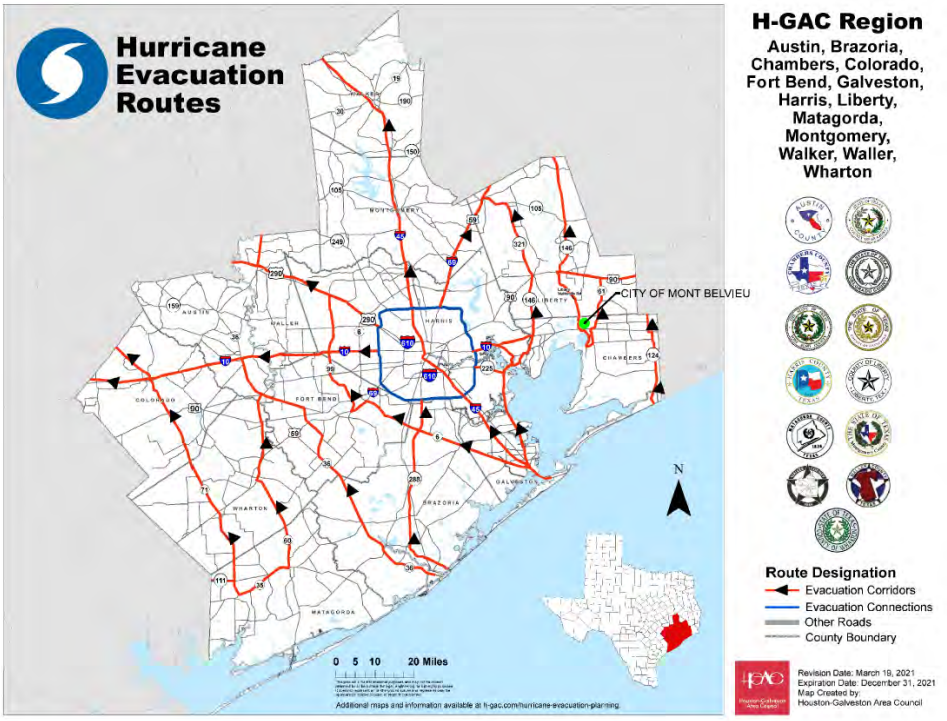
Evacuation Routing and Management

As with most coastal communities, the southeastern coast of Texas is highly susceptible to hurricanes and other natural disasters that may require evacuation of the area. While the Mont Belvieu area is not subject to the effects of storm surge and is not included in an evacuation zone, the threatened landfall of a Category 4 or 5 Hurricane may result in the need to evacuate surrounding communities. In addition, Mont Belvieu is affected by evacuation routes that have been established for coastal residents. These routes include State Highway 146 and IH 10. Mont Belvieu INFORCE is the City's emergency notification system. It has been developed to give you critical information at home or on the go by allowing you to register your mobile device, home phone, and email. Now, you will always be prepared when issues arise. Plus, you will be able to opt in to alerts about City programs and events.

Many of the features of TxDOT's Houston Transtar, the Greater Houston Transportation and Emergency Management Center, were designed to enable TxDOT to continue emergency management during an evacuation. The city of Mont Belvieu is more than 30 miles from Downtown Houston and/or Transtar. As part of its efforts at hurricane preparedness, in conjunction with the Houston-Galveston Area Evacuation and Response Task Force, local TxDOT maintains a hurricane evacuation plan to be implemented in the event of a mandatory evacuation of coastal areas.

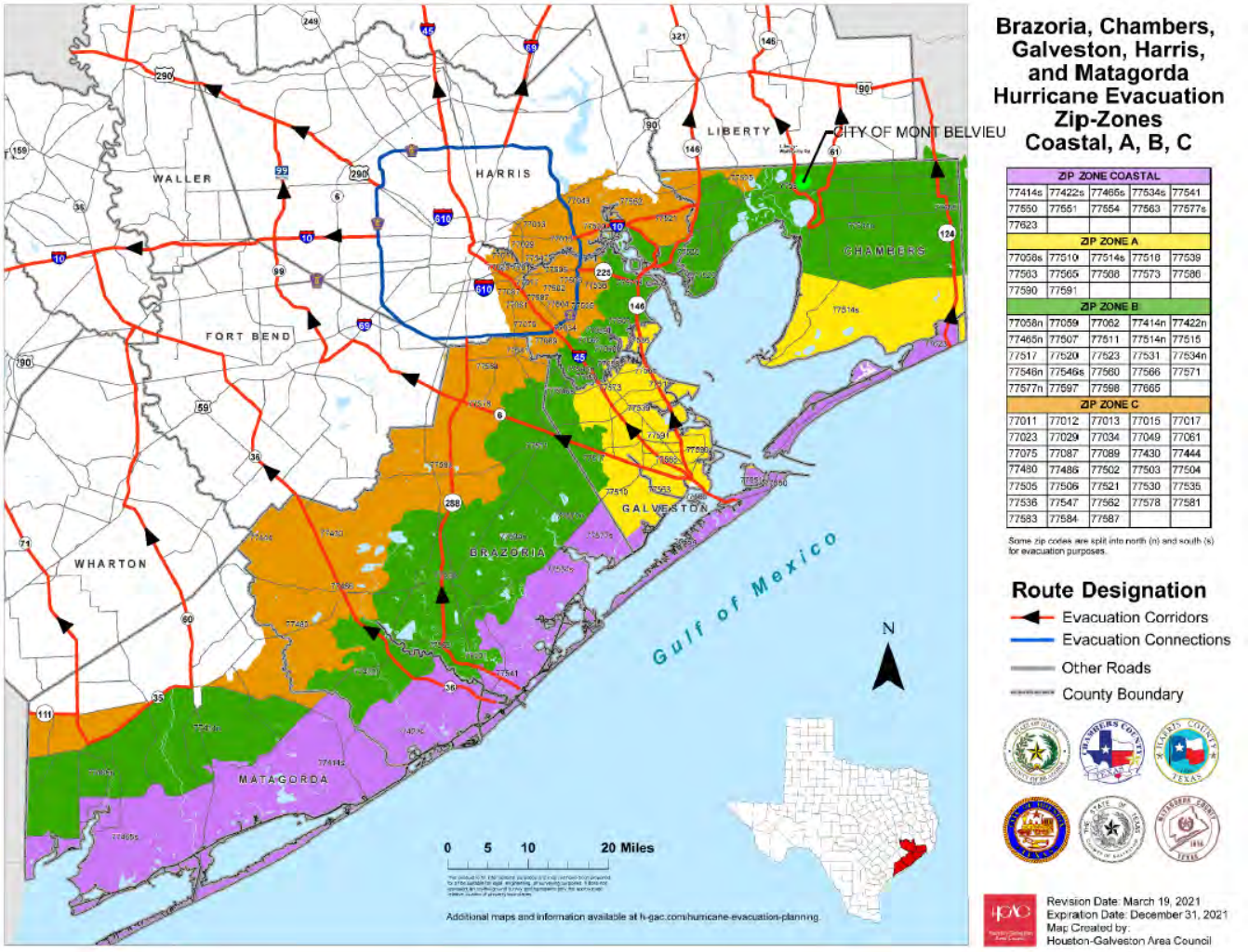
The Hurricane Evacuation Plan identifies the primary evacuation routes toward the north and the west. The main evacuation routes for the region are indicated in **Figure 2.0**. The route most directly impacting the City of Mont Belvieu is State Highway 146 and IH 10. For information on hurricanes and stores the City of Mont Belvieu provides the following website: https://www.montbelvieu.net/376/Storm-Center. Residents can register and stay informed on provided website: https://www.smart911.com/smart911/ref/reg.action?pa=montbelvieu.

Figure 2.2 — Hurricane Evacuation Routes



The City's traffic management responsibilities during an evacuation for Storms or Emergency Operations would benefit from a Management Center and several ITS capabilities. These include the ability to adjust traffic signal timing plans to optimize traffic flow along the evacuation routes; providing maps and other visual descriptions of the suggested routes to residents at home via the city web page and/or App and radio before they begin their evacuation; and providing en-route information to motorists via a local Highway Advisory Radio station and Dynamic Variable Message Signs.

Figure 2.3 — Hurricane Evacuation Routes



Traveler Subsystems

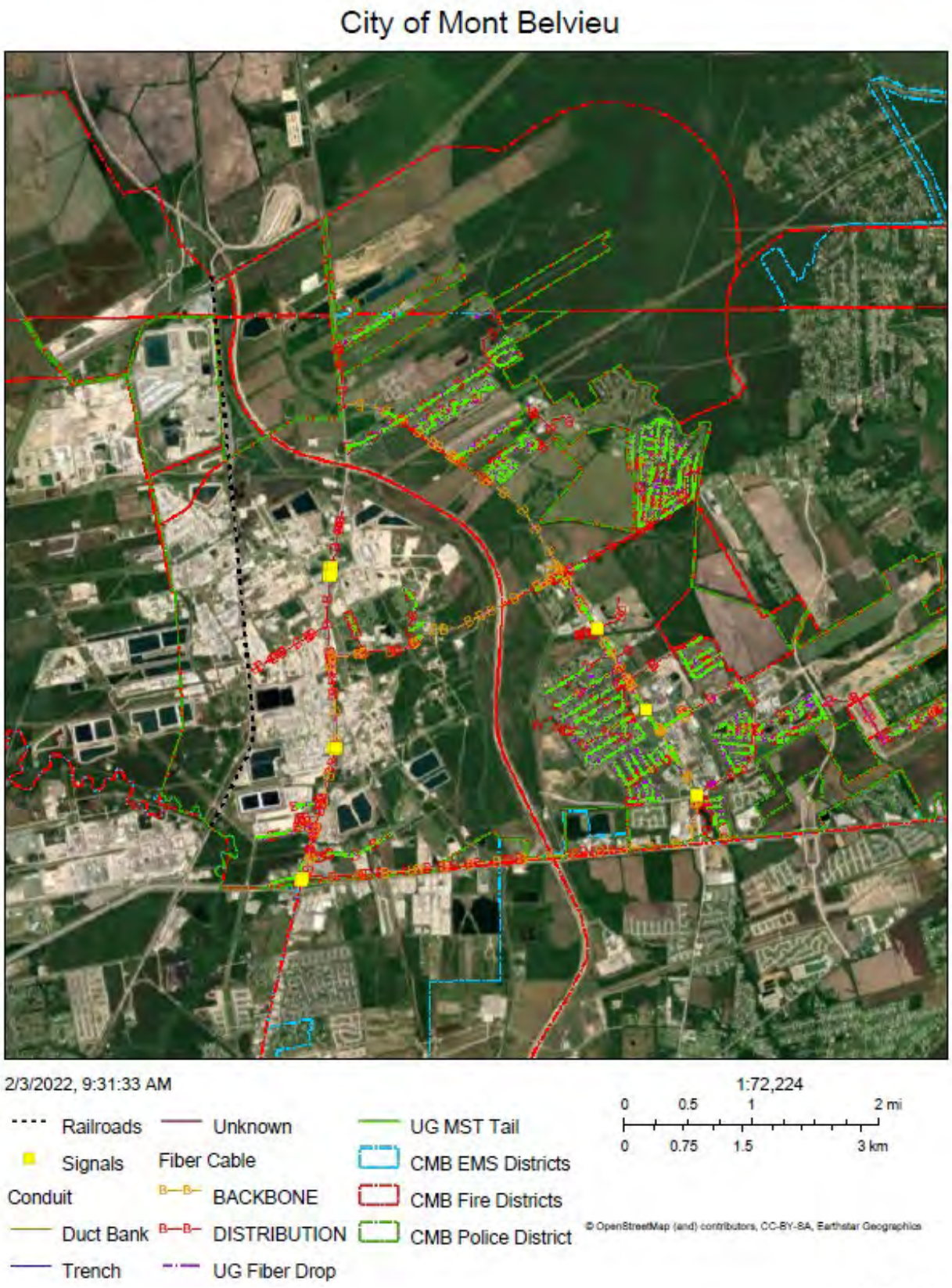
The Traveler Subsystems, as stated by the National ITS Architecture Executive Summary, "represent platforms for ITS functions of interest to travelers or carriers in support of multimodal traveling. They may be fixed or portable and may be accessed by the public or by individuals." There are four key land uses that generate traffic throughout the city: Schools Campuses, Employment, Retail and Community Events are major Traffic Generators.

Figure 2.4 — City Facilities

Communications System

Today there is no core communications connections to a local ITS equipment along any infrastructure routes within the city. The city has constructed fiber connects along all major arterial within the city limits and along residential easements/roadways. **Figure 2.5** shows the existing fiber available throughout the city for communication to Management Center and recommended ITS equipment also first responder emergency limits. The City of Mont Belvieu currently offers, MB Link which is Texas' first municipally owned fully fiber-optic broadband network. Bringing you fast and reliable internet service from our data centers to your home. MB Link is accessible to majority of all current and futures locations for ITS equipment and connects to Existing City Hall where the Management Center will be located, see **Figure 2.5**.

Figure 2.5 — MBLINK Fiber Layout in ETJ & City Limits



The City of Mont Belvieu website, https://www.montbelvieu.net/ currently provides several areas of information and interest related to transportation. These windows include Storm Hurricane Season and Traffic Alerts. Hurricane Season provides information and guidance on hurricane preparedness and recommendations to help keep citizens safe during emergencies. Traffic Alert provides notices of roadway construction and related traffic impacts.

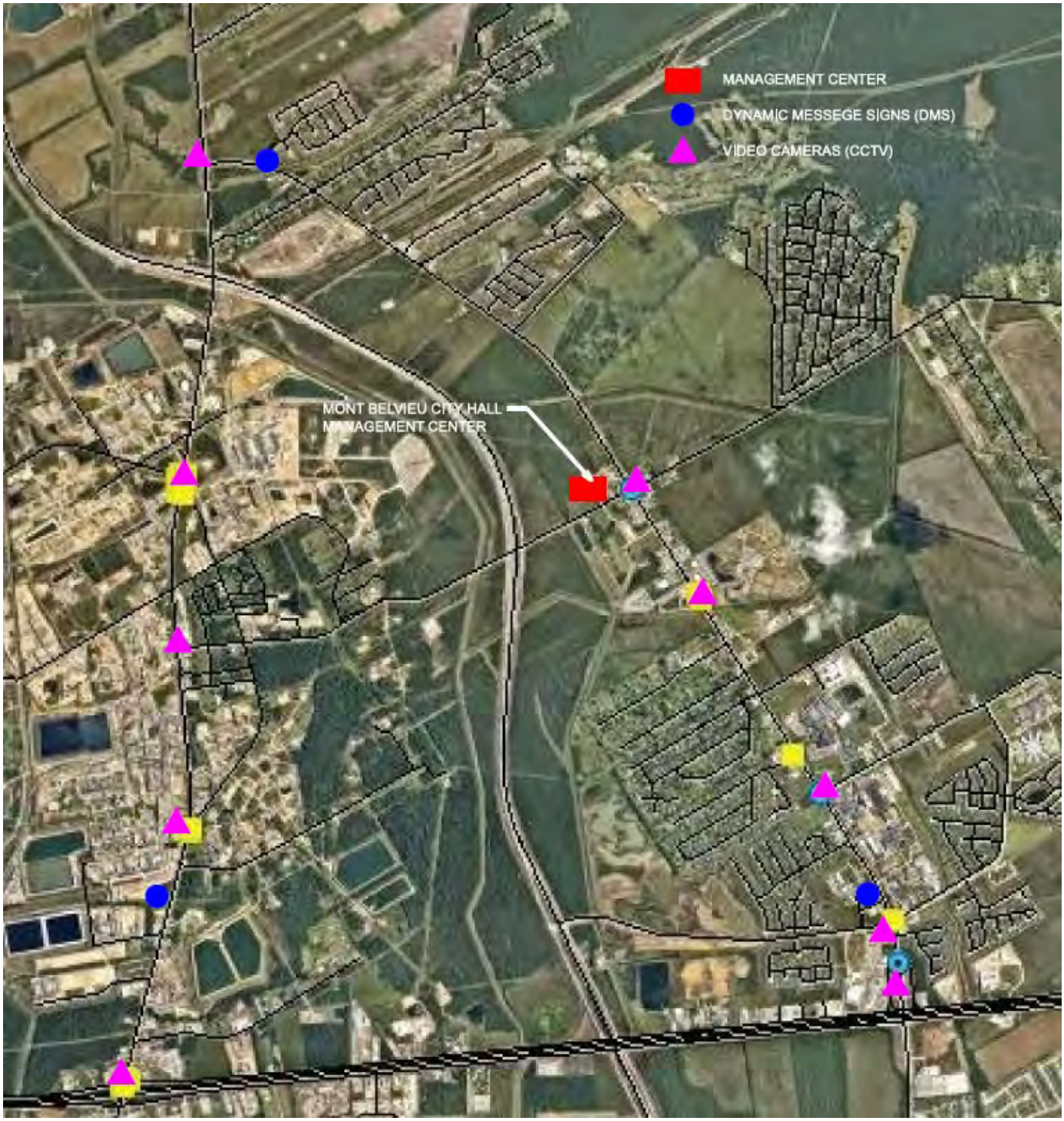
2.2.2 INCIDENT COMMUNICATIONS

Various departments within the city and other organizations communicate with each other to exchange information and coordinate responses during locally managed incidents. A Management Center will respond to requests for assistance from the Police Department. Mont Belvieu INFORCE is the City's emergency notification system. It has been developed to give you critical information at home or on the go by allowing you to register your mobile device, home phone, and email. Now, you will always be prepared when issues arise. Plus, you will be able to opt in to alerts about City programs and events. At the incident scene, either the Police Department or Fire Department will assume the command role for incident response depending on the situation. The Incident Command System (ICS) is put into effect on any scene where the presence of a supervisor is required. Such incidents include, but are not limited to, major accidents and natural disasters. The Incident Commander will decide of the need to contact Management Center and TxDOT regarding the incident.

ITS technologies in incident management systems can provide traffic operators with tools to enable quick and efficient response to accidents and other emergencies. Communications systems can link data collection points, transportation management centers, and decision support software into an integrated network that can be operated efficiently and intelligently.

Other technologies for incident management will be cameras for their ability to assist and observe emergencies from the Management Center. Cameras will help with coordination for all first responders to the initial site and provide better traffic management for detours. Cameras are planned to address incidents and are strategically place them throughout the city at intersections and along major arterials. **Figure 2.6** includes a map that shows Management Center and projected planned locations of the DMS and Cameras to be installed for emergency operations. Coordination the TxDOT Beaumont, Chambers County and Liberty County is planned to operate out of the Management Center or nearby office.

Figure 2.6 — Planned Locations DMS & Cameras within City



Chapter 3

Transportation Problems and Needs

3 TRANSPORATION CONCERNS AND NEEDS

3.1 INTRODUCTION AND SUMMARY

This chapter identifies the transportation concerns and needs of the City of Mont Belvieu as identified by the staff.

3.2 DEVELOPMENT OF FUNCTIONALITY STATEMENTS

The candidate functions for inclusion in the City's ITS Architecture were selected by the need to provide adequate emergency operations and management for the Mont Belvieu and surrounding communities. The first source was a list of functions reflecting the National ITS Architecture for the development of a Management Center to provide Emergency Operations and ITS structures.

3.2.1 FUNCTIONS BASED ON THE NATIONAL ITS ARCHITECTURE

Most of the functions that could be included in the Management Center Plan were taken from the service packages associated with the National ITS Architecture ARC-IT Version 9.0. The National ITS Architecture ARC-IT Version 9.0 provides a common structure for the design of intelligent transportation systems. It defines the framework around which multiple design approaches can be developed, each one specifically tailored to meet the individual needs of the user, while maintaining the benefits of a common architecture. These benefits include:

- Simplifying integration of Intelligent Transportation Systems by presenting a common structure around which standards can be developed.
- Encouraging compatibility that will allow the same equipment to work over the entire country.

Adherence to the National Architecture ARC-IT Version 9.0 and its framework allows the establishment of an Intelligent Transportation System with a core group of functions that can be expanded to include additional functions in the future. By establishing the ITS Operations Plan for the City of Mont Belvieu in conformance with the National ITS Architecture, additional functions are not precluded from being added in the future, even if they are not included in the original set.

3.3 FINAL LISTING AND RANKING OF CANDIDATE FUNCTIONS

Table 3 .1 shows a base list of 30 candidate functions that will be considered and ranked for inclusion in the City's Management Center Plan. As previously noted, other functions may also be added in the future and during finalization of plan to be developed in general conformance with the National ITS Architecture.

The following criteria was used to prioritize system functionality:

- Three indicates that the system should have the functionality
- Two indicates that the system may have the functionality
- One indicates that the system may or may not need the functionality
- Zero indicates that the system does not need the functionality

These Functionality Statements were then sorted based on the ratings.

Table 3-1 — Listing of Candidate Functions

Service Package	Function	Ranking
AD1	The system should save City traffic data for future analysis	3
ATMS01	The system should collect traffic volume data for monitoring traffic flow and displaying real-time conditions	3
ATMS01	The system should provide video images of key locations	3
ATMS03	The system should provide better signal timing and signal coordination	3
ATMS03	The system should adjust signal timing based on real-time traffic data	3
EM02	The system should provide fire trucks with a green light at traffic signals	3
EM02	The system should provide ambulances with a green light at traffic signals	3
AD3	The system should facilitate the exchange of archived data with other agencies	1
ATMS03	The system should adjust signal timing based on real-time event data from major traffic generators	3
ATMS02	The system should collect the average speed of traffic on major arterials	2
ATMS06	The system should provide information to drivers using Dynamic Message Signs	2
ATMS08	The system should improve coordination among organizations that respond to accidents	3
ATMS08	The system should improve coordination among organizations dealing with traffic at special events	3
EM06	The system should support Amber Alerts and other wide area emergency notifications	2
AD2	The system should save data on other transportation activities within the city (Transit, Parking, etc.)	2
ATIS01	The system should push traffic data to travelers through enhanced pagers, cell phones, etc.	3
ATMS09	The system should help predict future traffic volumes	3
ATMS13	The system should monitor the operation of railroad grade crossings	3
ATMS16	The system should direct drivers to parking garages where space is available	1
CVO01	The system should include an automatic vehicle location system for Public Works Dept. vehicles	2
CVO01	The system should include an automatic vehicle location system for other City-owned vehicles	2
CVO02	The system should support the monitoring of material/equipment on Public Works Dept. vehicles	2
EM02	The system should recommend routes for emergency vehicles based on traffic conditions	3
EM09	The system should support coordination of evacuation plans	3
ATMS07	The system should exchange data with TxDOT and other local traffic agencies	3
ATMS15	The system should coordinate grade crossing operation with the railroad	1
EM01	The system should support the computer-aided dispatch of emergency vehicles	3
EM08	The system should support coordination of emergency response plans	3
EM10	The system should provide disaster-related traveler information	3
ATIS04	The system should provide traffic data for in-vehicle route guidance systems	3

Chapter 4

Determine ITS Project Options

4 DETERMINE ITS PROJECT OPTIONS

4.1 INTRODUCTION AND SUMMARY

Chapter 3 identifies the transportation problems and needs of the City of Mont Belvieu. Most of these functions are based on the National ITS Architecture. This architecture was developed to provide a common framework for, and support the development of, a wide variety of transportation functions and capabilities.

The objective of this chapter is to summarize the ITS Projects recommended for the ITS Operations Plan Update. Intelligent Transportation Systems (ITS) provide a way of improving transportation through advanced technology and information systems that maximize the safety and efficiency of the transportation infrastructure.

The City's ITS strategy supports a range of operational areas such as traffic management, incident management, interagency coordination, and traveler information. Strategies focus on implementation opportunities for the three-year operations plan for deploying and integrating the most beneficial ITS plan for the City of Mont Belvieu.

ITS strategy has identified functional priorities for the City of Mont Belvieu to achieve the goals established as part of the strategic planning process. The process to develop ITS projects considered stakeholder needs, priorities, other transportation projects and initiatives already underway in the city. The timeframes identified within the strategy development process builds in flexibility to accommodate available funding.

The project discussions in this chapter provide brief descriptions of these projects, identify their relationships to the functional requirements, and summarize their benefits.

4.2 IDENTIFICATION OF PROJECTS

Based on stakeholder and staff input, several project types have been developed for achieving Mont Belvieu's Emergency Operations and Traffic ITS visions, goals, and objectives.

This Operations Plan will provide the City of Mont Belvieu with a summary of resources, guidelines and recommendations for phased implementation, future standards and expansion of devices and operational capabilities for the next few years.

Listed below are the proposed ITS Projects identified for implementation over the next three years beginning in Fiscal Year 2023:

- ✓ ***Traffic Management Center Emergency Operations including Master Software, ITS Equipment & Intersection Integration***
- ✓ ***Upgrade Intersection, Local Software, and Intersection Detection including Fiber Communication Equipment (Controller, Cabinet, Detection and Cameras)***
- ✓ ***Traffic Signal Standard Details for Construction (Future Signal Designs & ITS equipment needed)***
- ✓ ***Signal Timing Optimization Program (All Signals within City) (Updating Timing Plans including Events)***

- ✓ ***Installation of DMS for Emergency Operations Messaging linked to TMC***
- ✓ ***Wireless Communication (out of existing fiber range) - Only If Needed (Fiber limited areas)***

4.2.1 INTELLIGENT TRANSPORTATION SYSTEM (ITS) - CAPITAL IMPROVEMENT PROJECT

With ITS, advanced technology is used to coordinate signals, improved traffic progression, reduce incident clearance times, improve real-time traveler information, improve progression, and enhance special event traffic management and more. ITS guides the deployment, management, and operation of advanced traffic management technology within the area while serving as an educational tool. The actions described below will enable the city to satisfy the ITS vision as described in this plan. This ITS plan is designed to maintain, geographically expand, and strengthen the overall ITS system, which is vital to the continuing success of the City of Mont Belvieu's ITS program and continued smooth functioning of the City's transportation network. Budget and resources permitting, leveraging the ITS system to provide expanded ITS services may be accomplished as well.

Some initial projects will be required to perform the detailed engineering required for the

preparation of the plans and procurement documents for a number of these projects. Refer to Appendix for Intelligent Transportation System (ITS) – Capital Improvement Project sheets for all proposed projects. These project sheets show the project description, anticipated benefits, and estimated costs.

Traffic Management Center Emergency Operations including Master Software, ITS Equipment & Intersection

Management Center:

The new Management Center (TMC) will be located at in Existing City Hall Building along with other city facilities. The TMC will include the latest technologies and equipment to help provide the citizens of Mont Belvieu with improvement in emergency operation safety and congestion. With more people relocating and visiting the city, advancements in the latest technology are needed to enhance the quality of life in the community by a commitment to excellence in the delivery of the City's public service and emergency operations. The TMC will mitigate situations and provide better response on along all the City of Mont Belvieu's current and future roads. The new technology will improve the accuracy and time in alerting proper authorities of an accident, alerting travelers of congestion along routes, will provide better data collection, and management. Other improved operations include traffic signal management, inclement weather response, prioritizing signals for emergency vehicles, reporting incidents to the proper authorities, natural disaster evacuations, and maintaining equipment. Finalize city's Architecture Plan for regional connection and enhanced future ITS operations.

Some of the key features needed for TMC will include:

- Presentation Capabilities (Larger Wall Monitors and Seating)
- Incident Command Center Capability
- Efficient operations of personnel
- Extra screens for additional monitoring of multiple potential incidents along Evacuate Routes
- Extra command stations and furniture for additional personal & Conference space
- Can push feeds to other City Buildings

The Management Center (TMC) location will have a main console using Windows-based control workstations with central management software, which is designed around a cross-platform client-server architecture based upon the TCP/IP architecture, which utilizes IP addresses. The software shall be capable of a vast array of features. The TMC design shall allow for simultaneous NTCIP and/or local devices to attach through a distributed central system. The central software shall support any TCIP/IP based network at 10 – 1,000 megabits. The management center shall be equipped with video boards multiple working stations and conference area for emergency personnel to gather. Main communication will run through existing fiber installed by the city but may require additional drops and IT equipment.

Upgrade Intersection, Local Software, and Intersection Detection including Fiber Communication Equipment (Controller, Cabinet, Detection and Cameras)

Upgrading Traffic Signal Detection:

Currently there are existing video VIVDS (camera) detection at local intersections. Cameras establish zones that measure the presence of a vehicle and the amount of time the vehicle occupies the zone. The City's future system and intersection detection including mid-block detection (when needed), needs to provide complete and accurate coverage of the major links in the city traffic signal network. This project will provide for new detectors that can be installed below and/or above the roadway depending on field conditions, like weather, roadway conditions and geometry. Refer to **Table 4.1** for comparisons and evaluation of several types of modern technologies for vehicle detection.

Table 4-1 — Vehicle Detection Evaluation Matrix

									Approximate Cost		
Technology	**Data Collected**	**Power Supply**	**Lane Closure for Installation**	**Mounting Configuration**	**Calibration Difficulty**	**Signalized Intersection Application**	**Arterial/ Freeway Application**	**Accuracy**	**Intersection (per approach) [1]**	**Mid-block or Freeway (per location) [2]**	**Maintenance Difficulty**
Wireless Magnetometer	•Volume •Speed •Occupancy	DC Power for Access Point; Battery for Sensors and Repeaters	Yes	Sensors in roadway surface; Access Point and Repeaters mounted	Low	Yes	Yes	Very Good	$10,000 - $12,000	$10,000 - $13,000 [4]	Low
Radar	•Volume •Speed •Occupancy •Classification	DC Power or Solar	No	Overhead or Side Fire	Moderate	No	Yes	Very Good	$13,000 - $15,000	$12,000 [5]	Low
Microwave	•Volume •Speed •Occupancy •Classification	DC Power or Solar	No	Overhead or Side Fire	Moderate to High	No	Yes	Very Good	NA	$13,000 [5]	Low

Assumptions:

1) Intersection Approach Cost: Assumes 1 left, 2 through, 1 right turn lanes, with advanced detection.

2) Mid-block Cost: Assumes 3 lanes of traffic in one direction.

3) Assumes 2 loops/zones per lane for speed.

4) Assumes 2 units per lane for speed.

5) Assumes 1 unit with solar on existing pole with wireless to the controller cabinet

Accuracy of detection is extremely important for speeds, counts, occupancies, and classifications. Using accurate vehicle detection for traveler information and/or data collection has become increasingly prevalent for the future of ITS. All the data will be used to program different ITS equipment like: Dynamic Message Signs, traffic signal progression, emergency response systems, and others.

Based on the characteristics presented in the evaluation or comparison matrix, radar and wireless magnetometers are recommended as the primary detection technology for the city going forward.

Other detections are recommended depending on field conditions, weather, roadway conditions, geometry etc...

The major benefits of the new system and intersection detection are:

- Provide traffic data such as volume, TMC, speed, and occupancy
- Assist in the development of traffic signal timing
- Typically, single input per lane, although can have multiple lanes per input
- Enhance traffic adaptive control capability
- Single detector/zone per lane
- Will have the capability to generate a congestion map based on detector data from the field.

Upgrading and Future ITS Cabinets

With the future implementation of Advance Transportation Controllers (ATC), this controller is adaptable and will provide the power needed for more advanced adaptive control strategies. It will also provide a platform for allowing the traffic signal controllers to capitalize on the advances in computer technology with minimal impact on the software investment.

Along with the implementation of the ATC controller, the city should consider further development and future implementation of the new ITS cabinets along with the installation of future traffic control devices. The cabinet provides the communications paths between the various subsystems, as well as a system to monitor their operation. Further, the cabinet provides power supplies suitable for the various electronic subassemblies mounted throughout the cabinet.

The new cabinets will focus on providing necessary space for the existing traffic control technology of past practices. In addition to providing existing functions, the development of additional special function-oriented assemblies to support some of the cities ITS of the future. The future cabinets shall be developed based off the latest ITS Cabinet Standard v01.02.17b and/or future ITS Cabinet Standard v2.0, which is currently under development.

- Some key features that will be required of the ITS Cabinet(s) are: 48VDC or 24VDC which can save energy (energy efficient) and interchangeable modular parts like load switches and flasher relays.

Most of the controller cabinets are NEMA TS-2 with some NEMA TS-1 cabinets. In addition to traffic signal control components, the cabinets are also equipped with a UPS system and are in good working condition.

Advanced Transportation Controller (ATC)

For future and some existing locations, the implementation of Advance Transportation Controllers (ATC) will allow easy integration of the many new technology devices that may become available in the future. The ATC is more powerful, adaptable and can provide the power needed for more advanced adaptive control strategies. It will also provide a platform for allowing the traffic signal controllers to capitalize on the advances in computer technology with minimal impact on the software investment.

The ATCs are intended to be compatible with or inclusive of existing (present day) traffic controller capabilities. As a first step in the implementation process, all proposed and/or modified traffic signal intersections can be easily upgraded to the ATC. The second step in the implementation process will require the replacement of intersection controllers with the ATC. The phased replacement of controllers can begin with the major arterials.

Some ATC key features required:

- meet ITE ATC 5201 v06.10
- high resolution data loggers (rated at 1/10 of a second)
- time resolution to the nearest 100 milliseconds
- record Performance Measures Data (Enumerations)
- upgraded server (more memory for central system)
- compatibility with the central system
- compatibility with existing cabinets (if applicable)
- more feature to be identified

The following outlines the approach recommended for ATC selection and migration:

- Define needs and requirements
- Evaluate as many controllers as possible
- Involve maintenance and operations staff in the process
- Bench test controllers
- If possible, field test controllers
- Consult with other agencies

The benefits of the Advanced Transportation Controller (ATC) project would include:

- Interchangeability between manufacturers
- Improved competitive pricing
- Better adaptability to advances in technology
- Cost effective and modular construction
- Ensure interoperability within systems
- Provides well defined controller testing requirements
- Improved internal programming features
- Open architecture
- Recoverable software investment
- Flexible hardware platform

CCTV Cameras Integration (Video Cameras for Incidents)

Under this project cameras will be installed at locations most likely to experience congestion and high incidents. These include locations that experience daily traffic congestion because of commuting patterns, locations near parks, high school stadiums and other venues where special events take place on a periodic basis. The sites will be integrated with video streaming technology to provide links to the planned CCTV surveillance cameras to the proposed Management Center. Any supplementary hardware and software required to support this integration will be provided by this project. These

cameras will enable the engineers at the Management Center to adjust traffic signal timing in response to real-time events. These could be accidents, weather emergencies, evacuation emergencies, and special events that cause anomalies in the normal patterns of traffic flow. The cameras would also enable operations and staff to assist trouble calls from citizens in a timelier manner.

Traffic Signal Standard Details for Construction (Future Signal Designs & ITS equipment needed)

The updating of Traffic Standards and Specifications are needed to provide current and consistent public works construction traffic standards for public works infrastructure projects within the city limits. The City of Mont Belvieu Traffic Standards and Specifications should include design standards, standard drawings, general conditions, special provisions, and supplemental specifications when needed. These documents will establish the design and construction standards for any future Capital Improvement Projects (CIPs), maintenance projects, and private development projects. They will be utilized by both City Staff and the community, including engineers, developers, consultants, and others. The City's current specifications do not include Traffic specific standards and will be needed to supplement the Management Center and upgraded Traffic/ITS equipment.

Signal Timing Optimization Program (All Signals within City) (Updating Timing Plans including Events)

Signal Timing Optimization

Optimized signal timing is a highly effective low-cost approach to reducing congestion. Benefit-cost ratios as high as 40-to-1 can be realized after traffic signal retiming is performed. This project will include inter-jurisdictional and extraterritorial jurisdiction (ETJ) signal coordination, as well as evacuation route timing plans.

Studies will include inventory and operational assessment of traffic control devices as well as recommendations for geometric improvements. Specialized timing plans could be developed for special events that are known in advance and detour routes that can be used when there is a major incident in the city or on major Highways. These timing plans would minimize delay, fuel consumption, and emissions that occur when these activities take place.

The timing plan effectiveness will be enhanced by the implementation of several of the other recommended projects, but optimization efforts can begin on key City corridors at any time.

The National Traffic Signal Report Card published by the National Transportation Operations Coalition indicates the following:

Inefficient traffic signal operations affect the traveling public in many ways:

- Drivers pass through a green light at one intersection only to be stopped by a red light at the next intersection. Inconsistent travel on surface streets causes frequent stops and unnecessary delays. Intersections should be coordinated, and traffic signal timing plans updated based on changing travel patterns.
- Drivers must wait through more than one green signal at an intersection, causing long queues and clogged intersections. Traffic signal timing should be adjusted to manage traffic diverted from a work zone, crash, or special event.
- In addition to driver impacts, signal-related congestion has broader economic, social, and environmental impacts. Congestion not only wastes fuel, time, and money, but is also a significant

factor in shaping the quality of life for individuals and families. The real impact of congestion is felt in how and where people choose to live, how they commute and how much they pay for things resulting from the additional costs congestion imposes on society.

- Congestion causes the average peak-period traveler an extra 38 hours of travel time and an additional 26 gallons of fuel, amounting to a cost of $710 per traveler per year.
- As the consumers of the transportation system, everyday travelers observe these inefficiencies and know that something more can be done. Improving traffic signal operations must be a priority.

The city should review traffic signal and system performance continuously. Ideally, signal timing should be reviewed every year to evaluate effectiveness and efficiency. If necessary, a thorough signal retiming should be conducted. At a minimum, an operating agency should budget to retime traffic signals at least every three years, especially in developing areas and/or areas with sustained growth.

Installation of DMS for Emergency Operations Messaging linked to TMC

This project will install a series of permanently mounted dynamic message signs (DMS) at selected non-residential locations in the community. These signs would provide routing information for visitors entering the community, provide parking availability information and warn residents and employees of delays that can be avoided by using alternate routes. Dynamic message signs can change the message they display to reflect conditions or inform motorists of important information. The signs can convey information about emergency detours, emergency operations, roadway conditions, alternate routes, construction activities, or any information that may assist motorists in making decisions. Signs will initially be placed at select key locations within the city limits. The overall project benefits to area residents, employees and visitors are reduced delay, fuel consumption and vehicle emissions. The DMS will display emergency operations details, event guidelines, warnings, and other important data.

4.2.2 INTELLIGENT TRANSPORTATION SYSTEMS (ITS) – OTHER TRAFFIC OPERATION IMPROVEMENT

These additional traffic operation improvements will maximize the safety and efficiency of the transportation infrastructure.

Wireless Communication (out of existing fiber range) - Only If Needed (Fiber limited areas)

Only to be used when needed communication to outlining devices.

The wireless communications will connect to City structure hub/Building and will be connect to core element and the heart of the City's MBLINK system and program. The rapid exchange of information and the ability to remotely control field devices are extremely dependent on the performance and reliability of the communications network. The existing fiber communications network serves as an excellent foundation upon which to add data transmission bandwidth, management, and operation capabilities. The existing system's flexible and modular design allows efficiency in adding wireless communication or upgrading the system to meet future and changing needs. A comprehensive communication needs assessment should be conducted prior to adding any wireless system expansion.

Chapter 5

High Level Systems Architecture

5 High Level Systems Architecture

5.1 INTRODUCTION AND SUMMARY

One of the fundamental objectives are to provide travelers and system managers with information they can use to make effective decisions. For drivers, this may be information telling them that a road they expected to use is closed. It may be information that will enable an emergency agency dispatcher to dispatch the right number and type of emergency vehicles to an accident. Better information (knowledge) gives these dispatchers the power to do a better job. The high-level systems architecture identifies the organizational entities that are sending and receiving information to each other through improvements identified in the City's ITS Operations Plan.

In a sense, this architecture provides the overview of how the various projects in the management Center Operations Plan will work together to enable the exchange of information to offices within the city and to agencies and organizations outside of the city.

It provides the City of Mont Belvieu with an overview of the organizational entities that will be linked together through the Management Center Plan and the information exchanged between these entities. It also indicates the communication links to be implemented by the Public Works Department and those to be implemented by other City Departments and other agencies.

5.2 FUNCTIONS AND SERVICE PACKAGES

The high-level system architecture for the city will be based on the ITS functions that will best fit the city's ITS needs and emergency operations.

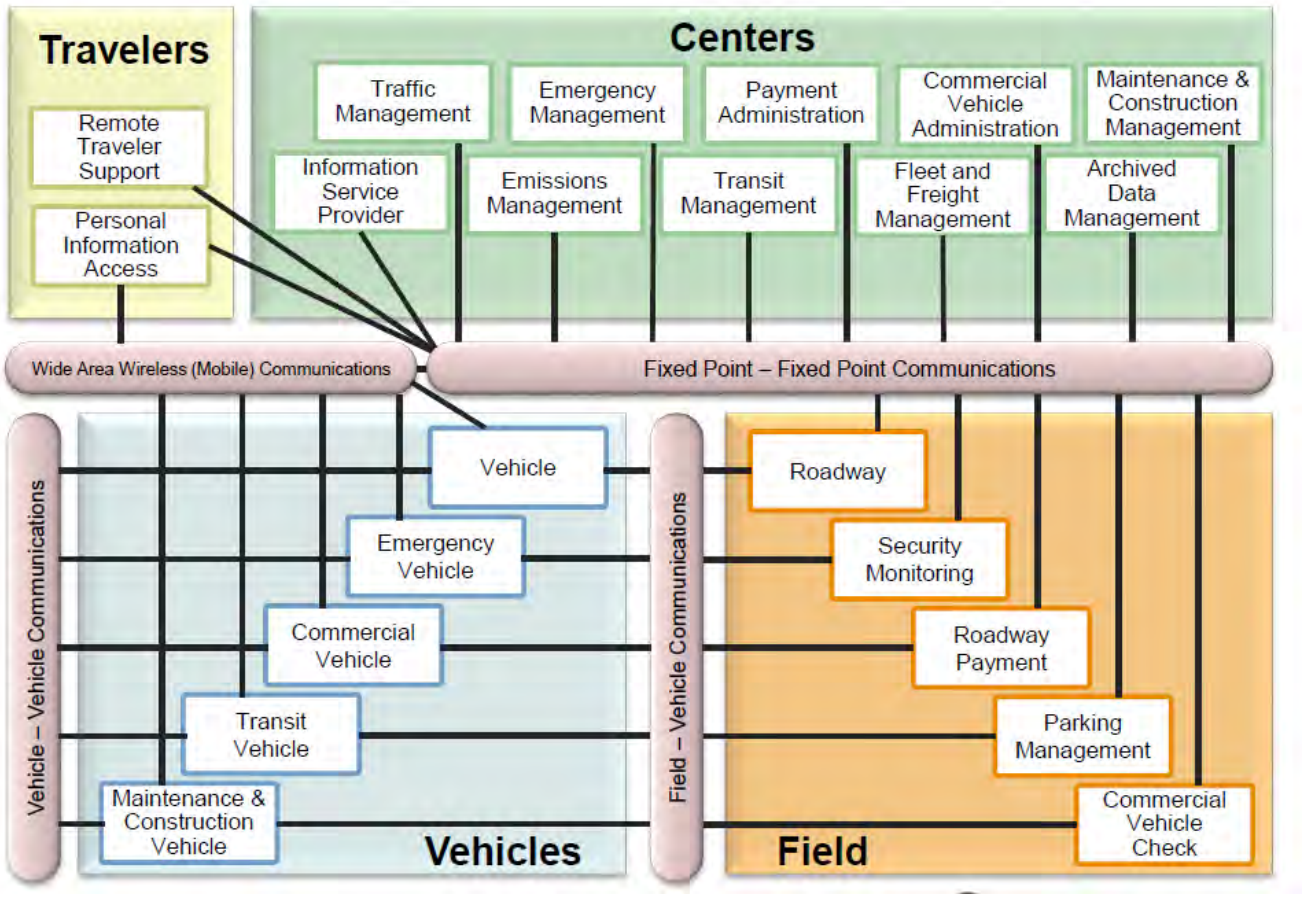
Service Packages represent slices of the Physical View that address specific services like traffic signal control. A service package collects several different physical objects (systems and devices) and their functional objects and information flows that provide the desired service. Refer to https://www.arc-it.net/html/servicepackages/servicepackages-areaspsort.html for Packages. Functions shall be ranked by a steering committee and applied to drawings.

5.3 DEVELOPMENT OF HIGH-LEVEL ARCHITECTURE DRAWINGS

The High-Level Architecture and its associated diagrams can be assembled with the aid of the "ARC-IT Version 9.0" SET-IT software. This software tool, developed by the National ITS Architecture Team, is a high level, interactive software program that aids transportation planners and systems integrators in the development of a Regional and/or Project ITS Architecture. The application will utilize user inputs and information from the National ITS Architecture databases to provide users with tabular and graphical outputs comprising a high-level representation of their Regional or Project Architecture.

The development of the high-level architecture can be performed in the step sequence built into the program and fit any city's needs. **Figure 5-1** shows the National ITS Architecture as a base to show how Mont Belvieu Management Center will be built based on Service Packages for Traffic Signals, Surveillance, data collection and other to be determined.

Figure 5-1 — National ITS Architecture



5.4 DEVELOPMENT STEPS

STEP 1 – Input Data

The High-Level Architecture and its associated diagrams will be assembled based off Arc-IT 9.0 and SET-IT software and can be linked to any Regional Architecture like HGAC. Through this type of dialog, the basic characteristics of the Mont Belvieu Management Center Plan can be entered into a program for the organizational "entities" listed below:

Mont Belvieu Traffic Management Center
Mont Belvieu Emergency Management Center
Mont Belvieu Public Works Department
TxDOT Beaumont ITS
Chambers County Public Works
Liberty County Public Works
Houston Galveston Area Council
Other Entities

The program uses the nature of the entity (traffic management center, emergency management center, transit management center, etc.) and the responses to the questions in the dialog to make an initial determination of the market packages that are included in the architecture.

Although the dialog is extensive, it does not cover all the service packages and the functionality included in the National ITS Architecture. A supplementary data input procedure in the software will be to add the additional service packages selected for future additions.

Step 2 – Build an Un-customized Architecture

provide a brief description of the information exchanged within the architecture, identifying the source of the information and the destination of the information. At this step, the program identifies all the flows that are included in the architecture based on the inputs from Step 1.

In the final Architecture for the City of Mont Belvieu Management Center Plan, city will determine interconnections between entities. These interconnections are the links between two entities transmitting one or more pieces of information from one entity to the other in either direction.

Step 3 – Customize the Architecture

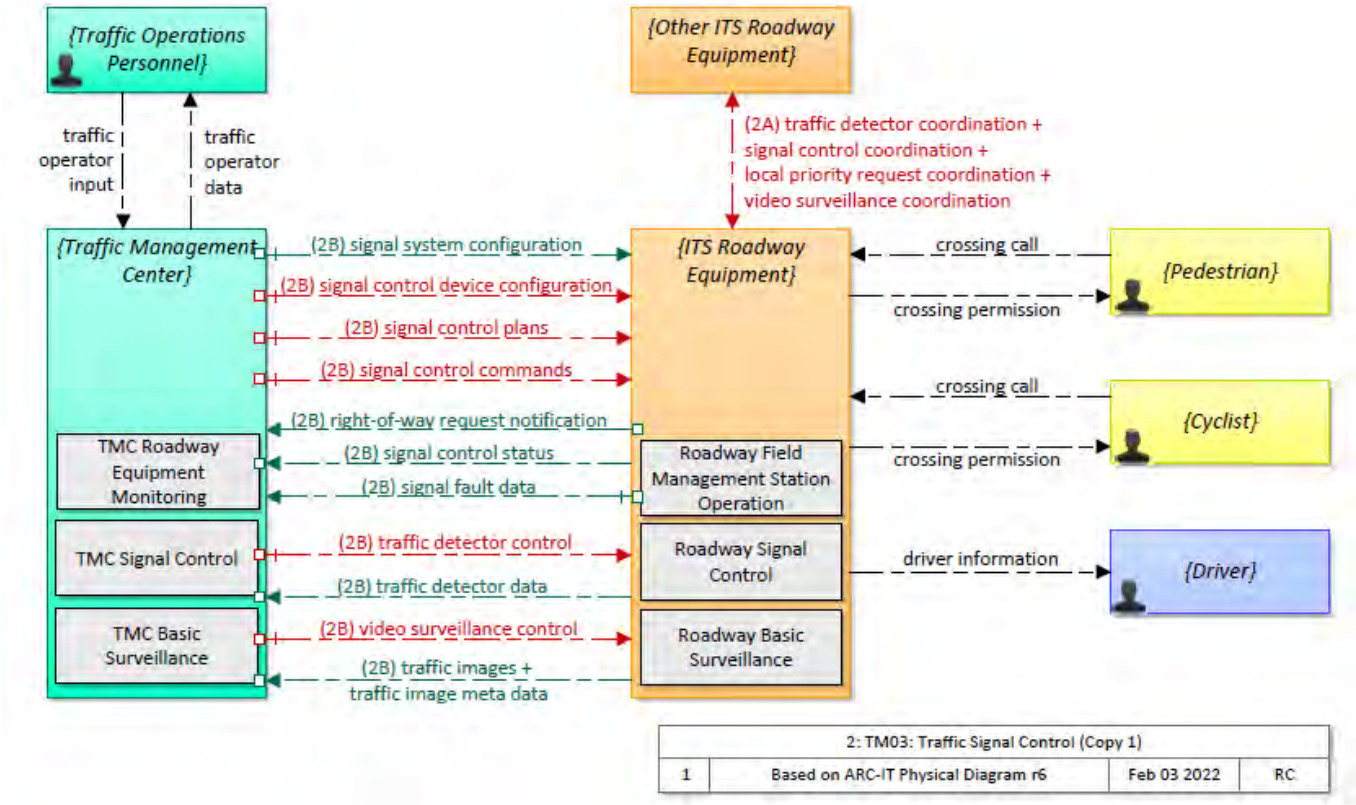
This is the most intensive step. The Architecture will be customized through an iterative process in which the interconnections between the entities, and the architecture flows, will be reviewed to determine if they could be eliminated from the City's ITS Architecture or if additional entities, interconnections, or architecture flows were needed.

Most of the activity in the customization of the Architecture will involve deleting interconnections and architecture flows that were included by the program because they are part of the full implementation of a service package. These are typically not part of the more limited implementations of these market packages envisioned in the City's Architecture. A basic run of Mont Belvieu Service Packages in located in **Appendix B**. SET-IT 9.0 was used to generate this set of Architectural Project Diagrams that are a base of operations to be used. SET-IT is a free software provided by the U.S. Department of Transportation.

Step 4 – Generate Outputs

In this step the results of these activities are documented. There will be a series of iterations involving Step 2, Step 3, and iterations. The results of these efforts are shown with the aid of a series of diagrams that were produced by the Turbo Architecture Program.

A basic run of Mont Belvieu Service Packages outputs is in **Appendix B**. Sample below:


{Traffic Operations Personnel}
{Other ITS Roadway Equipment}
traffic operator input
traffic operator data
(2A) traffic detector coordination + signal control coordination + local priority request coordination + video surveillance coordination
{Traffic Management Center}
{ITS Roadway Equipment}
(2B) signal system configuration
(2B) signal control device configuration
(2B) signal control plans
(2B) signal control commands
(2B) right-of-way request notification
(2B) signal control status
(2B) signal fault data
(2B) traffic detector control
(2B) traffic detector data
(2B) video surveillance control
(2B) traffic images + traffic image meta data
TMC Roadway Equipment Monitoring
TMC Signal Control
TMC Basic Surveillance
Roadway Field Management Station Operation
Roadway Signal Control
Roadway Basic Surveillance
crossing call
crossing permission
{Pedestrian}
crossing call
crossing permission
{Cyclist}
driver information
{Driver}
2: TM03: Traffic Signal Control (Copy 1)
1
Based on ARC-IT Physical Diagram r6
Feb 03 2022
RC

Chapter 6

Staffing

6 STAFFING

INTRODUCTION AND SUMMARY

This chapter documents the results of a review of the City's existing staffing levels within the Engineering and Public Works Operations Division. Dedication of adequate resources for operation and maintenance is required to fully realize the capabilities of the Advanced Transportation Management System and other ITS devices.

6.1 REQUIREMENTS FOR STAFFING

The staff needed to operate a traffic management part of the center is identified by **Figure 6.1**. To determine the adequacy of the present staff to operate and maintain the City's existing ATMS and planned ITS components, an evaluation was made of the City's traffic operations staff. Consideration of the requirements for staffing should include:

- City Staffing for Emergency Operations
- City Staffing for Website and Maintenance, Cameras and DMS
- Outsource staff based on number of signals

6.1.1 STAFFING FOR OPERATION

Staff will be responsible for tasks associated with new system implementation such as scheduling, conflict mitigation, updating timing plans, developing, and updating traffic timings, testing, inspection, addressing issues, conflicts, and system evaluation. System operations personnel are responsible for daily system monitoring, observation of intersection operation, control of system access, and maintenance of files and documentation.

Table 6-1 — Staffing for Operation in Other Cities

Number of City Signals			
Staff Position	**25 Signals or ITS Devices**	**150 Signals or ITS Devices**	**800 Signals or ITS Devices**
Signal Systems Manager	1 Manager/Engineer	1 Manager	1 Manager
Signal System/ITS Engineer	0	1 to 3	3 to 6
System Technicians	1	2 to 4	4 to 8
System Analysts	1	2 to 4	4 to 8
System Operators	1	2 to 4	4 to 8
Field Technicians or Workers	2 to 4	4 to 10	20 to 50

A survey of several cities revealed the following information on the number of personnel required for the operation of their systems. Mont Belvieu has experienced rapid growth in the last decade, with expectations for that trend to continue. Field Technicians and operators may be more beneficial to outsource when signals/devices of less than 25.

Table 6- 2 - Recommended Staffing for Operations and Maintenance

Staff Position	Recommended Number
Traffic Operations Manager / Supervisor	1
Traffic System Technicians / Operators	
Field Technicians	
Engineer I, II or III (Traffic)	1

Positions should be filled or outsourced as this management Operations Plan is approved and implemented. Current providers of Central Management software also can provide outsourced operations of devices and issues that arise. Based on number of signals on projected project plan, outsourcing is recommended but should be evaluated based on price, quality, and efficiency. Signal Optimization and plans can be outsourced as needed for events and updating signal timings.

Staffing Duties

Though each authority may have a unique way of referring to each employee or classifying their duties, the categories below are quite typical:

Traffic Operations Manager/Supervisor

The manager and staff evaluate and provide information about the program to upper management and communicate requirements and concerns to the organization. Staff will ensure Operational Procedures are developed, reviewed, implemented, and revised. Staff will also ensure that the technicians, operators, and wireless engineers are aware of the operational requirements of the system and technology.

Field Technician

The Signal Field Technician will be certified to perform and/or direct signal and equipment repair and may assist with signal timing. The technician would have IMSA Level II Certification which ensures the individual has additional training on traffic signal control system troubleshooting, on- site repairs, and maintenance methods and equipment.

Engineer I, II or III

This staff member would support the operation of the network management and video surveillance components of the ITS network and should be made available to assist with the design, installation, and testing of the network at the outset, and assist with the supervision, inspection, and maintenance of the network when field visits to the individual sites are required. This Engineer would also be responsible for the development of signal timing plans and maintenance of signal coordination.

6.1.2 STAFFING FOR MAINTENANCE

In addition to the engineering and operation staff analysis presented in Table 5.1 and Table 5.2, an additional assessment was made of the adequacy of the existing staff and on call maintenance signal contract to support on-going field equipment issues and yearly maintenance program. The installation of the recommended projects is expected to have the following effect:

- Increased maintenance requirements due to the installation of new higher tech equipment, additional system detectors and more sophisticated communications equipment.
- Decreased maintenance requirements due to the upgrade of traffic signal controllers to Ethernet-capable units.

Decreased maintenance requirements for system communications should moderately offset increased maintenance requirements for system detectors, ITS devices, and system functionality. **Table 6.3** shows the results of a literature search regarding maintenance staffing levels for other cities.

Table 6-3 — Maintenance Staffing in Other Cities

Survey Source	Number of Signals per Technician
NCHRP Synthesis 371 – Managing Selected Transportation Assets	30 to 40 signals per technician
Hampton, Virginia Survey	76 signals per technician
Menlo Park, California Survey	50 signals per technician
FHWA Computerized Traffic Signal System Training Class	40 to 50 signals per technician
2007 National Traffic Signal Report Card, average of six case study cities (Average City grade = C+)	50 signals per technician
ITE Operations Handbook	17 to 27 signals per technician
National Average	40 signals per technician

6.1.3 TRAINING FOR NEW STAFF

A significant amount of initial training will be required to ensure that the staff is qualified to operate and maintain new equipment. Training will be provided on operation of new central system modules, Ethernet hardware and communications, wireless communications equipment, and new systems hardware and software as they are installed and implemented.

The system or equipment provider will provide initial training. If turnover or retirement in City personnel is expected, then the Contract Documents could require additional system and controller training by the manufacturer, one year after acceptance.

There is a rapidly growing tendency of software vendors to provide professionally created training on-line or on CD-ROM/DVD. Most jurisdictions promote operators “from within,” finding intelligent, eager engineers or technicians. They are then brought “up through the system,” by increasingly more difficult assignments. In addition to the above training methods, the new operator can sit side-by-side and be “talked-through” various system activities.

6.1.4 SUMMARY

It must be recognized by the city that full utilization and capabilities requires a firm commitment of adequate personnel for the maintenance and operation of all systems and components. It must also be recognized that adequate training in Operations and Maintenance is critical to the success of the Management System.

Chapter 7

Performance Measures

7 PERFORMANCE MEASURES

7.1 CONTEXT

The Management plan is an important part of managing the City of Mont Belvieu's cyber- environment in terms of traffic safety and management, evacuation and emergency services, and other city services that depend upon Intelligent Transportation Systems.

7.1.1 PURPOSE OF PERFORMANCE MEASURES

Performance measurement is an integral part of transportation system management. Performance measures provide accountability to the public, improve communication between operators and users of the system, and will assist in the City's delivery of transportation services. Performance measurement in transportation can be used to set policy, allocate resources, and report on results (before/after analysis of improvement projects).

7.1.2 CURRENT STATE OF THE PRACTICE

The National Cooperative Highway Research Program's (NCHRP) defines performance measures in the following manner:

…the use of statistical evidence to determine progress toward specific defined organizational objectives. This includes both evidence of fact…and measurement of customer perception…performance measures should reflect the satisfaction of the transportation service user, in addition to those concerns of the system owner or operator.

Available online: Operations Performance Measurement - FHWA Operations (dot.gov)

The three primary types of performance measures used to manage operations are based on the latest literature in the industry and revolve around the following three questions:

- How well is the system operating in meeting the stated objectives of the system?
- How well do the owners and operators of the system believe it is operating?
- How well do the users of the system believe it is operating?

The use of performance measures provides a valuable tool to the owners and operators in continuing to improve the types and levels of service while staying within the budget of time, money, and human resources that are available.

Performance measures for each of the subsystems are a critical part of managing the subsystems and the overall system effectively. System and subsystem priorities were established by the original steering committee and were grouped to match the National ITS Architecture that is the industry standard.

7.2 METHODOLOGY

All performance measurement systems require a consistent process that includes monitoring, data collection, and user/operator input. Typically, performance measurements are taken on a quarterly and annual reporting cycle to streamline the process and keep the operating and evolving as the transportation system operates and evolves. This evolution can be maintained at optimal levels given careful use of available budget, staff, and the City of Mont Belvieu's transportation needs and priorities.

7.2.1 PROCESS

Monitoring

Successful performance measures require consistent monitoring to identify chronic, acute, and inherent issues in the system. This requires both the automatic collection of system statistics and the collection of any specific data needed to monitor, evaluate, and calibrate the system.

Data Collection

Data collection includes the system statistics that can be automatically collected by the system itself along with quarterly project reporting, annual operator reporting, and biennial customer surveys that are built into the City's existing citizen survey process. The system can be programmed to log basic operating information to provide baseline characteristics.

Quarterly Reports

Quarterly project reports will be prepared to provide an opportunity for pro-active management of chronic issues before they reach an acute state or exacerbate or become emergency situations. This continuous system monitoring allows operators to optimize the functionality and performance of the systems.

Annual Reports

Annual reports will be provided to the City Manager and the City Council by the Public Works Department as part of the annual budget cycle. These reports will incorporate summaries of the automated quarterly reports with results and recommendations for future improvements. The annual report will include the following as a minimum:

- Project Reviews
- Customer Satisfaction
- System Assessment
- Traffic Flow Measures

The completed report will provide information to the City Manager and City Council about the overall functioning of the system as perceived by system users in other departments. The Biennial Customer Survey (currently not conducted) will provide information every other year for users such as citizens and travelers.

7.3 METRICS

Performance Measures can be organized in several unusual ways depending upon the needs of the operators and users of the system. Overall System Metrics are of primary interest to the city leaders in monitoring overall performance and achievement of City goals and priorities. Project metrics revolve around the performance and implementation of specific projects and how well the projects are meeting the needs of the operators and the users. Functional metrics are organized around the subsystems and rely heavily on automated self- monitoring and quarterly and biennial monitoring of customer service.

7.3.1 CUSTOMER SERVICE

Customer satisfaction is a qualitative measure of customers' (citizens and travelers) opinions related to

the management and operations services provided in a specified region. The City of Mont Belvieu can complete a public outreach survey every two - four years to obtain information regarding the quality of service being provided by the traffic management operation. **Table 7.1** at the end of this chapter lists sample questions to be used or can be updated accordingly. Industry literature poses related questions and can be used to formulate additional questions, as necessary.

7.3.2 SYSTEM ASSESSMENT

The annual report should present an assessment of the performance of the City's program in meeting the established goals and objectives. **Table 7.2** - Annual System Assessment provides a rating scale for annual review based on the original goals of the system. Preferably, the annual assessment will be performed by an independent or third party.

7.3.3 TRAFFIC FLOW MEASURES

Traffic flow performance measures directly quantify the flow characteristics of the roadway based on physical measurements. Traffic flow performance measures are all derived from speed, travel time, and/or volume data. Of the various Traffic Flow Measures, travel time is the primary and dominant measure used. Its ease of application and inherent understanding by the traveling public provides the greatest benefit for application and reporting purposes. Other traffic flow measures include speed, throughput measures, reliability, delay, and congestion measures. Travel time and throughput data should be collected on the following major arterials:

- Eagle Drive
- Perry Rd, after widening and extension
- SH 146, if applicable

Table 7.3 presents a summary of the traffic flow performance measures for the Mont Belvieu system. As the system is implemented and matures, other performance measures should be reviewed for use in evaluating the system.

Table 7-1 — Biennial User Survey Sample Questions

	Original Focus Group Questions	Response	Additional Questions or Comments
1	What does "traffic mobility" mean to you?		
2	What is the biggest challenges relative to traffic in Mont Belvieu?		
3	Describe your commute/your family member's commute to/from work-the positive, the negative aspects.		
4	When is your ability to get around town the best?		
5	When is your ability to get around town the worst?		
6	What has been your very worst experience with traffic in Mont Belvieu?		
7	Describe the traffic in your neighborhood-any concerns, issues, etc.		
8	What is your source for information about traffic conditions in your area/on your commute route?		
	a. How often/when do you seek information about traffic conditions?		
	b. How reliable is the information?		
	c. How important is getting better information about traffic conditions?		
9	Who should provide information about traffic conditions? The city, TxDOT, County, Others?		
	a. From which of these sources, if any, do you receive information about traffic conditions?		
	b. How do you receive it?		
10	How would you like to receive information about traffic conditions?		
11	What is your opinion/perception of traffic signs in the community?		
12	Have you been to other places where traffic has worked well/better than you feel it working in Mont Belvieu?		
	a. Where was it? Describe what made it work well.		
13	What areas of the city are you most concerned about for future traffic/mobility?		
14	Other comments/suggestion about mobility/traffic management.		
	Satisfaction Questions (based on system goals)		
	In the past three years, has traffic congestion gotten better, worse or stayed about the same in the greater region?		
	In the past three years, has traffic congestion gotten better, worse or stayed about the same in the City of Mont Belvieu?		
	In the past three years, has traffic congestion gotten better, worse or stayed about the same in your neighborhood?		
	In the past three years, do you feel that the transportation system is getting safer, more dangerous, or staying about the same?		
	In the past three years, how often have you used transit? Never, Several Times, at least once a month, at least once a week		
	In the past three years, have you experienced a vehicular or pedestrian accident?		
	In the past three years, has any one in your immediate family experienced a vehicular or pedestrian accident in Mont Belvieu?		
	In the past three years, has your commute to work or school gotten longer in time, shorter in time or		

	stayed about the same?		
	In the past three years, has your commute to work or school gotten longer in distance, shorter in distance, or stayed about the same?		
	In the past three years, does your commute to work or school cost more, cost less, cost about the same?		
	Additional questions to be added based on current circumstances.		
Demographic Questions			
	What is the zip code of your residence?		
	What is the zip code of your work?		
	What is your age?		
	What is your Household Income?		
	What ethnicity do you consider yourself?		
	What level of education did you complete?		
	How many working vehicles is part of your household?		
	How many licensed drivers is part of your household?		
	How many people live at your address?		

Questions for the biennial customer survey can be selected from this list or can be used as models for other issues that arise.

Table 7-2 — Summary of Traffic Flow Performance Measures

ITS Assessment and Scoring			Rating Scale 1=No 3=Partially 5=Yes					
Number	**Function**	**Ranking**	**1**	**2**	**3**	**4**	**5**	**Score**
1	Does the system save City traffic data for future analysis?	4						
2	Does the system collect traffic volume data for monitoring flow and displaying real-time conditions?	4						
3	Does the system provide video images of key locations?	4						
4	Does the system provide better signal timing and signal coordination?	4						
5	Does the system adjust signal timing based on real-time traffic?	4						
6	Does the system provide Fire trucks with green light pre-emption?	4						
7	Does the system provide ambulances with green light pre-emption?	4						
8	Does the system facilitate exchange of archived data with other agencies?	3.7						
9	Does the system adjust signal timing based on real-time event data from	3.3						
10	Does the system collect average speed on major arterials?	3.3						
11	Does the system provide information to drivers using dynamic message signs?	3.3						
12	Does the system improve coordination among organizations that respond to accidents?	3.3						
13	Does the system improve coordination among organizations with special	3.3						
14	Does the system support Amber Alerts & other emergency messaging?	3.3						
15	Does the system save data on transit parking and other transportation activities?	3.0						
16	Does the system push traffic data to travelers on cell phones, pagers, etc.?	3.0						
17	Does the system help predict future traffic volumes?	3.0						
18	Does the system monitor operations of railroad grade crossings?	3.0						
19	Does the system direct drivers to space available parking garages?	3.0						
20	Does the system include an automatic vehicle location system for Public	3.0						
21	Does the system include an automatic vehicle location system for other City vehicles?	3.0						
22	Does the system monitor material/equipment on Public Works vehicles?	3.0						

23	Does the system recommend routes for emergency vehicles based on traffic conditions?	3.0						
24	Does the system support coordination of evacuation plans?	3.0						
25	Does the system exchange data with TxDOT and other traffic agencies?	2.7						
26	Does the system coordinate grade crossing operations with the	2.7						
27	Does the system support computer-aided dispatch of emergency vehicles?	2.7						
28	Does the system support coordination of emergency response plans?	2.7						
29	Does the system provide disaster-related traveler information?	2.7						
30	Does the system Provide traffic data for in-vehicle route guidance systems?	2.3						
							System Implementation Score =	
Percentage System Implementation Score =								
							Perfect system score (100%) = 486.5	

Table 7-3 — Traffic Flow Performance Measures

Performance Measure	Collection Method	Unit of Measurement	Sample Size	Application
Travel Time	Wireless data collection or Floating car method (GPS- based)	Minutes per segment	10 runs per direction during AM (7-9 am) and PM (4-6 pm) peak periods	Congestion tracking and assessment of signal coordination
Throughput	Fixed sensor (Vehicle detection)	Vehicles per hour	Monthly 7-day count by hourly intervals at 2 locations along each corridor	Assess maximum throughput productivity and indicator of facility utilization

7.4 COLLECTION METHODS

7.4.1 TRAVEL TIME DATA COLLECTION

Now, with the rise of the mobile phone, in particular the smartphone, hands-free kits in cars and tablet computers, it is becoming increasingly possible to monitor traffic flows using Bluetooth and Wi-Fi signals. While not all vehicles contain mobile phones emitting Bluetooth or Wi-Fi signals, the proportion that do is now high enough that, according to system suppliers, meaningful travel time data can be obtained by tracking signals from such devices. Probe vehicle techniques such as Bluetooth technology involve direct measurement of travel time (along a route or point to point) using data from a portion of the vehicle stream. This technology is based on collecting vehicle identification data and time stamps of vehicles passing a roadside reader device and checking against the last reader passed to determine the travel time between reader locations.

Although the City will continue to explore technologies such as Bluetooth for travel time data collection, manual methods such as the floating car technique will be used in the near term until a technology can be chosen and programmed for future use.

7.4.2 THROUGHPUT AND TRAFFIC VOLUME DATA COLLECTION

Accurate and reliable detection is the foundation for safe and efficient management of signalized intersections, ITS systems, and traffic data collection. Based on the characteristics presented in the evaluation of detection technologies presented in previous chapters of this report, inductive loops and wireless magnetometers will be the primary detection technologies for the city. These technologies will also be utilized to collect traffic volume data for system operations and performance measurement.

7.4.3 PERFORMANCE MANAGEMENT SYSTEM SOFTWARE

As the City continues to development and execute future consideration will be given to the identification and implementation of a Performance Management System that analyzes traffic data for comparative analyses and actionable information, and to automate the reporting of performance measures such as travel time, speed, throughput measures, reliability, delay, and congestion measures.

Chapter 8

Prioritized ITS Operations Plan

8 IMPLEMENTATION PLAN

8.1 INTRODUCTION AND SUMMARY

This chapter presents the Implementation Plan based on the work performed in all the prior tasks. This Plan summarizes the results and provides a guide for the implementation of a Management Center and ITS elements over the next three years. Our process to develop projects considered stakeholder needs, priorities, other transportation projects and initiatives already underway in the city. The timeframes identified within the strategy development process builds in flexibility to accommodate available funding. These projects are summarized in detail in the Appendix - Recommended Projects, which provides an assessment for each project that includes the following information:

- Project Description
- Benefits
- Cost Estimate

8.2 PROJECT PRIORITIZATION

The list of recommended projects was identified in Chapter 5 - Determine ITS Projects Options. In that chapter, the projects were described in terms of their relationships to the functional requirements. The plan provides the City of Mont Belvieu with a summary of resources, guidelines, and recommendations for phased implementation a management center and devices for operational capabilities.

8.3 PROJECT SCHEDULE

The anticipated sequence of project implementation by fiscal year is presented in **Table 8.1.**

Table 8-1 — Project Implementation Schedule

Project List	FY 2023	FY 2024	FY 2025	Comment
Traffic Management Center Emergency Operations including Master Software, ITS Equipment & Intersection Integration		✓	✓	Management Center to be installed with central software and necessary integration
Upgrade Intersection, Local Software, and Intersection Detection including Fiber Communication Equipment (Controller, Cabinet, Detection and Cameras)	✓	✓		Update existing intersections with local software, controllers, cabinets, detection, and Cameras
Traffic Signal Standard Details for Construction (Future Signal Designs & ITS equipment needed)	✓			Establish Standards and Details for Future intersection and ITS needs
Signal Timing Optimization Program (All Signals within City) (Updating Timing Plans including Events)			✓	Optimize signal timings on bi-annual basis for growth and pattern changes
Installation of DMS for Emergency Operations Messaging linked to TMC			✓	Implement message signs for emergency operations and event assistants
Wireless Communication (out of existing fiber range) - Only If Needed (Fiber limited areas)		✓		Accommodate future system outside of communication limits, when needed

A project cost summary by fiscal year is included in the Appendix.

8.4 IMPLEMENTATION PLAN GUIDE

8.4.1 OVERVIEW

The basic structure of this section corresponds to the standard sequence of materials included in a completed Implementation Plan, and most subsections are written as they should appear in the Plan.

Overall, this Implementation Plan demonstrates a serious commitment from the City and the stakeholders to implement, fund, construct, and perpetually operate and maintain the system for the City of Mont Belvieu.

8.4.2 LEGISLATION

If any features of a project conflict with existing laws, conventions, rules, or regulations, it may be necessary to generate legislative amendments or "enabling legislation" to facilitate construction and operation of that project. No hurdles of this type have been identified for any of the projects in the Mont Belvieu Plan.

8.4.3 SYSTEMS DESIGN

Systems Designer

The Systems Designer is to be determined by the city. There are several ways the city can design the projects and prepare the necessary Plans, Specifications, and Cost Estimates. They include:

- The city can design the system
- The city can select an experienced System Consultant to prepare the design
- The city can select a Design/Build Contractor
- The city can justify a sole-source purchase and installation of an "off-the-shelf" system, which is a variation of the first three items.

System Design Life

It is acknowledged that the design life of the system is about 10 years. However, some expendable items begin to fail at five to seven years, some control equipment may last 12 to 15 years, and heavy hardware (signal poles) may last 20 to 30 years. It is advised that the city begin thinking about the next generation (system upgrade or replacement) system after about eight years of operation.

System Coverage

All the signals under the control of the City of Mont Belvieu are included.

System Design and Operations/Maintenance Philosophies

The system itself should continue to monitor proper operation of on-street components, log failures and generate maintenance reports and work orders. The use of off-the-shelf computers, controllers, and other devices simplifies the maintenance and upkeep of the system. If something breaks, it is easy to make a direct replacement. The failed component should be returned for factory service or repaired off-line by City personnel. City personnel should also perform routine maintenance.

System Architecture

The central system and software will need to be modular so ITS features can be added, as necessary.

Integration with Other Functions

ITS features should be an integral part of the system. The central system is modular so that the ITS features desired by the city can be added with minimal disruption. System upgrades should be designed to be consistent with the H-GAC Regional ITS Architecture. Specifications should be based as far as possible on the National ITS Architecture. Being modular in nature, the system should be easily updated and upgraded through its design life. The system should be designed to provide for information sharing and even some control with TxDOT, surrounding cities, other agencies, and the public. National Standards have been addressed by using NEMA Standard controllers and by consideration of NTCIP.

System Components and Functions

The heart of the system is a networked, PC-based arrangement that forms the "Central Computer" that is connected via a communications server to the communications network and thence to the local on-street controllers. Using LAN, WAN, and the Internet, various degrees of access can be provided to other agencies, adjacent cities, and the public. The primary purpose of the system is to control traffic signals, DMS, cameras, and software modules should be added to the system to operate other desired functions.

Communication Subsystem Design Approach

The city currently has Fiber Communication along corridors that feed residential and commercial businesses. City owned MBLINK supplies internet services.

Traffic Operations Center Design Features

The Traffic Management Center will be in existing City Hall building.

Project Phasing/Scheduling

Previous sections of this document provided general descriptions of the features and location associated with each Project Group and the recommended construction phasing of the projects. Detailed write-ups and cost estimates have been provided for each group elsewhere in this Plan.

Design Review

Plans, Specifications, and Cost Estimates should be reviewed, revised as required, and finally approved.

8.4.4 PROCUREMENT

The method of procurement of for the identified ITS projects will have a major impact on the ability of the city to select the most appropriate system for its situation. Code of Federal Regulation, Title 23 requires procurement of ITS systems and components to be competitive, unless certain conditions are met. However, competitive procurement does not mandate "low- bid" procurement. In fact, in procurement of complex IT and ITS system, "low- bid" is inappropriate. The requirement for competitive procurement is satisfied through an RFP or similar process that allows for careful evaluation of the extent to which each requirement is met, and the suitability of the method used to satisfy the requirement. The evaluation process may also include consideration of costs to determine best value for money.

The requirements for a complex system may be classified as mandatory, desirable, and optional. All

should be considered in the evaluation. Very often, optional can be used to define requirements that will be important at a future date but need not be included in the package purchased at this time. This ensures that future system expansion and migration paths are not precluded by the initial system design and capabilities. In some cases where the city will be using a well-defined and proven specification, a low-bid procurement will be appropriate. Also, some system expansions may be limited to sole-source selections for system compatibility with an existing ITS system.

8.4.5 CONSTRUCTION MANAGEMENT PROCEDURES

Division of Responsibilities

Following development, review, and approval of the Plans, Specifications and Estimates (PS&E), and bid letting and contract award, the City's responsibilities in the implementation phase should include participation in tests of all equipment and software. The city should play an active role in inspection of equipment installations and the coordination of the contractor's activities with utilities. The City's inspection activities should include any system software as well as the hardware, and the city should provide advice and guidance to the Contractor as requested.

Scheduling and Establishment of Mileposts

The contract documents should state the contract time for completion. In the specifications, the contractor should be required to submit a detailed milestone/calendar schedule using an industry standard software package that is based upon critical path analysis or PERT. A licensed copy of the software should be provided to the city to track accomplishments and changes. The city (as well as the CEI Consultant if used) should approve the schedule.

Conflict Mitigation

The City's Project Engineer has the ultimate responsibility for strict but fair enforcement of the Contract Documents. City or State inspectors (or contract inspectors) should report to the Project Engineer. If the City has retained the Design Consultant into the construction phase, then that Consultant should assist with problems, decisions, and disputes. The most common problems involve errors in quantities, overlooked items, or inappropriate installation techniques. The solution to these problems is what "field engineering" is all about. Frequent meetings of the construction partners are important, particularly during the initial stages.

8.4.6 SYSTEM START-UP PLAN

Software Acceptance Tests

As stated in the system specifications that should be developed, the contractor should be required to submit for approval complete software and system acceptance test procedures. These tests should be performed in the presence of City personnel and an inspector (either TxDOT or a CEI consultant). All aspects of ATMS field and central firmware and software should be confirmed to still operate properly through acceptance testing, including:

- Local Intersection Program
- Upload/Download
- Central System Software Features

Again, every specification requirement should be verified. When failures or "action items" occur, the

contractor should have some period of time, usually about 30 days, to perform a "fix," and re-testing should be at the contractor's expense, including CEI consultant expenses, if one is used.

System Acceptance Tests

As stated in the system specifications that should be developed, the contractor should be required to submit for approval complete software and system acceptance test procedures. These tests should be performed in the presence of City personnel and an inspector. The system specification should require the provision of system startup equipment, which includes high-tech test equipment that should be used by the contractor during installation and the acceptance tests, but which become the property of the City.

The acceptance test procedure should verify the operation of every feature of the operational requirements. About hardware system acceptance, each feature of the entire network should be tested during the acceptance test.

Partial Acceptance

As permitted by City ordinance and TxDOT in the State's standard specifications, the contractor may request partial acceptance and payment for permitted equipment, installation, and software. Payments should be structured so that a substantial final payment is not made until final acceptance has been successfully completed. Final acceptance should only occur after the following:

All field and central equipment has been installed and tested.

All documentation has been completed, including manuals, warranties, wiring diagrams, redlined plans, etc.

All training has been received

All spare parts have been received

All "punch-list" items have been corrected

Documentation

The contract documents should state the documentation requirements. It is recognized that to be more "green," paper documentation is giving way to "On-line" manuals and drop- down help screens. Nevertheless, some form of documentation should be required for all software, controllers, and other equipment. Documentation should include backup software on disc.

Transition from Old to New Control

The contractor should be required to submit for approval a "Transition Plan" as part of their schedule. Continuity of operation and maintenance of traffic flow should be stressed.

New communications connections should be established between the signal controllers and the Traffic Management Center, and then each channel should be connected to the central communications server. During the communications switchover, the existing controllers can run time-of-day plans. As soon as new communications are available, the controllers on that channel should be upgraded to ethernet-capable units and immediately operated from the central computer. Timing plans and database parameters should have been previously programmed and stored in the central database. Upon connection, the central computer should download the parameters to the upgraded controllers.

Operational Support and Warranty Period

With the entire system operating, the project should enter an observation period, typically 30 to 45 days. During this time, the contractor must correct anything that malfunctions, at which time the observation period is restarted. After the observation period, the project moves toward "Final Acceptance."

Contract documents should establish a strong warranty for two years to get the project through the start-up period and into the maintenance phase.

For computer equipment, the City should purchase a renewable On-Site Service Contract in the name of the City. Most vendors have several different options available.

Training

The System Specification, covering communications equipment and software, should require several training sessions. Training can be expensive; therefore, it is important that it be based on actual functions to be performed by the staff, as well as the deficiencies the staff may have in terms of technical understanding of the system. Operator training should use the system documentation provided by the contractor and should familiarize the city staff with all aspects of system operation. Maintenance training should be conducted prior to system acceptance and should emphasize direct troubleshooting and the repair of central hardware and on-street communications equipment.

8.4.7 OPERATIONS AND MAINTENANCE PLAN

The city has been operating and maintaining the existing system for many years and has proven very capable and dedicated to this task.

Evaluation

About six months after the system has been upgraded, the city (or a consultant) should perform an evaluation of the system, including its features, operability, and maintainability. This would be a "How well did we do?" report. Changes could be made to the project before proceeding with other phases of the project.

Maintenance Plans

City personnel should perform maintenance procedures. As stated earlier, by using off-the-shelf computers and other devices, the maintenance and upkeep of the system becomes much easier. If something breaks, it is easy to make a direct replacement. To expedite direct replacement, contract documents should require "system support equipment," which are spares of every type of device furnished for the system.

Appendix A

Capital Improvement Project - City of Mont Belvieu

Upgrade Intersection, Local Software, and Intersection Detection including Fiber Communication Equipment (Controller, Cabinet, Detection and Cameras)

FY 2023

PROJECT DESCRIPTION

Detection: The future system and intersection detection needs to provide complete and accurate coverage of the major links in the City traffic signal network. This project will provide for new detectors that can be installed below and/or above the roadway depending on field conditions, like weather, roadway conditions and geometry. The primary technology will be wireless magnetometer s and inductive loops.

Cabinet & Controller: The implementation of Advance Transportation Controllers (ATC) will allow easy integration of the many new technology devices that may become available in the future. The ATC is more powerful, adaptable and can provide the power needed for more advanced adaptive control strategies. It will also provide a platform for allowing the traffic signal controllers to capitalize on the advances in computer technology with minimal impact on the software investment. The ATC's are intended to be compatible with or inclusive of existing (present day) traffic controller capabilities. As a first step in the implementation process, all proposed and/or modified traffic signal intersections can be easily upgraded to the ATC devices. The second step in the implementation process will require the replacement of intersection controllers with the ATC.

Cameras: The City has a number of traffic surveillance cameras already in place. Under this project additional cameras will be installed at locations most likely to experience congestion. These include locations that experience daily traffic congestion because of commuting patterns and locations near parks, stadiums and other venues where special events take place on a periodic basis.

BENEFITS

Detection: System and Intersection detectors will provide current traffic volume, occupancy and System and Intersection detectors provide current traffic volume, occupancy and speed data along with detection on key arterials. These detectors can be implemented for signal timing plans and real-time display of congestion levels to the motoring public. The detector traffic data can also be archived for future analysis and forecasting. In addition to improved system operations, the upgraded detection will assist the City in evaluating performance measures.

Cabinet & Controller: The benefits of the project would include: Interchangeability between manufacturers, Improved competitive pricing, Better adaptability to advances in technology, Cost effective and modular construction, Ensure interoperability within systems, Provides well defined controller testing requirements, Improved internal programming features, Open architecture, Recoverable software investment, Flexible hardware platform.

Cameras: These cameras will enable the staff at the management center to adjust traffic signal timing in response to real-time events. These could be accidents or special events that cause anomalies in the normal patterns of traffic flow. The cameras would also enable operations and maintenance staff to respond more quickly to calls from citizens reporting problems.

COSTS

Description and Calculation	Cost	Communication and Contingency	Total Element Cost
Upgrade System and Intersection Detection			
Intersection Detection 5 @ $18,000	$0	$0	$0
Camera Installation 8 @ $5,000	$0	$0	$0
Controller Upgrade 5 @ $4,500	$0	$0	$0
Cabinet Upgrade 5 @ $18,000 **May not be needed determine during design.**	$0	$0	$0
Detailed Design and Implementation Support	$50,000	$7,500	$57,500
Totals for Project	$50,000	$7,500	$57,500

Capital Improvement Project - City of Mont Belvieu

Traffic Signal Standard Details for Construction (Future Signal Designs & ITS equipment needed)

FY 2023

PROJECT DESCRIPTION

The updating of Traffic Standards and Specifications are needed to provide current and consistent public works construction traffic standards for public works infrastructure projects within the city limits. The City of Mont Belvieu Traffic Standards and Specifications should include design standards, standard drawings, general conditions, special provisions, and supplemental specifications when needed.

BENEFITS

These documents will establish the design and construction standards for any future Capital Improvement Projects (CIPs), maintenance projects, and private development projects. They will be utilized by both City Staff and the community, including engineers, developers, consultants, and others. The City's current specifications do not include Traffic specific standards and will be needed to supplement the Management Center and upgraded Traffic/ITS equipment.

Some of the benefits of the City Traffic Standards include:

- Improved design criteria per latest Manuals
- Provide latest techno;lgoy including ITS equipoment
- Provide staff, developers and designers a unoform design for city
- Enhance city standards signage, pavement markings, and lighting
- Allow city design criteria for pole colors, signal head colors and layout

COSTS

Description and Calculation	Cost	Communication and Contingency	Total Element Cost
City Standard Details for Construction			
5-8 Standard Sheets including Specifications	$5,000	$750	$5,750
Design and Implementation Support	$25,000	$3,750	$28,750
Totals for Project	$30,000	$4,500	$34,500

Capital Improvement Project - City of Mont Belvieu

Upgrade Intersection, Local Software, and Intersection Detection including Fiber Communication Equipment (Controller, Cabinet, Detection and Cameras)

FY 2024

PROJECT DESCRIPTION

Detection: The future system and intersection detection needs to provide complete and accurate coverage of the major links in the City traffic signal network. This project will provide for new detectors that can be installed below and/or above the roadway depending on field conditions, like weather, roadway conditions and geometry. The primary technology will be wireless magnetometer s and inductive loops.

Cabinet & Controller: The implementation of Advance Transportation Controllers (ATC) will allow easy integration of the many new technology devices that may become available in the future. The ATC is more powerful, adaptable and can provide the power needed for more advanced adaptive control strategies. It will also provide a platform for allowing the traffic signal controllers to capitalize on the advances in computer technology with minimal impact on the software investment. The ATC's are intended to be compatible with or inclusive of existing (present day) traffic controller capabilities. As a first step in the implementation process, all proposed and/or modified traffic signal intersections can be easily upgraded to the ATC devices. The second step in the implementation process will require the replacement of intersection controllers with the ATC.

Cameras: The City has a number of traffic surveillance cameras already in place. Under this project additional cameras will be installed at locations most likely to experience congestion. These include locations that experience daily traffic congestion because of commuting patterns and locations near parks, stadiums and other venues where special events take place on a periodic basis.

BENEFITS

Detection: System and Intersection detectors will provide current traffic volume, occupancy and System and Intersection detectors provide current traffic volume, occupancy and speed data along with detection on key arterials. These detectors can be implemented for signal timing plans and real-time display of congestion levels to the motoring public. The detector traffic data can also be archived for future analysis and forecasting. In addition to improved system operations, the upgraded detection will assist the City in evaluating performance measures.

Cabinet & Controller: The benefits of the project would include: Interchangeability between manufacturers, Improved competitive pricing, Better adaptability to advances in technology, Cost effective and modular construction, Ensure interoperability within systems, Provides well defined controller testing requirements, Improved internal programming features, Open architecture, Recoverable software investment, Flexible hardware platform.

Cameras: These cameras will enable the staff at the management center to adjust traffic signal timing in response to real-time events. These could be accidents or special events that cause anomalies in the normal patterns of traffic flow. The cameras would also enable operations and maintenance staff to respond more quickly to calls from citizens reporting problems.

COSTS

Description and Calculation	Cost	Communication and Contingency	Total Element Cost
Upgrade System and Intersection Detection			
Intersection Detection 5 @ $18,000	$90,000	$13,500	$103,500
Camera Installation 8 @ $5,000	$40,000	$6,000	$46,000
Controller Upgrade 5 @ $4,500	$22,500	$3,375	$25,875
Cabinet Upgrade 5 @ $18,000 **May not be needed determine during design.**	$90,000	$13,500	$103,500
Detailed Design and Implementation Support	$8,000	$1,200	$9,200
Totals for Project	$250,500	$37,575	$288,075

Capital Improvement Project - City of Mont Belvieu

Traffic Management Center for Emergency Operations including Master Software, ITS Equipment & Intersection Integration

FY 2024

PROJECT DESCRIPTION

The Management Center will be located in Existing City Hall Building. The Center will include the latest technologies and equipment to help provide the citizens of Mont Belview with improvement in emergency operation safety and congestion. With more and more people relocating and visiting the city, advancements in the latest technology are needed to enhance the quality of life in the community by a commitment to excellence in the delivery of the City's public service and emergency operations. Finalized City Mont Belvieu Architecture using base model including Regional Coordination.

BENEFITS

The center will improve safety and reduced delay along all the City of Mont Belview's current and future roads. The new technology will improve the accuracy and time in alerting proper authorities of an accident, alerting travelers of congestion along routes, will provide better data collection, and management. Other operations include traffic signal management, inclement weather response, prioritizing signals for emergency vehicles, reporting incidents to the proper authorities, natural disaster evacuations, and maintaining equipment.

Some of the benefits of the Management Center include:

- Provide single location for emergency operations
- Provide Access to Cameras at intersections or along emergency routes, DMS, communication signal adjustments
- Enhance and notify emergency personnel of incidents and traffic conditions
- Enhance traffic adaptive control capability
- Help re-route traffic along major routes due to emergency accidents

COSTS

Description and Calculation	Cost	Communication and Contingency	Total Element Cost
Management Center & Intersection Integration			
Management Center, master software, computers, video boards, teleconference technology, IT Infrastructure to center and Integration	$150,000	$22,500	$172,500
Design and Implementation Support	$75,000	$11,250	$86,250
Totals for Project	$225,000	$33,750	$258,750

Capital Improvement Project - City of Mont Belvieu

Signal Timing Optimization Program (All Signals within City) (Updating Timing Plans including Events)

FY 2024

PROJECT DESCRIPTION

Signal timing is effective only as long as the traffic patterns that were used to generate the signal timing are reasonably constant. Traffic patterns change over time; developments in surrounding areas also can cause a significant change in traffic patterns. Existing signal timing cannot operate efficiently with newer traffic patterns. Signal timing should be fine-tuned to operate better. For traffic signals to operate efficiently, the complete retiming of a traffic signal or system often is necessary.

BENEFITS

Optimized signal timing is considered to be a very effective low-cost approach to reducing congestion. Benefit-cost ratios as high as 40 to 1 can be realized after traffic signal retiming is performed. This project will include inter-jurisdictional and extraterritorial jurisdiction (ETJ) signal coordination, as well as evacuation route timing plans. These timing plans would minimize delay, fuel consumption and emissions that occur when these activities take place.

COSTS

Description and Calculation	Cost	Communication and Contingency	Total Element Cost
Signal Timing Optimization			
6 Intersections @ $3,000/intersection	$18,000	$2,700	$20,700
Additional Adjust Timings with other enities	$4,500	$675	$5,175
Totals for Project	$22,500	$3,375	$25,875

Capital Improvement Project - City of Mont Belvieu

Installation of DMS for Emergency Operations Messaging linked to TMC

FY 2024

PROJECT DESCRIPTION

This project will install a series of permanently mounted dynamic message signs (DMS) at selected non-residential locations in the community. These signs would provide routing information for visitors entering the community, provide parking availability information and warn residents and employees of delays that can be avoided by using alternate routes.

BENEFITS

Dynamic message signs can change the message they display to reflect conditions or inform motorists of important information. The signs can convey information about roadway conditions, alternate routes, construction activities, or any information that may assist motorists in making decisions. Signs will initially be placed at select key locations. The overall project benefits to area residents, employees and visitors are reduced delay, fuel consumption and vehicle emissions. DMS are effective for alerting motorists to operational, regulatory, warning or guidance announcements at a specific location. The motorists can then respond by adjusting driving behavior, choosing an alternative route, or changing when they travel.

COSTS

Description and Calculation	Cost	Communication and Contingency	Total Element Cost
Installation of DMS			
2 Locations @ $100,000	$0	$0	$0
Design and Implementation Support	$50,000	$7,500	$57,500
Totals for Project	$50,000	$7,500	$57,500

Capital Improvement Project - City of Mont Belvieu

Signal Timing Optimization Program (All Signals within City) (Updating Timing Plans including Events)

FY 2025

PROJECT DESCRIPTION

Signal timing is effective only as long as the traffic patterns that were used to generate the signal timing are reasonably constant. Traffic patterns change over time; developments in surrounding areas also can cause a significant change in traffic patterns. Existing signal timing cannot operate efficiently with newer traffic patterns. Signal timing should be fine-tuned to operate better. For traffic signals to operate efficiently, the complete retiming of a traffic signal or system often is necessary.

BENEFITS

Optimized signal timing is considered to be a very effective low-cost approach to reducing congestion. Benefit-cost ratios as high as 40 to 1 can be realized after traffic signal retiming is performed. This project will include inter-jurisdictional and extraterritorial jurisdiction (ETJ) signal coordination, as well as evacuation route timing plans. These timing plans would minimize delay, fuel consumption and emissions that occur when these activities take place.

COSTS

Description and Calculation	Cost	Communication and Contingency	Total Element Cost
Signal Timing Optimization			
6 Intersections @ $3,000/intersection	$18,000	$2,700	$20,700
Additional Adjust Timings with other enities	$4,500	$675	$5,175
Totals for Project	$22,500	$3,375	$25,875

Capital Improvement Project - City of Mont Belvieu

Installation of DMS for Emergency Operations Messaging linked to TMC

FY 2025

PROJECT DESCRIPTION

This project will install a series of permanently mounted dynamic message signs (DMS) at selected non-residential locations in the community. These signs would provide routing information for visitors entering the community, provide parking availability information and warn residents and employees of delays that can be avoided by using alternate routes.

BENEFITS

Dynamic message signs can change the message they display to reflect conditions or inform motorists of important information. The signs can convey information about roadway conditions, alternate routes, construction activities, or any information that may assist motorists in making decisions. Signs will initially be placed at select key locations. The overall project benefits to area residents, employees and visitors are reduced delay, fuel consumption and vehicle emissions. DMS are effective for alerting motorists to operational, regulatory, warning or guidance announcements at a specific location. The motorists can then respond by adjusting driving behavior, choosing an alternative route, or changing when they travel.

COSTS

Description and Calculation	Cost	Communication and Contingency	Total Element Cost
Installation of DMS			
3 Locations @ $100,000	$300,000	$45,000	$345,000
Design and Implementation Support	$5,000	$750	$5,750
Totals for Project	$305,000	$45,750	$350,750

Capital Improvement Project - City of Mont Belvieu

Wireless Communication (out of existing fiber range) - Only If Needed (Fiber limited areas)

FY 2025 Later

PROJECT DESCRIPTION

This project will install the hardware and software to enable Ethernet IP "standards-based" communications to improve traffic signal and ITS device system management. Connecting signal and ITS controllers to an intelligent network with a standards-based wireless IP infrastructure, versus installing fiber to unoccupied areas, will be cost effective, provide flexibility in design, enable faster deployment, and provide a network infrastructure for future additional applications. **NOTE: Wireless Communication is not anticapted unless Camera or DMS is needed outside of existing Fiber areas. Cost is for Information only and as needed in future city expansion.**

BENEFITS

The major benefits of the new communications infrastructure are:

- Flexibility, ease of expansion, lower installation costs, and higher reliability. For example, the wireless approach protects the network from cabling cuts as have been occurring at construction sites.
- Enhances the ability to monitor the operation of the signal system to identify failures that delay traffic and cause hazardous conditions
- Provides flexibility and growth for wide-band mobile communications capabilities.
- The flexible wireless network preliminary concept perfectly fits a growing area with dynamic needs, allowing re-deployment to meet future needs and applications to match.
- Traffic communications may leverage wireless systems with as many expansion capabilities as possible.

COSTS

Description and Calculation	Cost	Communication and Contingency	Total Element Cost
Wireless Communication Infrastructure			
Field Equipment, Tower(high site) and Head End	$75,000	$11,250	$86,250
Design and Implementation Support	$30,000	$4,500	$34,500
Totals for Project	$105,000	$15,750	$120,750

Appendix B

Project Schedule and Estimated Costs

Management Center ITS Emergency Operations Program			
Project	**Estimated Project Costs**		
	FY 23	**FY 24**	**FY 25**
Upgrade Intersection, Local Software, and Intersection Detection including Fiber Communication Equipment (Controller, Cabinet, Detection and Cameras)	$ 50,000.00	$ 250,500.00	$ -
Traffic Signal Standard Details for Construction (Future Signal Designs & ITS equipment needed)	$ 30,000.00	$ -	$ -
Traffic Management Center Emergency Operations including Master Software, Central Equipment & Intersection Integration	$ -	$ 225,000.00	$ -
Signal Timing Optimization Program (All Signals within City) (Updating Timing Plans including Events)	$ -	$ 22,500.00	$ 22,500.00
Installation of DMS for Emergency Operations Messaging linked to TMC	$ -	$ 50,000.00	$ 305,000.00
Wireless Communication (out of existing fiber range) - **NOTE: Wireless Communication is not anticipated unless Camera or DMS is needed outside of existing Fiber areas.**	$ -	$ -	**$ 105,000.00**
Total Costs Needed for Traffic Management Center Emergency Operations	**$ 80,000.00**	**$ 548,000.00**	**$ 432,500.00**
Total of 3 Year Cost	**$**	**1,060,500.00**	
Incidental - 15% Contingency	**$**	**159,075.00**	
Grand Total of 3 Year Cost	**$**	**1,219,575.00**	