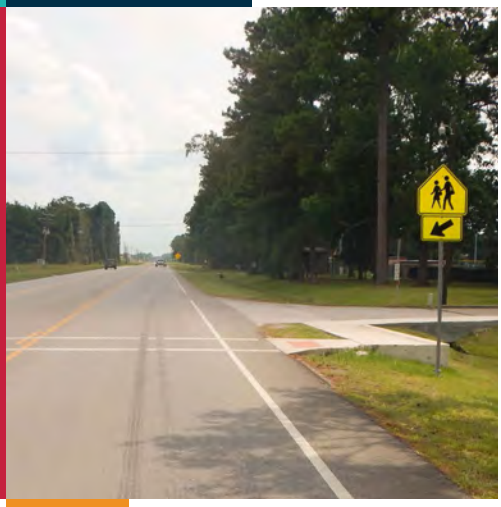
SEPTEMBER 2022

Houston-Galveston Area Council

LIBERTY COUNTY MOBILITY STUDY



PREPARED BY

Kimley»Horn

Expect More. Experience Better.

Acknowledgements

CITIZENS OF LIBERTY COUNTY

This plan was made for the community, with the help of the community. The continuous dedication of time and effort by members of the community, not only in the planning process, but in their daily interests, is what made this effort possible.

STEERING COMMITTEE

LIBERTY COUNTY

Hon. Jay Knight
David Douglas

CITY OF LIBERTY

Tom Warner
Chris Jarmon

CITY OF CLEVELAND

Robert Reynolds

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Steve Floyd
Kimberly Judge
Ann Miller

TXDOT

Lisa Collins
Noel Salac
Jeffrey English

STAKEHOLDERS

CLEVELAND AREA

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Superintendent Scott Mackey, *Hardin ISD*
Rhonda Campbell, *Liberty-Dayton Regional Medical Center*
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COUNTYWIDE

Tyson Moeller, *Union Pacific Railroad*
Gary Laffoon, *BNSF Railroad*
Taslima Khandaker, *Brazos Transit District*
Jake Noxon, *Texas Department of Parks and Wildlife*

H-GAC STAFF

Thomas B. Gray, AICP, Planner, *Project Manager*
Allie Isbell, AICP, *Transportation Assistant Director and Project Manager*
Carlene Mullins, *Principal Planner*
Justin Kuzila, *Senior Planner*
Susan Jaworski, *Senior Planner*
Megan Kennison, *Senior Data Analyst*
Eric Boulet, *Senior GIS Analyst*
Meagan Coughlin, *APR, Director of Communications*
Ashley Seals, *Communications and Outreach Manager*
Kristina Michel, *Senior Writer and Editor*
Robyn Egbert Balaban, *Outreach Coordinator*
Crystal Thomas, *Outreach Specialist*

CONSULTANT TEAM

Michael Feeney, P.E., Project Manager, *Kimley-Horn*
Josie Ortiz, AICP, Planner, *Kimley-Horn*
Andi Vickers, Planner, *Kimley-Horn*
Jenny Abrego, Graphic Designer, *Kimley-Horn*
Kadence Novak, Planner, *Asakura Robinson*
Matt Rufo, AICP, Planner, *Asakura Robinson*
Patti Joiner, AICP, Planner, *Knudson & Associates*
Thomas Kuykendall, P.E., Roadway Engineer, *CivilCorp, LLC*
Roy Dill, P.E. Roadway Engineer, *CivilCorp, LLC*
Roger Allen, Vice President, *CJ Hensch & Associates*

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Houston-Galveston Area Council

Executive Summary

The Houston-Galveston Area Council (H-GAC), in partnership with Liberty County, began the Liberty County Mobility Study to address the county's mobility challenges. With the recent and future growth of the county, planning is required to address existing traffic and safety issues so that they are not exacerbated by this growth. A primary focus in development of the study was to engage the public and develop a plan for citizen input. The planning process coordinated with and included existing plans of the incorporated cities, as well as those of Liberty County and the Texas Department of Transportation (TxDOT). In developing the Liberty County Mobility Study, a public engagement process, an overarching vision and a corresponding set of goals guided its creation. Specific focus was given to the cities of Cleveland, Dayton, and Liberty.

0.1 VISION AND GOALS

The vision of the Liberty County Mobility Study is "to address County needs through multimodal transportation, development, and economic policy, while meeting H-GAC's goals of mobility, safety, and enabling economic opportunity."

The corresponding goals and objectives are used to ensure that the recommendations from this study help the subregion achieve the vision over time.

GOAL	OBJECTIVES
Mobility	Provide county-wide connections and travel options for all road users
Freight	Increase truck travel time reliability and reduce disruptions due to railroad activity
Efficiency	Increase operational efficiency and reliability of major intersections and roadways
Safety	Reduce crash rates and improve sense of comfort for all road users
Economic	Enhance opportunities for accommodating incoming growth

0.2 PLAN DEVELOPMENT

PUBLIC INVOLVEMENT

Input from daily users of the transportation system was an important part of the planning process. To ensure that the correct issues were being addressed, input was solicited from the community through public meetings, a project website, surveys, an online interactive commenting map, and comprehensive outreach using various outlets. A Steering Committee and two stakeholder groups were also formed to ensure that the planning process and final recommendations aligned with the county's goals and addressed pertinent issues.

EXISTING CONDITIONS

Data was collected for the county that included population, employment, environmental characteristics, and the transportation network.

POPULATION GROWTH

From 2010 to 2020, the county's population grew by 16,000 people, over 20% in 10 years. With a study area encompassing 1,176 square miles, this equates to about 79 people per square mile. Additionally, the county's population grew 9.5% from 2019 to 2020 alone.

CRASHES

The overall number of crashes in the county steadily increased between 2015 and 2019, by 7% overall. However, in 2019, there were still approximately 1,500 crashes total, with 1.0% of those crashes involving bicycles or pedestrians.

CONGESTION

The existing traffic level-of-service (a measure of congestion) for the study area shows that the majority of the transportation network is nearing capacity or will be by 2045. This indicates a need for improvements within the network to address future capacity.

PREVIOUS STUDIES

The areawide, corridor, and intersection improvements recommended in this study incorporate those recommended in studies previously conducted by H-GAC, Liberty County, and individual cities and entities. Plans that were incorporated into the creation of the Liberty County Mobility Study include:

- Liberty County Strategic Plan 2016-2036
- Cleveland ETJ Study (2009)
- City of Cleveland Zoning Map
- #Dayton Tomorrow 2035 Comprehensive Plan
- #Dayton Tomorrow 2035 Parks and Recreation Master Plan
- Downtown Dayton Revitalization Plan
- City of Liberty Comprehensive Plan 2014-2035

NETWORK, CORRIDOR, AND INTERSECTION ANALYSIS

Using a traffic analysis software, intersections were evaluated to determine how well they operate with current traffic levels; recommendations were made to address existing issues. To analyze future operations, anticipated future growth in the area was added to the traffic model, simulating conditions in 2045. Recommendations were then made to address issues identified for future years.

0.3 PROPOSED IMPROVEMENTS

Areawide improvements include **recommendations for freight, transit, active transportation, and policy.**

Some highlights include:

Widening designated freight corridors to accommodate more heavy traffic

84 miles *of new, repaired, or improved sidewalk*

A future Thoroughfare Plan to improve county-wide connectivity

Location-specific recommendations for study corridors and intersections vary according to needs and include the ***Improvements Toolbox on page viii***.

Individual summary sheets, which include existing condition data and recommended improvements, are provided for each intersection and corridor segment.

0.4 EVALUATION OF IMPROVEMENTS

Improvements were then evaluated to determine how effective they might be in advancing the goals and overall vision of the study. These improvements should be measured regularly in the future to determine their continued effectiveness. Some measurements include:

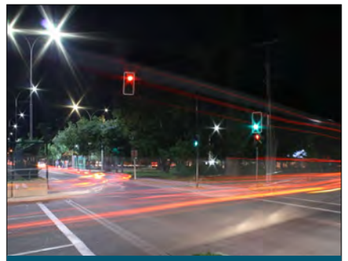
Crash reduction

Travel time delay

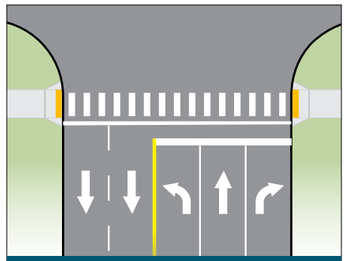
ROW acquisition cost

0.5 IMPLEMENTATION PLAN

A plan for implementing improvements recommended in this study was developed for each major city in the county and for Liberty County overall. Improvements were identified as short-term or long-term to provide a general timeline for jurisdictions to consider as they develop their Capital Improvement Plans. Additionally, local, state, and federal funding sources were identified to illuminate opportunities for jurisdictions.

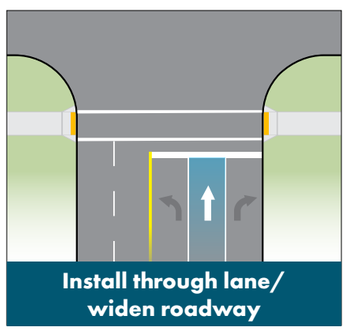


Install LED intersection lighting



Install/upgrade pavement markings

Install Dallas flashing yellow arrow turn signal



Install through lane/ widen roadway

ACTIVE MODES

Recommendation	Intersection	Corridor	Timeline
Install pedestrian elements	✓	✓	Both
Install shared use path	✓	✓	Both
Install sidewalk	✓	✓	Long-Term

GEOMETRY

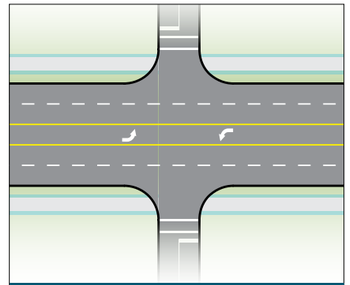
Recommendation	Intersection	Corridor	Timeline
Install left-turn lane	✓		Both
Install right-turn lane	✓		Both
Install through lane / widen road	✓	✓	Both
Realign intersection	✓	✓	Both
Construct roadway extension		✓	Long-Term
Improve drainage		✓	Long-Term
Construct grade separation		✓	Long-Term
Refine access management		✓	Long-Term
Proposed US 90 Bypass	✓	✓	Long-Term
Install / improve pavement markings	✓	✓	Short-Term
Install / improve pavement		✓	Short-Term

SIGNAL

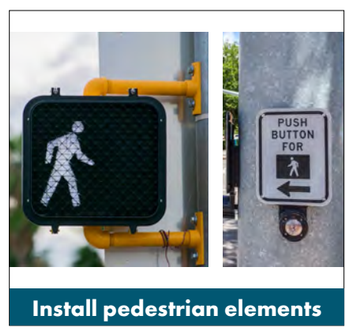
Recommendation	Intersection	Corridor	Timeline
Optimize/coordinate signal	✓	✓	Both
Change left-turn phasing	✓		Both
Add right-turn overlap	✓		Both
Signalize	✓		Short-Term
Install Flashing Yellow Arrow signal	✓		Short-Term
Install intersection lighting	✓		Short-Term
Install stop signs	✓	✓	Short-Term

Upgrade pavement

Refine access management



Install sidewalks



Install pedestrian elements

1

Introduction

CHAPTER 1

Introduction

This chapter describes the inception, vision, and goals of the Liberty County Mobility Study.

1.1 OVERVIEW

As the eight-county Houston-Galveston Area Council (H-GAC) region continues to grow, adding residents and jobs, Liberty County finds itself in transition from a rural county to one experiencing more development. According to the US Census, the county's population has increased from 75,643 people in 2010 to 91,268 people in 2020 – a growth rate of over twenty percent. Residential, commercial, and industrial growth is creating pressure on the County's transportation network, and the construction of the Grand Parkway (State Highway 99) will further open the county up to new development.

Liberty County approached H-GAC in the fall of 2018 about conducting a multi-modal transportation study aimed at addressing the county's mobility challenges, including congestion, safety, roadway connectivity, freight traffic and quality-of-life issues, especially within the cities of Cleveland, Dayton, and Liberty. Subsequent discussions between the county, cities, and H-GAC resulted in the development of the Liberty County Mobility Study, which examines existing transportation conditions and recommends short- and long-term multi-modal improvements intended to manage growth, maintain mobility, and focus on the safety of the transportation system for all users, with special emphasis on conditions in and around the cities of Cleveland, Dayton, and Liberty.

The Liberty County Mobility Study is the first such study of its kind for the county. One of its purposes is to develop actionable recommendations that can then qualify for transportation grants through H-GAC and the Texas Department of Transportation (TxDOT).

1.2 VISION AND GOALS

The vision and goals of the Liberty County Mobility Study were developed to reflect the issues faced by the county, specifically congestion, safety, and freight. H-GAC presented the study's Vision and Goals to the Steering Committee at their first meeting on December 2, 2020. The Vision statement is as follows:

> *"The Vision of the Liberty County Mobility Study is to address County needs through multimodal transportation, development, and economic policy, while meeting H-GAC's goals of mobility, safety, and enabling economic opportunity."*

The goals for the Liberty County Mobility Study and their respective objectives are listed below:

GOAL	OBJECTIVES
Mobility	Provide county-wide connections and travel options for all road users
Freight	Increase truck travel time reliability and reduce disruptions due to railroad activity
Efficiency	Increase operational efficiency and reliability of major intersections and roadways
Safety	Reduce crash rates and improve sense of comfort for all road users
Economic	Enhance opportunities for accommodating incoming growth

Exhibit 1.2a – H-GAC Vision, Goals, and Performance Measures

1.3 PLAN ORGANIZATION

The Table of Contents is available as an overview of where specific items are located within the study. Generally, the study is organized into the following chapters:

CHAPTER 1 **Introduction** describes the inception, vision, and goals of the Liberty County Mobility Study

CHAPTER 2 **Discovery** reviews previous planning efforts in Liberty County, locally-identified issues, and the data collection process

CHAPTER 3 **Elements** explains how the priorities and concerns of the public are integrated into the study; describes existing conditions review and analysis methodology; reports existing policies and practices in Liberty County

CHAPTER 4 **Liberty County** provides assessment of existing conditions and recommendations to address needs across the entire county

CHAPTER 5 **City of Cleveland** provides assessment of existing conditions and recommendations to address needs specific to Cleveland

CHAPTER 6 **City of Dayton** provides assessment of existing conditions and recommendations to address needs specific to Dayton

CHAPTER 7 **City of Liberty** provides assessment of existing conditions and recommendations to address needs specific to Liberty

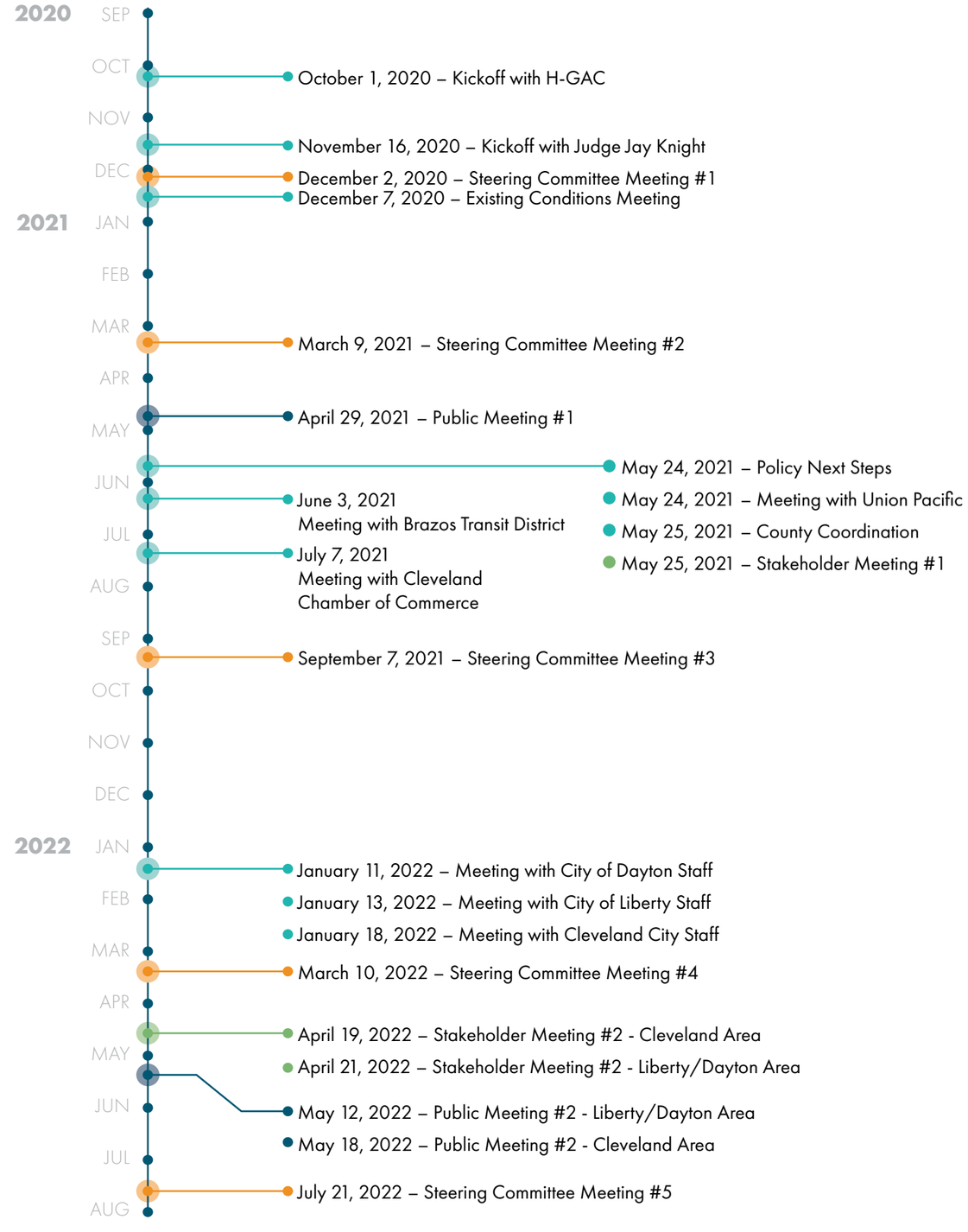
CHAPTER 8 **Implementation** summarizes recommended improvements, evaluates their effects on safety and mobility, and provides funding source suggestions

An overview of the project's schedule, including major milestones, is illustrated in ***Exhibit 1.3a***:

Exhibit 1.3a – Project Schedule

LIBERTY COUNTY MOBILITY STUDY SCHEDULE								
	2020		2021				2022	
TASK	FALL	WINTER	SPRING	SUMMER	FALL	WINTER	SPRING	SUMMER
Identification of Issues and Needs								
Data Assembly and Evaluation								
Analysis								
Implementation and Funding Plan								
Final Report								
Public Outreach								

DURATION OF TASK · ONLINE ENGAGEMENT ACTIVITY · STEERING COMMITTEE MEETING · STAKEHOLDER MEETING · PUBLIC MEETING



2

Discovery

CHAPTER **2**

Discovery

This chapter reviews previous planning efforts in Liberty County, locally identified issues, and the data collection process.

2.1 PREVIOUS PLANNING EFFORTS

LIBERTY COUNTY STRATEGIC PLAN 2016-2036

County officials partnered with the Texas Target Communities program at the Texas A&M University Department of Landscape Architecture and Urban Planning to provide a guide for twenty years of growth in Liberty County. It was intended to communicate a long-term vision for the County, guide development approvals, serve as a foundation for policies and regulations, and inform capital improvement plans.

Goals of the Strategic Plan included:

- **Coordination** – create an inter-organizational council – with membership open to all cities, counties, and organizations located in the Trinity River basin below Lake Livingston – to actively coordinate regional efforts.
- **Transportation** – develop transportation infrastructure that enhances connectivity and safety, provides alternative modes (i.e., transit, bicycles, etc.), and supports regional economic development.
- **Institutions** – maintain and add community facilities and services that support the human capital – health, education, culture, security, etc. – of Liberty County residents.
- **Economy** – support the existing economic assets – such as local businesses and farms – improve employment opportunities and provide career guidance and training.
- **Environment** – protect and preserve natural environment and mitigate flood hazards.
- **Housing** – increase range of high quality, affordable housing options.

CLEVELAND ETJ STUDY (2009)

Montgomery & Associates submitted this study to the Cleveland Economic Development Corporation (CEDC) to provide recommendations with a 5-year planning horizon. The recommendations listed in the plan, and summarized below, were intended to help the City of Cleveland and its extraterritorial jurisdiction "tell its story" in the wake of rapid regional growth.

Relevant recommendations included:

- Update development and construction standards
- Launch a marketing program to target developers
- Develop City Mobility Plan
- Consider partnering with a conservation group
- Prioritize planning and policy development
- Identify funding sources and methods

CITY OF CLEVELAND ZONING MAP

Relevant goals/recommendations included:

- In 2022, the City of Cleveland updated its Zoning Map. The updated document is included in ***Appendix A.***

#DAYTON TOMORROW 2035 COMPREHENSIVE PLAN

The goal of this plan was to develop principles that provide guidance for the city's decision-makers. These recommendations were grounded by prioritizing short-, mid-, and long-term strategies with an emphasis on near-term "catalysts" that activate desired change.

By adopting the process outlined in this plan, the expected end results included:

- Unifying the City's vision and associated goals regarding the future growth and enhancement of the community, improvements in the transportation network, and continued economic prosperity for all existing and future Dayton citizens.
- Strengthening partnerships, communication channels, and sense of unified direction across all public, non-profit, and private community stakeholders.
- Engaging widespread citizen involvement in the identification and prioritization of leading community issues and opportunities.
- Guiding regulatory strategies to ensure community values and desired outcomes are managed and promoted, particularly community character.
- Providing greater predictability for residents, landowners, developers, and potential investors. and
- Fulfilling Texas Local Government Code (TLG) guidance, especially with the intent of promoting sound development, public health, safety, and welfare for existing and future Dayton citizens.

#DAYTON TOMORROW 2035 PARKS AND RECREATION MASTER PLAN

The purpose of the Dayton Parks and Recreation Master Plan was to determine the community's current (2018) and future (2040) needs for improving its parks and recreation system and to provide for adequate areas and facilities to meet both the short and long-term needs of the community. The master plan is a guide for policy and decision-making related to the availability, location, type, scale and quality of park and recreation opportunities to meet the needs of Dayton residents and visitors. The plan considered the needs and priorities based on the current and projected population and development within Dayton.

Goals in this plan were defined as follows:

- Accommodate the current and future needs of residents and visitors by providing a variety of park and recreation facilities
- Maintain, enhance, and operate existing parks in a cost-effective and sustainable manner
- Design new parks and facilities to be safe, durable, and sustainable into the future
- Connect parks, natural areas, and community features with a network of trails and sidewalks
- Contribute to economic development by providing attractive parks and recreation resources

DOWNTOWN DAYTON REVITALIZATION PLAN 2018

With the help of Kendig Keast Collaborative, the City of Dayton aimed to create a fiscally-sustainable, walkable, high-quality, and mixed-use environment with public and private amenities.

This plan identified six "catalyst" sites that could be redeveloped to enhance the appeal of the downtown area:

1. **The Rice Dryer** – redevelop the site as a brewery and restaurant, using the elevators as space to showcase a beautiful mural; create indoor and outdoor entertainment spaces
2. **Adams Trucking** – convert the site into mixed office and retail space; this would improve the aesthetics of the area but also provide more employment opportunities
3. **Community Center** – provide residential properties (specifically for the elderly) and outdoor amenities, such as a hike and bike path and park, near the community center
4. **Eight Acres along US 90** – establish mixed-use development and walkable zone
5. **City Hall** – Enhance the existing plaza and create a permanent space for more events and vendors; provide mixed use development in surrounding lots
6. **Sterling Infill Block** – provide more mixed retail and office space and pedestrian pathways to connect to Main Street

CITY OF LIBERTY COMPREHENSIVE PLAN 2014-2035

The purpose of this comprehensive plan is to promote orderly growth and development of the City of Liberty, particularly considering economic opportunities, quality housing, and improved infrastructure.

Some recommendations resulting from this plan included:

- Adopt zoning ordinances
- Secure funding for housing projects
- Clear unsightly and dilapidated buildings and/or cluttered lots that are fire hazards and eyesores, and encourage the restoration of older buildings and houses that are in good condition
- Preserve open spaces within the current corporate limits and the existing extraterritorial jurisdiction and designate natural areas for use as nature parks, plant and wildlife conservation areas and greenbelts, throughout the city
- Assemble and maintain a marketing package that emphasizes the quality of life for residents of Liberty to attract developers
- Develop a Heritage Tourism Program
- Develop the proposed collectors and arterials as outlined in the city's Thoroughfare Plan

2.2 DATA COLLECTION

2.2.1 TRAFFIC VOLUME DATA

Traffic counts, both 24-hour bi-directional volumes along study corridors and peak hour turning movement counts at study intersections, were collected by CJ Hensch in April and May of 2021 and March of 2022.

Turning Movement Counts (TMCs) were collected at 25 study intersections on April 21, 2021, and May 5, 2021, between 6:30am – 8:30am and 4:30pm – 6:30pm. 24-hour bidirectional Average Daily Traffic (ADT) counts were collected at 28 locations along study corridors to understand daily traffic patterns along each corridor. Truck traffic was identified as a concern, so volumes were collected by vehicle class to determine the percent of heavy vehicles at each intersection and along each corridor. Maps of these collection locations can be seen in ***Exhibit 3.1.3a*** and ***Exhibit 3.1.3b*** in the following chapter. Raw traffic counts are available in ***Appendix A***.

2.2.2 CRASH DATA

Crash data was collected from TxDOT's Crash Records Information System (CRIS) for years 2015 through 2019. Raw crash data is available in ***Appendix A***.

2.3 CITY-LED IDENTIFICATION OF ISSUES

The development of the study was guided by input received from staff from Liberty County and its three major cities – Cleveland, Dayton, and Liberty. Many areas of concern were identified by the cities at the study's inception. Follow-up meetings with county and city staff were held in January 2022 to further illuminate the following areas of concern:

2.3.1 CLEVELAND

- Congestion at the intersection of FM 2025 and IH-69 is a key concern.
- The City of Cleveland needs an updated Strategic Plan for Economic Development.
- Members of the public are not aware that the City of Cleveland is served by the Brazos Transit District (BTD); an expanded marketing campaign is needed.
- People with disabilities and elderly people use their wheelchairs on Houston Street and Peach Street; ADA-compliant pedestrian facilities are needed along these roads to improve safety and mobility.
- BTD local buses currently have capacity for only one wheelchair; larger buses are needed.
- The influx of young people – specifically families – will generate demand for expanded bicycle facilities.
- School-age pedestrians require at least one safe crossing location along Houston Street (SH 321).
- A new thoroughfare, Northside Boulevard, is proposed to run from FM 2025 to Washington Street; this would serve incoming schools (opening in Fall 2022 and Fall 2023) to the north and would accommodate truck traffic.
- Pelican Road (CR 2201/CR 2204), which connects FM 787 to SH 105 to accommodate the industrial park north of FM 787, needs to be paved.
- There are many fatal crashes along the SH 105 bypass; improved lighting, signage, and other sight distance elements are needed.
- There is significant truck traffic in the city; enforcement of truck routes (i.e., the SH 105 bypass) is needed.
- The railroad crossing at Hanson Road is being closed; a new railroad crossing would improve east-west mobility.

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2.3.2 DAYTON

- More railroad and waterway crossings are needed to improve cross-town mobility.
- A grade-separated railroad crossing at Klemp Road is needed; Klemp Road could be extended north to connect with SH 321.
- Church Street needs to be studied and possibly widened.
- A bypass of US 90 would alleviate congestion in the downtown area.

2.3.3 LIBERTY

- There is a consensus that there isn't enough existing parking at the County courthouse, so taking away parking could be a major inconvenience to visitors and employees of the courthouse; may consider a garage around the corner or down the street. Concern about parking came in response to a recommendation made about improving the Courthouse Square.
- Main Street should be mixed-use, primarily commercial; residential development will fan out from the corridor.
- Revised zoning along Main Street is proposed.
- Main Street will likely need a continuous two-way left-turn lane.
- Students are mostly not allowed to walk or bike to and from school; pedestrian facilities may be useless.
- New striping around the school as well as a three-way stop at the intersection of Bowie & Grand are needed for safety.
- An east-west bypass north of Liberty may not be feasible because of the levee and floodplain
- When IH-10 is closed, US 90 experiences exacerbated congestion.
- The intersection of the SH 146 bypass with US 90 experiences significant delay due to trucks making left turns.
- New subdivisions are expected to bring significant growth to the local school district.

Detailed notes from the meetings held with City and County staff are included in ***Appendix B***.

3

Elements

- 3.1 Methodology
- 3.2 Public Outreach

3.1 METHODOLOGY

3.1.1 EVALUATING POLICY AND PRACTICE

The subdivision and development ordinances for Liberty County and each partner city were reviewed and documented. Through conversations with the cities and county, existing practices were also considered. Where any major conflicts occurred between jurisdictions or between any jurisdiction and resulting roadway or active transportation recommendations, updates, revisions, or additions were recommended to the corresponding policies and practices. Policy recommendations were also made if existing practices were in conflict with general accepted planning practices.

3.1.2 INTERSECTION CAPACITY ANALYSIS

A capacity analysis was performed to identify study intersections with deficiencies and poor level of service (LOS) and recommend mobility improvements if necessary. Analyses were performed during the morning and afternoon peak traffic hours for four scenarios, as summarized in ***Table A***.

Table A - Analysis Scenarios

Analysis Scenario	Network	Traffic Volumes
2021 Existing	Existing	Adjusted 2021 Volumes
2021 Improved	Existing + **Short-Term Improvements**	Adjusted 2021 Volumes
2045 Existing	Existing	Adjusted 2021 Volumes + **24 Years Annual Growth**
2045 Improved	Existing + Short-Term Improvements + **Long-Term Improvements**	Adjusted 2021 Volumes + **24 Years Annual Growth**

Analysis results are in terms of LOS, which is a qualitative term describing conditions a driver will experience while traveling on a roadway, and it ranges from A (very little delay) to F (long delays and congestion). ***Exhibit 3.1.1a*** below illustrates roadway conditions at each LOS.

Exhibit 3.1.1a - Roadway Conditions at each Level-Of-Service

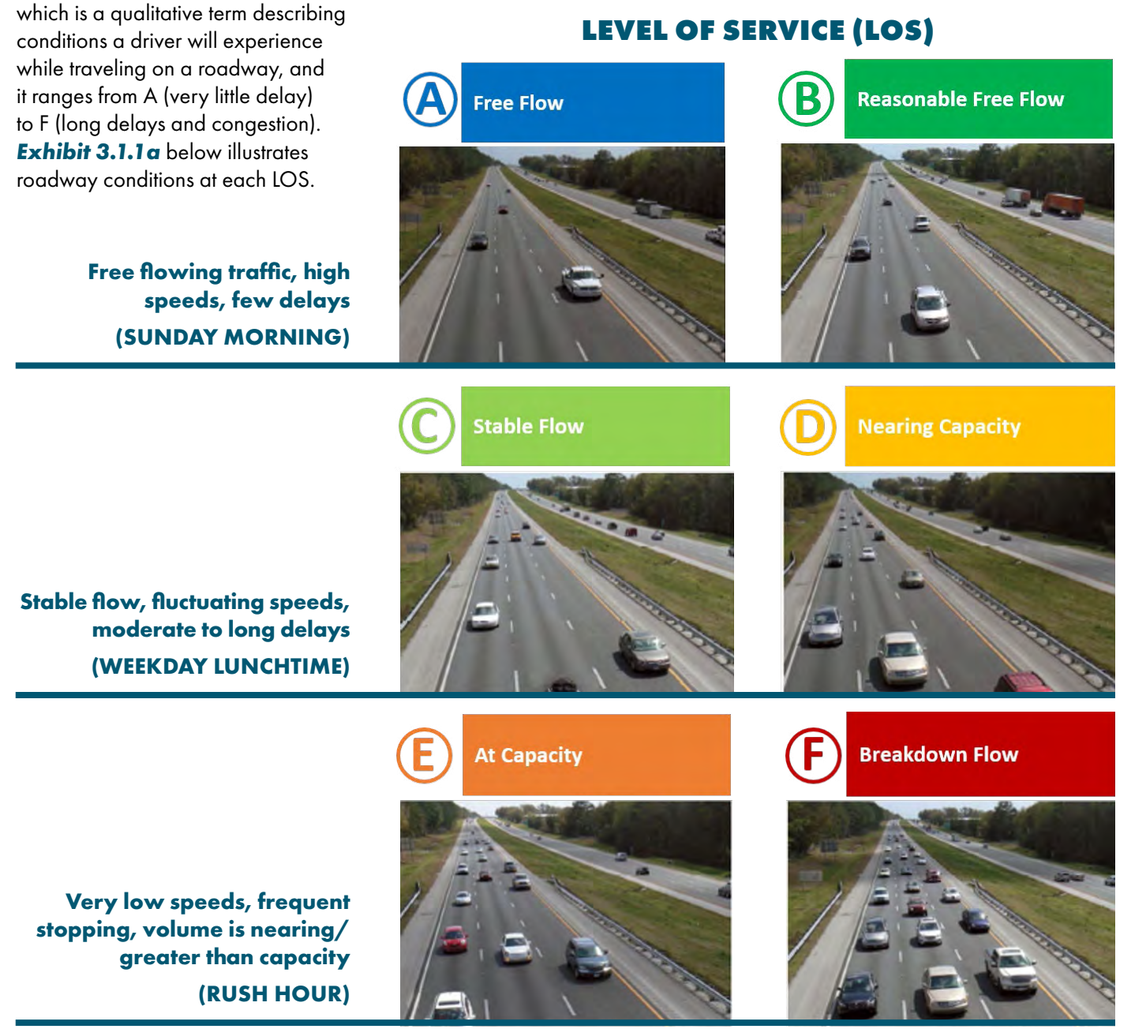


Table B shows the definition of LOS for signalized intersections.

The analysis was conducted using the Synchro 11™ software package, and Highway Capacity Manual calculations were used to determine LOS for each study intersection.

Table B
Level-Of-Service Thresholds

LOS	Average Total Delay *(seconds per vehicle)*
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

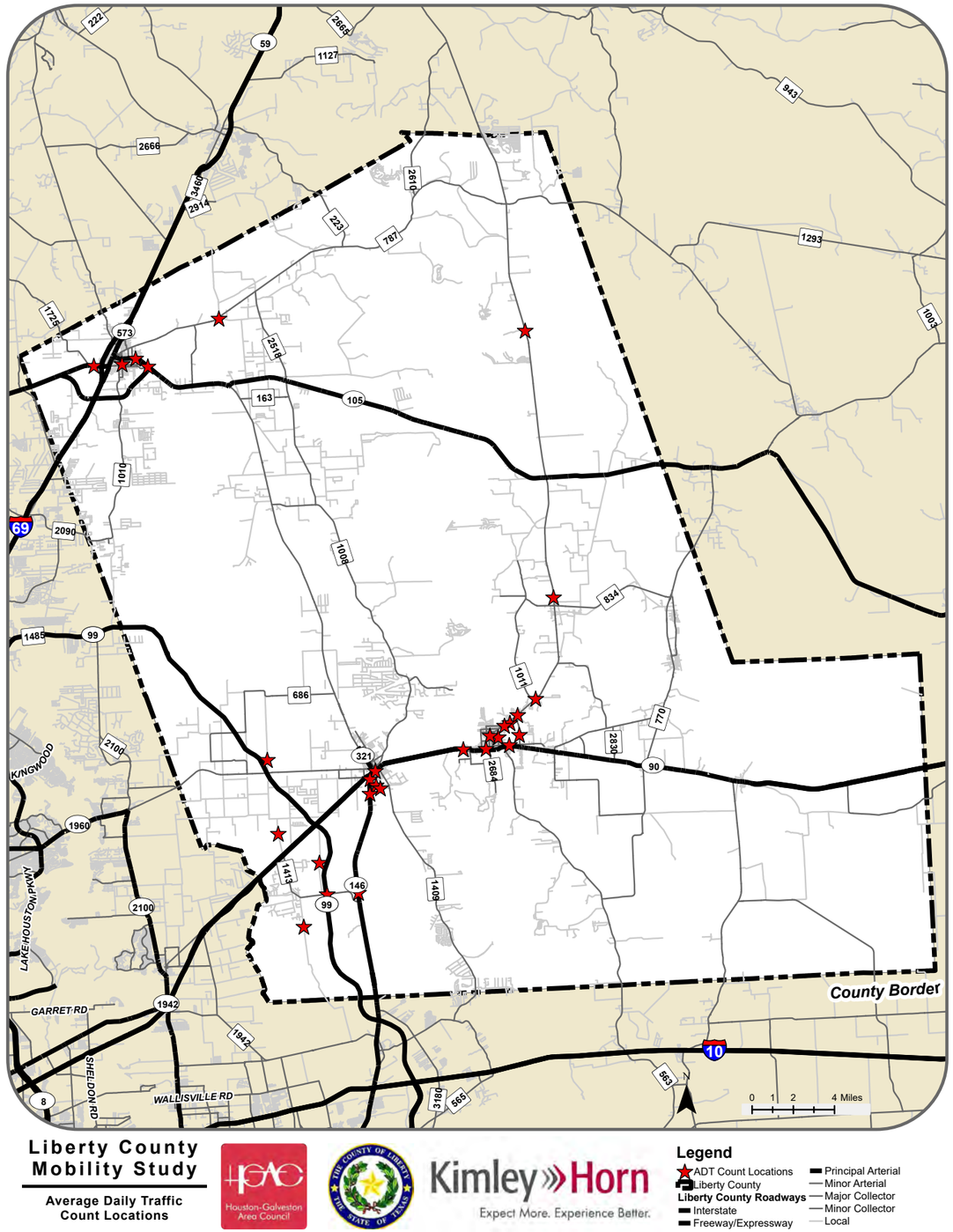
3.1.3 ACCOUNTING FOR COVID-19

EXISTING TRAFFIC VOLUMES

Bi-directional average daily traffic (ADT) volumes were collected in the study area by CJ Hensch in May 2021. At the time, it was assumed the traffic reductions due to the COVID-19 pandemic were still in effect. If this collected data had been used in the capacity analysis, deficiencies in the network would have been underestimated and improvements recommended at the end of this study would have not prepared Liberty County for future non-pandemic traffic conditions. Therefore, the "actual" collected data needed adjustment to reflect non-reduced, non-pandemic traffic conditions.

To adjust the "actual" data to reflect non-pandemic conditions, first, historic average daily traffic (ADT) volumes were obtained from TxDOT's Statewide Traffic Analysis and Reporting System (STARS) database. These historic ADTs were obtained at the same locations (or as close as possible) where "actual" ADTs were collected in 2021, as shown in ***Exhibit 3.1.3a***.

Exhibit 3.1.3a – Map of ADT Count Locations



The average annual growth rate at each location was calculated using the three most recent historic ADT datapoints, and it is considered a "historic growth rate." This calculation is illustrated below in ***Table C***.

Table C
Historic Growth Rate Calculation

SH 3 N of Timbercreek Dr		
Year	**ADT**	**Compound Annual Growth**
2017	2,095	
		-4.11%
2018	2,009	
		17.57%
2019	2,362	
2021	2,691	6.73% (average)

The historic growth rate was applied to the most recent historic ADT to project an "expected" 2021 ADT that could be compared to the "actual" 2021 ADT. The "expected" ADT divided by the "actual" ADT is known as the Daily Adjustment Factor.

Equation 1
Example Calculation of Daily Adjustment Factor

$$\frac{\text{"Expected" 2021 ADT}}{\text{"Actual" 2021 ADT}} = \frac{2{,}691}{2{,}333} = 1.15 \text{ Daily Adjustment Factor}$$

The Daily Adjustment Factor describes how "expected" traffic compares to "actual" traffic in 2021:

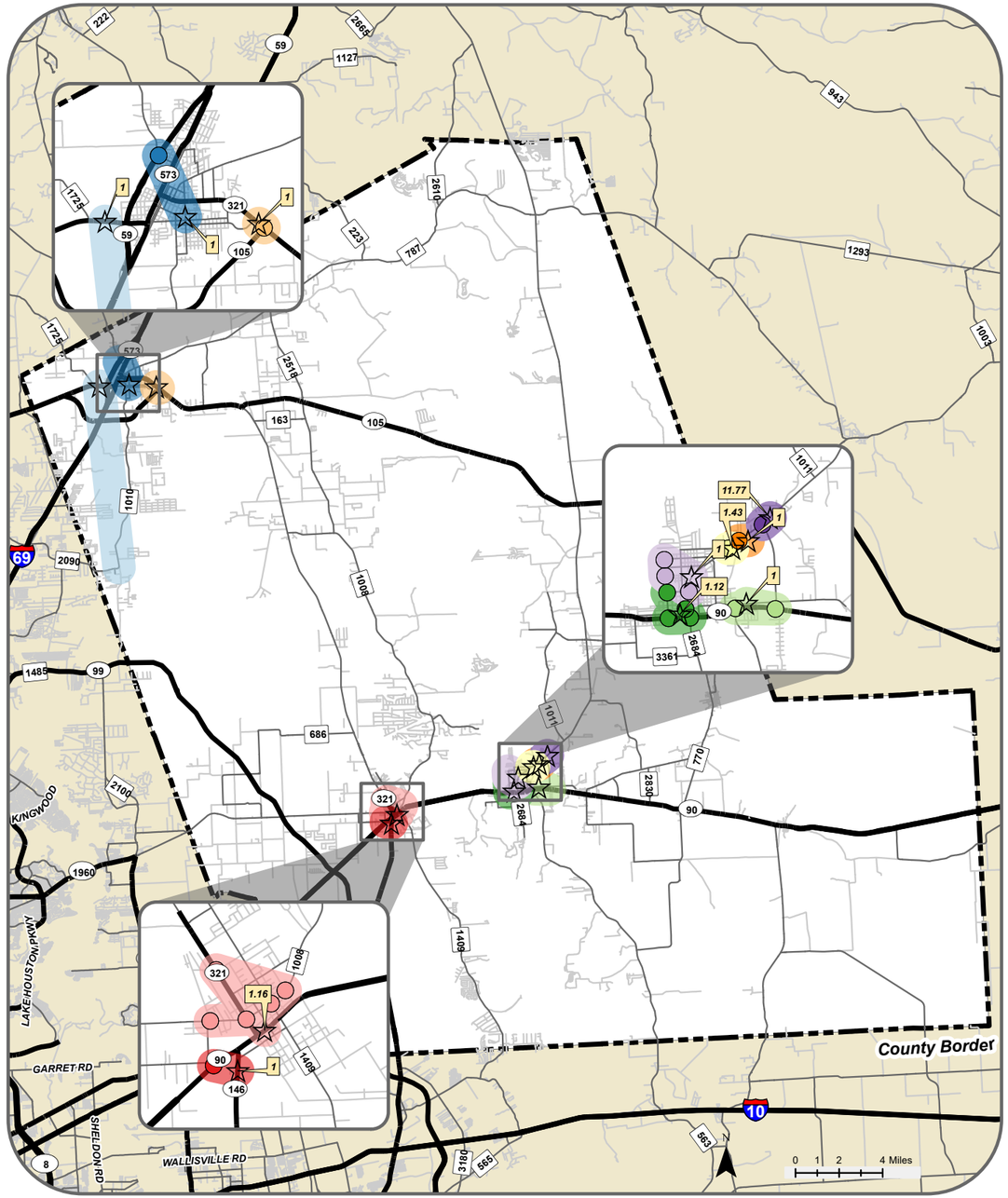
- **Daily Adjustment Factor < 1.0** – "actual" ADT is greater than "expected" ADT, implying that traffic volumes under pandemic conditions are greater than what was projected using the historic growth rate, which is unlikely because activity in public spaces was reduced overall during the pandemic.
- **Daily Adjustment Factor = 1.0** – "actual" ADT equals "expected" ADT, implying that traffic volumes under pandemic conditions are equal to what was projected using the historic growth rate, which is more likely along roadways where activity was still occurring during the pandemic.
- **Daily Adjustment Factor > 1.0** – "actual" ADT is less than "expected" ADT, implying that traffic volumes under pandemic conditions are less than what was projected using the historic growth rate, which matches the assumption that overall traffic was reduced due to the pandemic.

Because it is unlikely for "actual" traffic to be greater than "expected" traffic, the Daily Adjustment Factor was assumed to be 1.0 where it was calculated to be less than 1.0.

Along with ADTs, turning movement counts (TMCs) were collected by CJ Hensch at study intersections in March, April, and May 2021. Again, because traffic reductions were still in effect when this data was collected, using these "actual" TMCs in the analysis would have resulted in underestimated capacity deficiencies. Therefore, the TMCs also needed to be adjusted to reflect non-pandemic conditions before analysis could proceed.

First, each study intersection was associated with the nearest ADT count location, as illustrated in ***Exhibit 3.1.3b***. Each ADT location can have several TMC locations associated with it, therefore it acts as a "parent" to them.

Exhibit 3.1.3b – Map of TMC Locations and Adjustment Factor Clusters



TMCs were collected during the morning (AM) and afternoon (PM) peak hours of each intersection. To obtain the "adjusted" 2021 peak hour volume, the "actual" peak hour volumes were multiplied by the "parent" Adjustment Factor.

FUTURE TRAFFIC VOLUMES

H-GAC travel demand modeling staff provided the study team with travel demand model outputs that projected traffic volumes throughout the study area for years 2020 and 2045. These volumes are bi-directional average daily traffic (ADT) volumes, similar to what was collected in May 2021, representing traffic along every link of roadway larger than a local road (as classified by TxDOT).

Historic growth was used to determine an expected future growth rate in the sub region. The average historic growth rate across all ADT locations is 2%. This compound growth rate was applied to the 2021 adjusted turning movement counts (TMCs) to obtain TMCs for the 2045 analysis scenarios.

3.1.4 CORRIDOR CAPACITY ANALYSIS

Volume-to-capacity ratio (V/C), or how much traffic a roadway serves versus how much it was designed to accommodate, was the key metric used to evaluate mobility along study corridors and determine if installation of additional through lanes should be recommended. Corridors with V/C greater than 0.5 (approaching capacity) are most likely to have new through lanes recommended. Additionally, if through lanes were recommended at study intersections along the corridor after the intersection capacity analysis, then it is possible that new through lanes would be recommended throughout the corridor to maintain a consistent cross-section.

Corridor capacity was estimated using the following guidance from the Highway Capacity Manual (HCM):

- Collect bi-directional, 24-hour vehicle volumes
- Collect K-factor (the proportion of annual average daily traffic occurring in an hour) and D-factor (the proportion of traffic traveling in the peak direction during a selected hour) for years 2016-2021
- Determine the "areawide average" K-factor and D-factor
- Determine AM and PM peak hour volumes from bi-directional 24-hour counts
- Divide each peak hour volume by the average areawide K-factor to calculate two "theoretical" AADTs
- Divide each AADT by the number of lanes of roadway to calculate ADT per lane
- Identify the type of roadway - Urban Street, Two-Lane Highway, Multi-Lane Highway
- Identify the current capacity of the roadway depending on the roadway type, posted speeds, and number of lanes
  - If the roadway is an Urban Street, use HCM Exhibit 16-16
  - If the roadway is a Two-Lane Highway, use HCM Exhibit 15-5
  - If the roadway is a Multi-Lane Highway, use the following ***Table D***, provided by NCHRP 825
- Calculate the Volume-to-Capacity ratios for existing conditions depending on the type, posted speeds, and number of lanes
  - If the roadway is an Urban Street or a Multi-Lane Highway, divide ADT per lane by ADT at LOS E.
  - If the roadway is a Two-Lane Highway, divide AADT by AADT at LOS E.

Table D - Capacity Parameters

Source: NCHRP 825

		Peak Hour Peak Direction (veh/h/ln)			AADT (2-way veh/day/ln)		
Area Type	Terrain	LOS A-C	LOS D	LOS E (capacity)	LOS A-C	LOS D	LOS E (capacity)
Urban	Level	1,360	1,700	1,940	12,600	15,700	17,900
Urban	Rolling	1,270	1,580	1,800	11,800	14,600	16,700
Rural	Level	1,220	1,520	1,730	10,200	12,600	14,400
Rural	Rolling	1,100	1,370	1,560	9,200	11,400	13,000

To estimate the volume side of the V/C ratio, 24-hour vehicle volumes were collected in the study area by CJ Hensch in May 2021. Refer to Section 3.1.2 for details on how these volumes were adjusted.

3.1.5 ACTIVE TRANSPORTATION ANALYSIS

Existing active transportation patterns, using Strava data and data provided by the Brazos Transit District, were examined to identify hot spots. Existing infrastructure was documented to identify gaps within the active transportation network. Then, potential users of the active transportation network were documented, including low-income residential developments, schools, and commercial nodes.

Quantitative and qualitative analyses of available data and stakeholder interviews with the Brazos Transit District and Liberty Dayton Bike Club revealed opportunities and challenges within the County.

Using a combined analysis of these factors, recommendations were made for implementing pedestrian, bicycle, and transit improvements in Liberty County.

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3.2 PUBLIC OUTREACH

3.2.1 PUBLIC INVOLVEMENT PLAN (PIP)

A Public Involvement Plan (PIP) was created for the Liberty County Mobility Study to ensure an open planning process that supports early and continued engagement with the public through timely public notices and easy-to-access information regarding the development of the Liberty County Mobility Study. Actions of the PIP include:

- Collaborating with elected officials by establishing a Steering Committee to guide the technical development of the plan.
- Engaging public and private stakeholders through a series of stakeholder meetings to provide input on the development of the plan.
- Involving residents in the planning process by providing adequate public notice of information with sufficient time to review and comment at public meetings and by providing opportunities to review and comment on the project through various online platforms.

The full PIP can be found in ***Appendix C***.

3.2.2 STEERING COMMITTEE

The Steering Committee consisted of participants from the major agencies within the study area and project team, including Liberty County, the City of Dayton, the City of Cleveland, the City of Liberty, H-GAC, and TxDOT. The purpose of the Steering Committee was to guide the technical development of the Liberty County Mobility Study. Meetings were scheduled at major decision points throughout the project. Technical information and draft public meeting presentations were presented to the Committee for feedback.

MAJOR OUTCOMES

- Stakeholder membership identified
- Agency priorities identified
- Vision and goals confirmed
- Issues and needs for County and all three cities identified and discussed
- Comments from public and stakeholders reviewed
- Draft recommendations reviewed and feedback provided
- Draft report reviewed and revised

A full list of Steering Committee members is included in the acknowledgments section at the beginning of this report. Complete details of each meeting are included in ***Appendix B***.

3.2.3 STAKEHOLDERS

The project team, with feedback from the Steering Committee, formed the study's two Stakeholder Committees. One Committee was focused on the Cleveland area, while the other was centered on the Dayton/Liberty region of the county. The purpose of the Stakeholder Committees was to provide feedback on proposed recommendations and to solicit and build continuing support for report recommendations. Participants in the Stakeholder Committees included representatives for law enforcement; emergency services; government officials and staff members; the real estate and healthcare industries, transportation, education, and general business.

There were two rounds of Stakeholder meetings throughout the life of the project; each round consisted of a meeting for the Cleveland area and a meeting for the Dayton/Liberty area. Due to the COVID-19 pandemic and the need for social distancing, all meetings were held virtually.

MAJOR OUTCOMES

- Additional locations of concern for study added
- Draft recommendations reviewed and feedback provided

Complete details of each meeting are included in ***Appendix B***.

In addition to the meetings above, additional meetings were held to obtain pertinent information from a few key stakeholders, including the Brazos Transit District, the Greater Cleveland Chamber of Commerce, local developers, and representatives of both Class I railroads (Union Pacific and BNSF).

A full list of solicited Stakeholders is included in the acknowledgments section at the beginning of this report. Complete details of each meeting are included in ***Appendix B***.

MAJOR OUTCOMES

- Made aware of future BNSF facility
- Got input about agency priorities and issues
- Received relevant transit data

BRAZOS TRANSIT DISTRICT

Greater Cleveland Chamber of Commerce Established 1935

UNION PACIFIC

BNSF RAILWAY

County Judge Jay Knight addresses members of the public at the public meeting in Liberty, Texas on May 12, 2022.

3.2.4 PUBLIC MEETINGS

Members of the public were given the opportunity to provide feedback through a project website (see next page) and two rounds of public meetings.

The first public meeting, held on April 29, 2021, was held virtually due to the need for social distancing during the COVID-19 pandemic. The purpose of this meeting was to introduce the project's purpose, vision and goals; present existing conditions as well as identified issues and needs; and solicit feedback. A recording of the virtual public meeting was made available on the project website (explained in further detail on the next page) for people to view if they could not attend online.

The second round of public meetings was held in person in May 2022: one public meeting for the Dayton/Liberty area was held in Liberty on May 12, and another was held in Cleveland on May 18. The meeting in Liberty was held concurrently with a meeting for the H-GAC Regional Transportation Plan (RTP) Update. The purpose of these meetings was to present and solicit public feedback on the study's draft recommendations. In addition to the two in-person meetings, a recording of the meeting presentation was placed on the project website for people to view if they could not or did not feel comfortable attending in public.

Complete details of each meeting are included in ***Appendix C.***

Liberty County residents visit with H-GAC staff at the public meeting in Liberty, Texas on May 12, 2022.

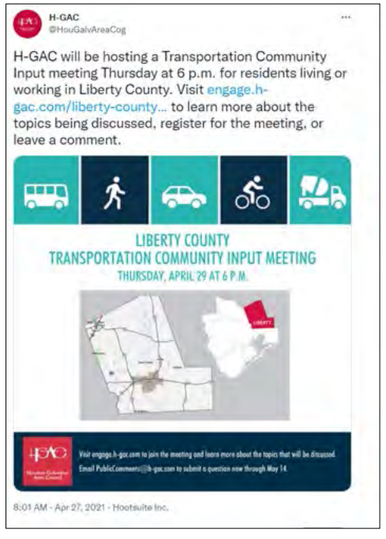
MAJOR OUTCOMES

- Comments about specific problem areas received
- Draft recommendations reviewed and feedback provided

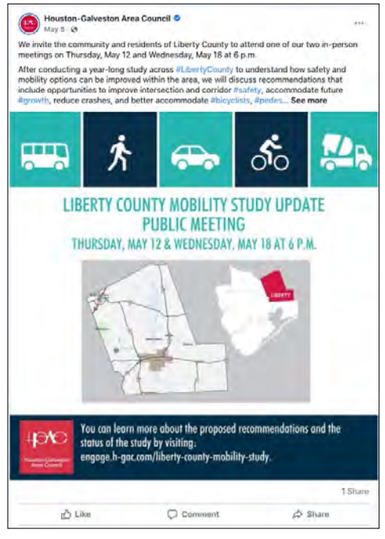
3.2.5 ONLINE INVOLVEMENT

SOCIAL MEDIA

H-GAC posted information about the Study and public meetings to Facebook, Twitter, Instagram and LinkedIn. These posts contained information about the times and locations of upcoming public meetings as well as a link to the project website. A few examples of these social media posts follow:



This post announcing the first public meeting and project website was made to Twitter on April 27, 2021. It received 253 impressions and two retweets.



This post announcing the second round of public meetings and project website was made to Facebook on May 5, 2022.

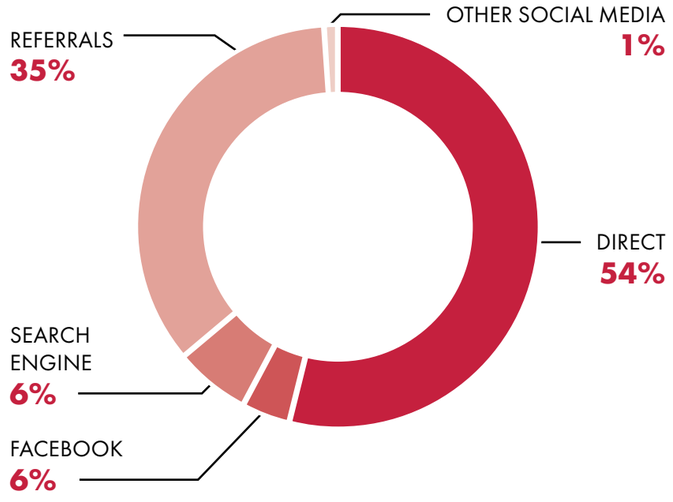
PROJECT WEBSITE

H-GAC hosted an online website to solicit feedback from the public. There were a variety of engagement tools and opportunities to submit input. From the date the website went live on March 19, 2021 to July 17, 2022, there were 704 unique visitors to the webpage and a total of 29 people registered for updates about the project.

704 unique visitors to the webpage

29 people registered for updates about the project

Visits to Webpage Sources



SURVEY RESPONSES

Around the time of the first public meeting, a survey and the map tool were opened to solicit feedback on existing conditions. A total of 48 people visited the survey page; 23 people submitted survey responses. The survey responses are summarized in the graphics.

23 people submitted survey responses

74% lived/worked in Liberty County for 11+ years

Issue Prioritation

MORE IMPORTANT

REDUCE CONGESTION

IMPROVE SAFETY

ADDITIONAL CONNECTIONS/ALTERNATE ROUTES

REDUCE DELAY AT RAILROAD CROSSINGS

MITIGATE HEAVY TRUCK TRAFFIC

MAKE INTERSECTION IMPROVEMENTS

IMPROVE/EXPAND WALKING AND BIKING OPTIONS

IMPROVE/EXPAND PUBLIC TRANSPORTATION

LESS IMPORTANT

Existing Network

Respondents were asked to rank the existing transportation network as good, fair, bad, or no opinion, for seven different categories. The majority of respondents answered that bike lanes and paths, sidewalks and crosswalks, public transit, traffic congestion, and alternative route options are bad, while traffic signals and overall safety is fair. No category was ranked good or no opinion by the majority of respondents.

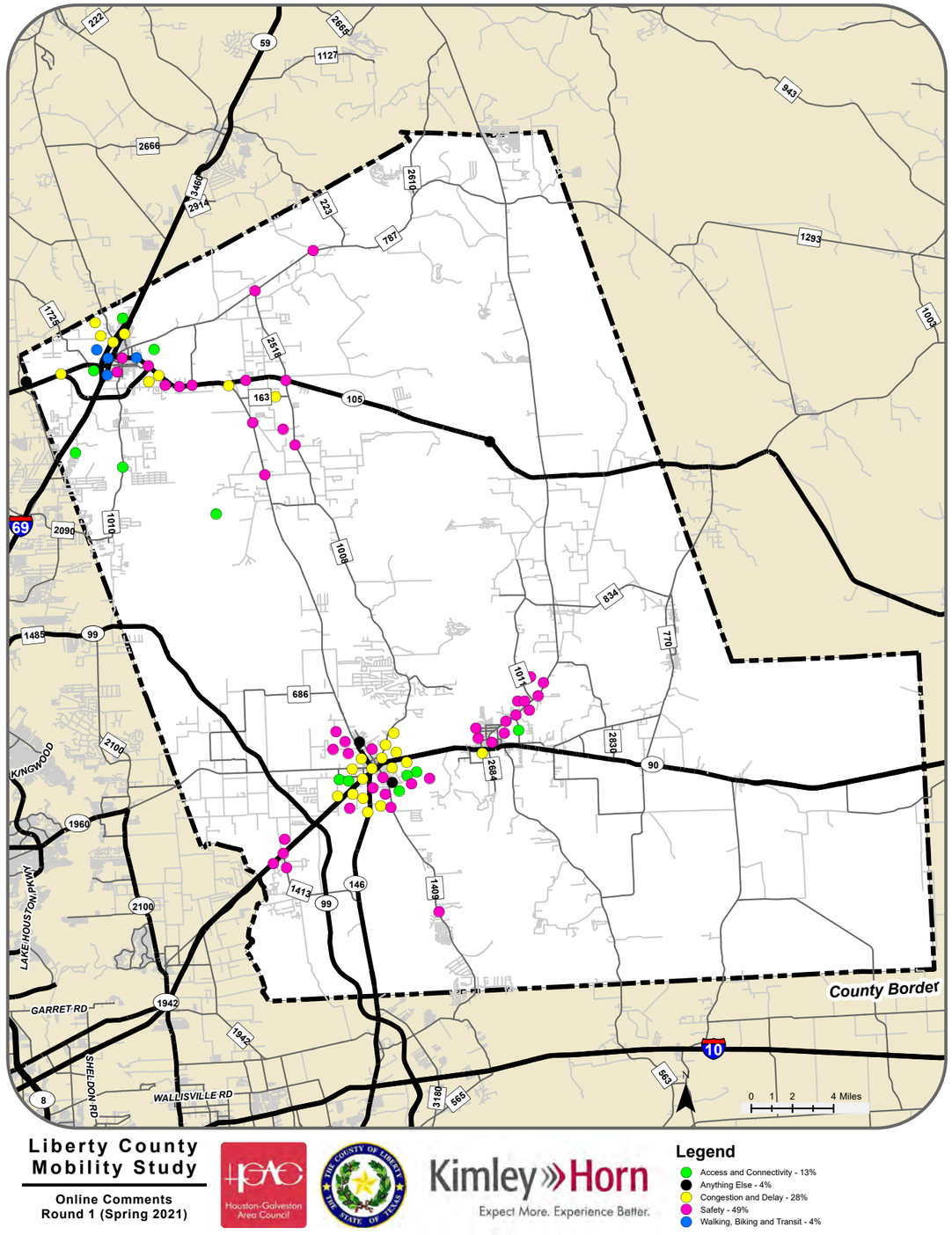
Top Priorities for Transportation Improvements

1. Reduce delay along US 90 through Dayton and Liberty
2. Build a bypass highway around Dayton
3. Reduce delay at railroad crossings
4. Build new roads to provide alternative routes, close gaps and minimize delays

MAPPING EXERCISE

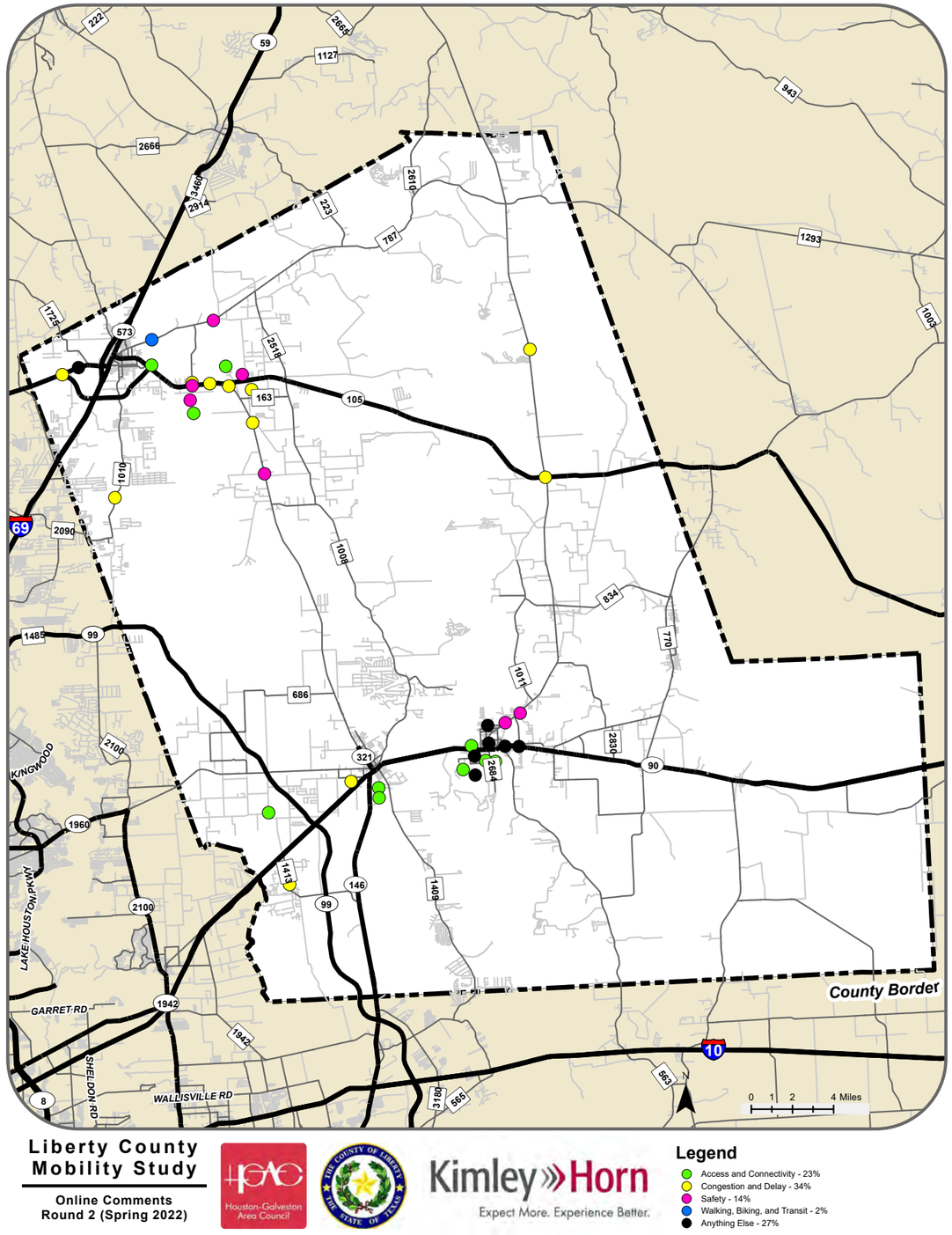
In Round 1, a total of 142 people visited the comment map page; 18 people placed pins on the map for a total of 74 pin submissions. An additional 15 people submitted comments via email. These responses were also mapped and included in the overall analysis. The location and topic (e.g. access, congestion, safety, etc.) of the pins is shown in ***Exhibit 3.2.5a***. The location of markers on this map have been dispersed to show individual markers; the location of each marker may or may not represent its exact location. ***Appendix C*** provides exhibits showing the exact location of each marker, as well as a table with corresponding comments.

Exhibit 3.2.5a – Round 1 (Spring 2021) Public Comments



In Round 2, a total of 14 pin submissions were made on the comment map page by members of the public and 22 were made by Steering Committee members. The location and topic (e.g. access, congestion, safety, etc.) of the pins is shown in ***Exhibit 3.2.5b***. The location of each marker may or may not represent its exact location. ***Appendix C*** provides exhibits showing the exact location of each marker, as well as a table with corresponding comments. Additional comments were collected during in-person public meetings, which can be found in ***Appendix C***.

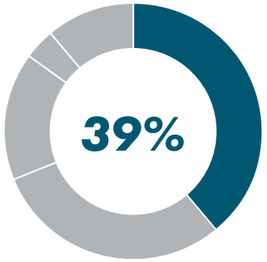
Exhibit 3.2.5b – Round 2 (Spring 2022) Public Comments



3.2.6 MAJOR FEEDBACK THEMES

ROAD SAFETY

Throughout this study, 39% of all public comments expressed concerns about road safety.

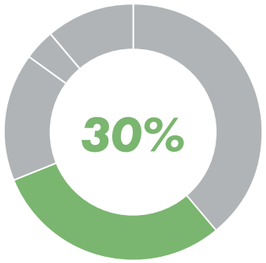


RECURRING COMMENTS

- Intersection of FM 1413 and US 90 is very dangerous; would like to see an overpass or signalized intersection constructed
- Using residential streets to avoid traffic on main roads – US 90, SL 227 – and speeding
- Insufficient lighting and signage along the SH 105 bypass around Cleveland leads to crashes with commercial vehicles

CONGESTION AND DELAY

Throughout this study, 30% of all public comments expressed concerns about congestion and delay.

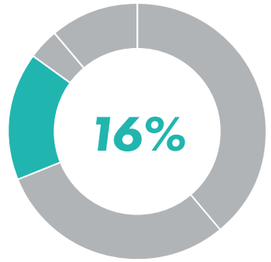


RECURRING COMMENTS

- Uncoordinated traffic signals along US 90
- Trains and flooding cause major delays in Dayton
- Commercial vehicles make large, slow turns that delay the vehicles behind them
- Long school pick-up and drop-off queues in Liberty

ACCESS AND CONNECTIVITY

Throughout this study, 16% of all public comments expressed concerns about access and connectivity.

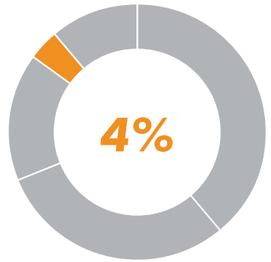


RECURRING COMMENTS

- Cleveland ISD would like access to FM 2025/Old Cold Spring Road (proposed Northside Boulevard)
- New subdivisions in the Plum Grove area put strain on existing roadways
- Drivers in Dayton need alternative routes to US 90

TRANSIT AND ACTIVE MODES

Throughout this study, 4% of all public comments expressed concerns about transit, active modes, and other non-vehicular modes of travel in the county.



RECURRING COMMENTS

- Sidewalks needed along SH 321/ Houston Street in Cleveland – students and wheelchair-users currently use the road shoulders
- Limited sidewalks, bike paths, or shoulders to provide pedestrian access to public parks

**The remaining 11% of all comments pertained to other topics*

4

Liberty County

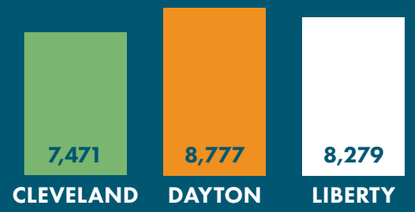
- 4.1 Existing Conditions
- 4.2 Policy and Practices Assessment
- 4.3 Analysis and Recommendations

Liberty County

4.1.1 DEMOGRAPHICS

POPULATION

Based on data from the US Census Bureau, the total population of Liberty County was 91,628 people as of the 2020 Census. The population of the three largest cities accounted for 24,527 people (26.8%) of the total population in Liberty County in 2020 and can be broken down as follows:



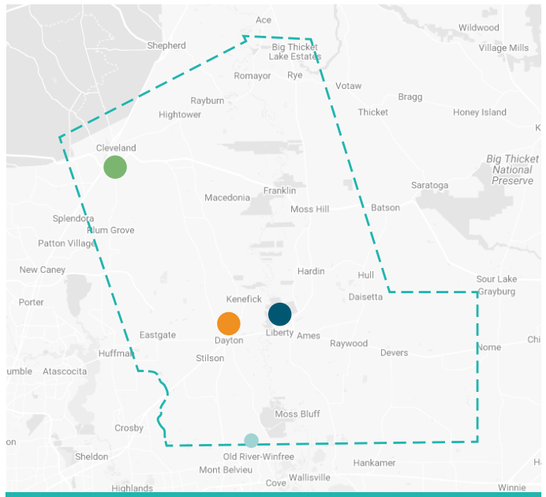
POPULATION DENSITY

LIBERTY COUNTY	STATE OF TEXAS
79	112
PERSONS PER SQ. MILE	*PERSONS PER SQ. MILE*

AVERAGE HOUSEHOLD SIZE

LIBERTY COUNTY	STATE OF TEXAS
3.34	2.94
PERSONS	*PERSONS*

4.1 EXISTING CONDITIONS



LIBERTY COUNTY TOTAL POPULATION: **91,268**

Relative to the State of Texas, Liberty County is sparsely populated. The population density of the county is 79 persons per square mile, whereas the state's is 112 persons per square mile. However, the major cities of Liberty County are much denser than the county overall. Population densities of Cleveland, Dayton, and Liberty are 459, 360, and 195 persons per square mile, respectively.

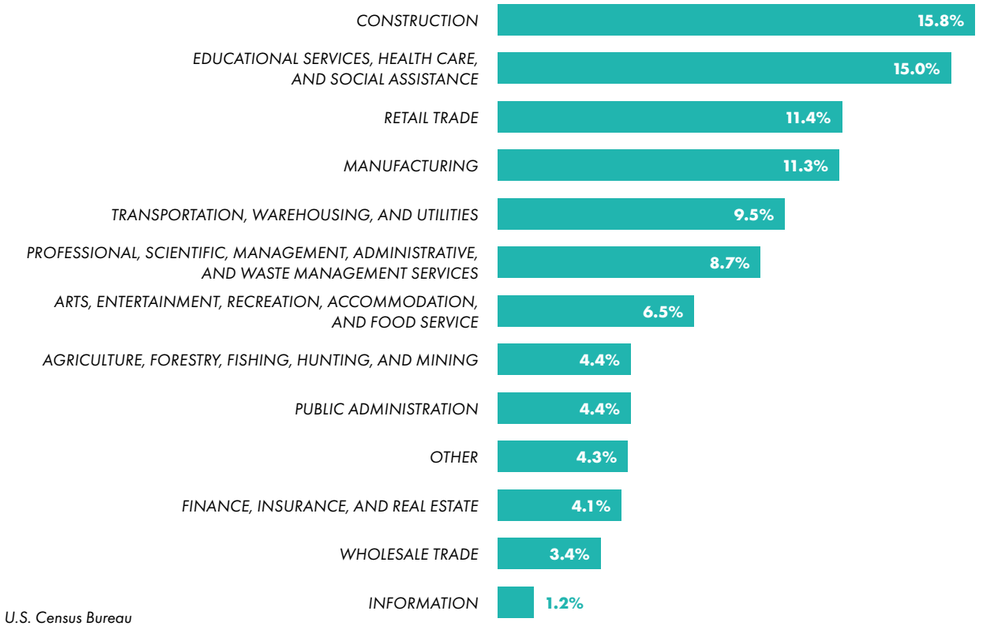
Despite being more sparsely populated, more individuals live in each household in Liberty County than in the State of Texas overall. In the county, average household size is 3.34 persons, whereas in the state, average household size is 2.94 persons.

Liberty County is facing significant growth due to expanding residential, commercial and industrial development. According to the US Census, the county's population has increased from 75,643 people in 2010 to 91,268 people in 2020 – a growth rate over twenty percent – and from 2019 to 2020, the population grew 9.5%.

EMPLOYMENT

Employment opportunities in Liberty County are available in a variety of industries. The construction industry is expected to grow over the next twenty years due to increased residential development along and near the Grand Parkway (SH 99). The Grand Parkway will also shorten travel times to Port of Houston facilities, making Liberty County more attractive for industrial and logistics development.

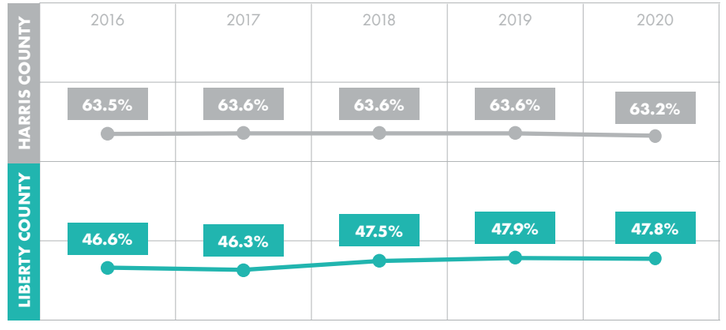
INDUSTRIES IN LIBERTY COUNTY



Source: U.S. Census Bureau

EMPLOYMENT RATE (%)

The overall employment rate in Liberty County is lower than that in the neighboring Harris County, but it has been steadily increasing since 2017. With the anticipated development and growth in the area, employment rate is expected to increase.

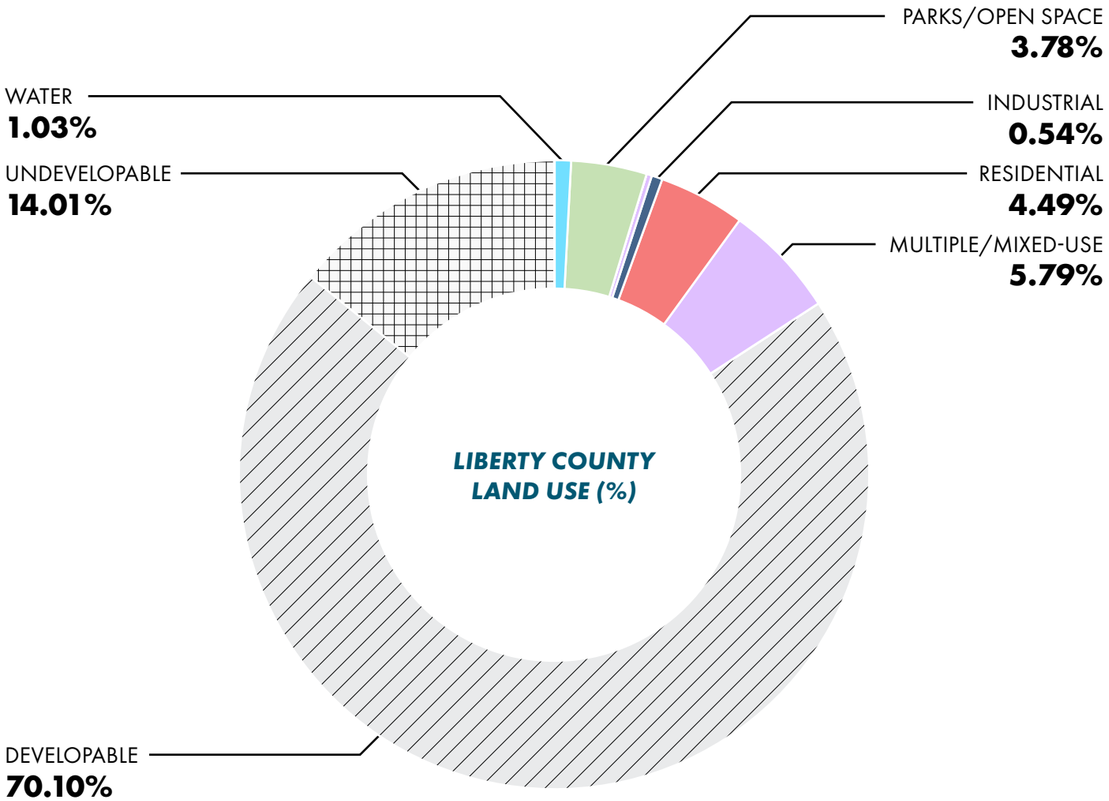


Source: U.S. Census Bureau

4.1.2 LAND USE

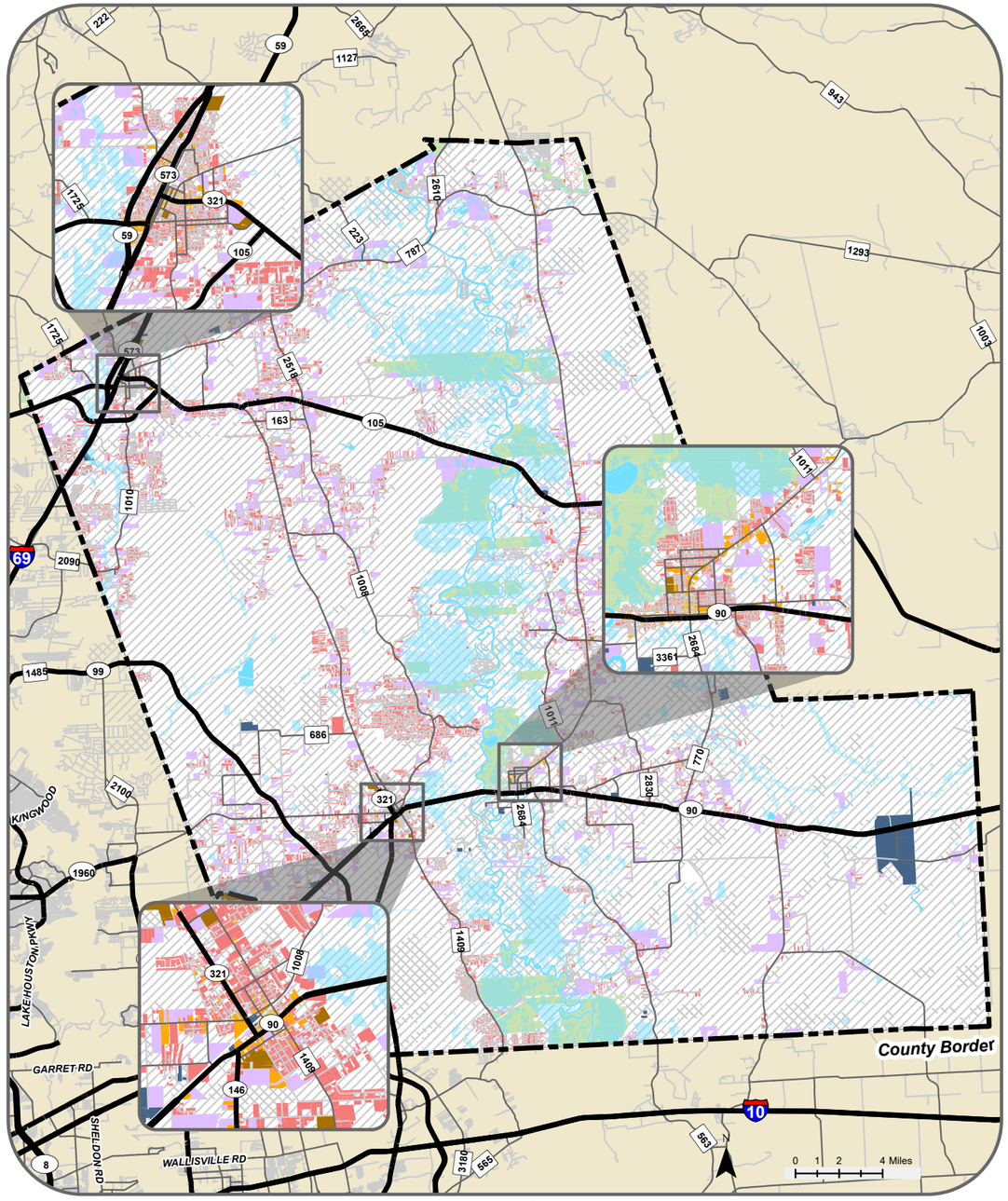
Liberty County encompasses 1,176 square miles of land east of Harris and Montgomery Counties and north of Chambers County. It is a predominantly rural county with sporadic development, 3 major cities, and 10 smaller and unincorporated communities. As such, land use throughout the county is varied.

Most of Liberty County is undeveloped rural land with large natural ecological areas along the Trinity River, including the Trinity River National Preserve Wildlife Refuge and parts of the Big Thicket National Preserve. Residential and commercial development is concentrated within the downtown areas of Cleveland, Dayton, and Liberty and along state highways. ***Exhibit 4.1.2a*** illustrates the distribution of land use throughout Liberty County.



Source: H-GAC Regional Land Use Information System (R-LUIS)

Exhibit 4.1.2a – Land Uses in Liberty County



Source: H-GAC R-LUIS; as development continues, map does not reflect current conditions in certain areas

Institutional land use refers to government buildings, schools, and hospitals. Vacant Undevelopable land is land that cannot be practicably developed due to natural characteristics, whereas Vacant Developable land can be developed but may include existing farmland.

Wetlands are prevalent throughout Liberty County, as described in the Environmental Features section. However, most of the land in Liberty County is developable – currently vacant or used for agriculture – thus, there is potential to accommodate the expected growth.

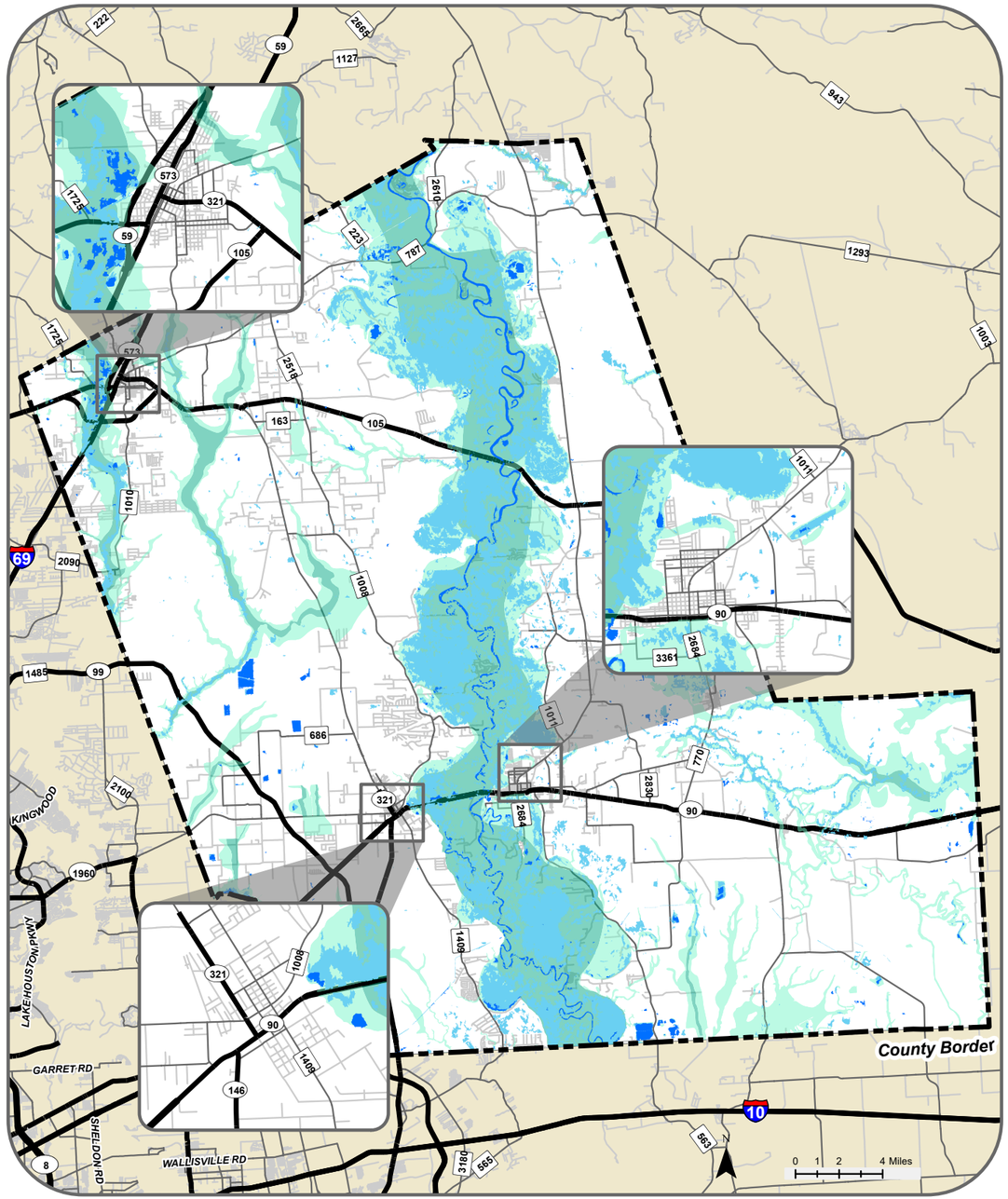
ENVIRONMENTAL FEATURES

Approximately 77 miles of the Trinity River run through the County, splitting it nearly in half between the cities of Liberty and Dayton. The river flows south from the Dallas area and empties out into Trinity Bay, part of the Port of Houston.

715 square miles of Liberty County is in the floodway or 100-year floodplain, mostly concentrated along the Trinity River. Additionally, 111 square miles of Liberty County are considered wetlands and may be undevelopable. See these waterways in ***Exhibit 4.1.2b***.

While these waterways pose the threat of flooding, they can also serve as potential recreational space and natural paths for hike and bike trails. Currently, there are 49 total square miles of park space in Liberty County, including part of Big Thicket National Preserve. See the location of parks and open spaces in ***Exhibit 4.1.2a***.

Exhibit 4.1.2b – Environmental Features in Liberty County



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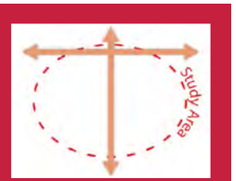
4.1.3 TRANSPORTATION

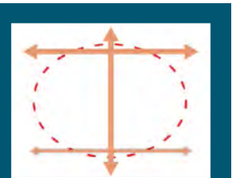
ROADWAYS

The transportation network in Liberty County was built on a rural roadway network. Roadways are classified by TxDOT to better regulate uses as well as maintain safety and efficiency.

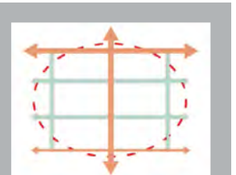
INTERSTATE: These roadways have the highest capacity and span the longest distances with limited access points, allowing great distances to be traveled without excessive delay. Interstate Highway 69 (IH-69) is the only interstate in Liberty County.



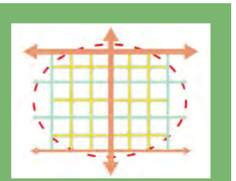
FREEWAY/EXPRESSWAY: Similar to interstates but serving shorter distances. As they are limited access, they do not directly serve the adjacent land uses. The Grand Parkway (SH 99) is an example of an expressway in Liberty County, even though it is tolled.



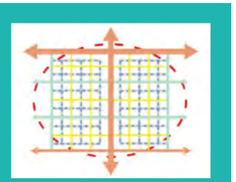
PRINCIPAL ARTERIAL: High-capacity, high-speed roadways that have at-grade crossings and directly serve adjacent land uses, although access is still more limited than lesser classifications. Principal Arterials typically connect cities and major communities. Examples of Principal Arterial roads in Liberty County are US 90 and SH 105.



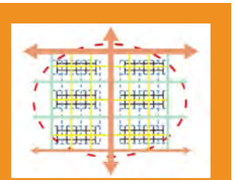
MINOR ARTERIAL: Major roadways that provide connectivity within communities. Minor Arterials connect Major Collectors to Principal Arterials. Examples of Minor Arterial roads in Liberty County are FM 563 and SH 146.



MAJOR COLLECTOR: Moderate capacity roadways providing connections from local roadways to Minor Arterials. Examples of Major Collectors in Liberty County are FM 787 and FM 563.



LOCAL: Minor Collector roadways collect traffic from local roads and abutting lots and conduct it to a higher class of road. Examples of Minor Collectors in Liberty County are FM 2830 and FM 834.



The following are important corridors are illustrated in ***Exhibit 4.1.3a***:

- **State Highway 146 (SH 146)** runs north-south through the center of the county, connecting the cities of Dayton and Liberty with Mont Belvieu and Baytown to the south.
- **US Highway 90 (US 90)** runs east-west through the southern third of the county, connecting Dayton and Liberty with Beaumont and Louisiana to the east and Houston to the west.
- **State Highway 99 (Grand Parkway)** is a 180-mile circumferential highway traversing seven counties in the Greater Houston Area. It improves mobility between the outer suburbs of Houston and is being used by residents to gain better access to Bush Intercontinental Airport, employment, and commercial opportunities in the North Houston suburbs. Construction of the section through Liberty County was completed in 2022. The section of Grand Parkway in Liberty County extends from IH-69 to IH-10, provides an additional evacuation route with decreased congestion, and is expected to encourage more development in Liberty County.
- **IH-69/US 59** connects Cleveland with Houston to the southwest and other cities to the north.
- **FM 573/Washington Avenue** runs through downtown Cleveland, allowing north-south traffic to permeate the city rather than passing it by along IH-69/US 59.
- **SH 105/Southline Street** pierces into the core of Cleveland, providing access to the main north-south corridors in the city: IH-69/US 59 and FM 573. SH 105 extends west to Conroe and provides access to IH-45. SH 105 also has a section that bypasses Cleveland to the south, providing a path for heavy vehicles and long-distance commuters that avoids signalized intersections.
- **SH 321/Houston Street** connects Cleveland to Dayton in the south. It also acts like a "Main Street" in downtown Cleveland.
- **FM 1010/Plum Grove Road** connects Cleveland to the City of Plum Grove. Due to the expected explosive growth in the Colony Ridge development adjacent to Plum Grove, this is an up-and-coming major corridor in Liberty County. Currently, there is no direct interchange between FM 1010 and SH 99.

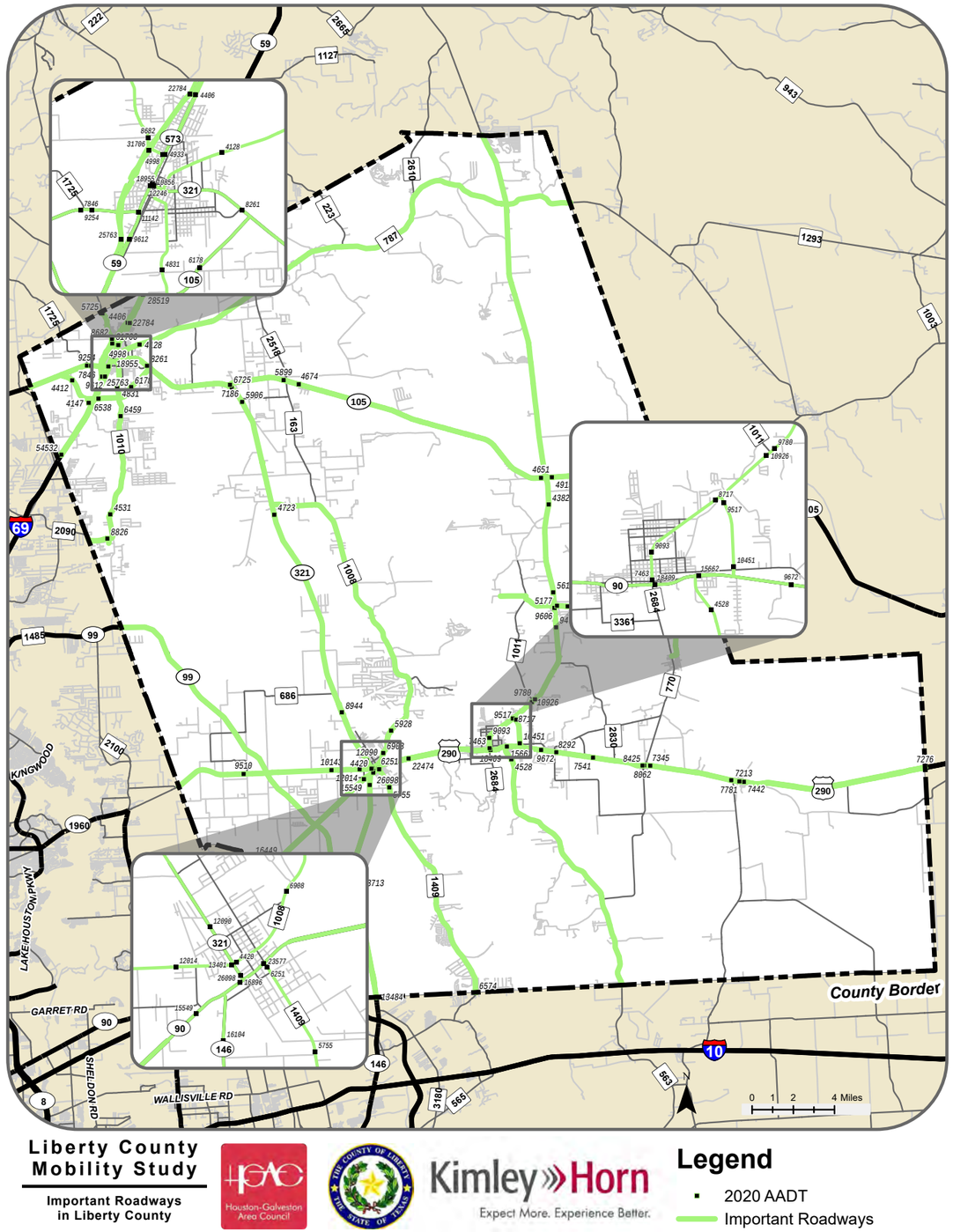
It should also be noted that TxDOT plans to conduct two projects along the Grand Parkway (SH 99) within Liberty County during the timeframe of this study (before year 2045). These projects are as follows:

- **SH 99 from Community Drive to US 90** – expand from 2 toll lanes to 4 toll lanes
  - Projected letting Fiscal Year 2032
  - Projected Open to Traffic by 2035
  - Estimated Total Cost: $220M CAT 3 Toll 100% State funded
- **SH 99 from US 90 to Liberty/Chambers County Line** – expand from 2 toll lanes to 4 toll lanes
  - Projected letting Fiscal Year 2036
  - Projected Open to Traffic prior to 2040
  - Estimated Total Cost: $176M CAT 3 Toll 100% State funded

Below is a list of TxDOT's other programmed expansion projects for the County. Any recommendations listed within this report should be coordinated with TxDOT where projects overlap:

- US 90 at Union Pacific Railroad in Dayton: bridge construction
- US 90 from FM 160 E to SH 61 - widen road, add lanes
- US 90 from FM 563 to FM 160 - widen road, add lanes
- US 59 from Cleveland Bypass to Montgomery County Line - construct new road
- SH 105 from Montgomery County Line to BS 105T - widen road, add lanes

Exhibit 4.1.3a – Important Corridors in Liberty County



ACTIVE MODES

The existing active transportation network in Liberty County is limited. Data collected from H-GAC's Open Data portal indicates that there are approximately 11.7 miles of existing sidewalks in the county, which exist entirely within city limits. There are no designated on-street bikeway facilities within or between any of the cities within the county.

Denser areas with more concentrated land uses have the potential to generate more biking and walking trips. Major destinations include natural areas, parks, and schools. There are seven independent school districts (ISD) within or partially within Liberty County, including Cleveland ISD, which is the fastest growing school district in the state of Texas. Student transportation may increase demand for Safe Routes to School (SRTS) opportunities, especially for newly built schools.

A high-level review of existing plans reveals that there is varying interest in building and implementing active infrastructure among cities and the county.

- The **Liberty County Community Plan** prioritizes areas near schools for robust sidewalk networks, downtown areas with the county's three largest cities are prioritized for bike lane facilities, and undevelopable natural areas along creeks are prioritized for hike and bike trails to preserve floodplains.
- The **Dayton Tomorrow 2035 Comprehensive Plan**, completed in 2017, specifically recommends the City develop a Bicycle and Pedestrian Master Plan and proposes a multiuse sidewalk along SH 321 near Grand Parkway that could be the "spine" of such a plan. Not exclusively centered on bicycle and pedestrian improvements, the 2019 Dayton Mobility and Infrastructure Strategy focuses on needed investments to maintain the transportation network with the city, reduce traffic congestion, and improve pedestrian safety.

Popular fitness and activity tracking apps are widely available on smartphones, smart watches, and bike computers. One such platform, Strava, allows its user data to be mapped by public agencies to highlight areas where there is bicycling and walking demand and better understand where infrastructure improvements may be desired. Although a useful database of information, one caveat with Strava data is that the data collected is user reported and not fully representative of a community's full demographics, especially for people who do not use Strava or other GPS tracking apps to share their data; Strava users tend to skew white, male, and median age.

Pedestrian Infrastructure

Sidewalks are neither standard nor uniformly available within the county's three largest cities; sidewalks are not present within the county outside of Cleveland and Dayton except for newer subdivisions recently built outside of these city boundaries due to growing family households moving to Cleveland ISD. Across the county, sidewalks are not generally provided for students to walk to and from school campuses, although some school campuses have limited sidewalks within campus between buildings and outdoor play areas and fitness facilities. Both the Liberty County Community Plan and Dayton Tomorrow 2035 Comprehensive Plan specifically call out the need to improve pedestrian safety and provide sidewalk connections for students walking and biking to schools.

Where there are sidewalks present, short and discontinuous segments, a lack of ADA accessible curb cuts or curb ramps, narrow non-ADA compliant sidewalk widths, deteriorating concrete and other materials, unmarked crosswalks, and a lack of trees, shade, and greenspace buffer or boulevards separating pedestrians from parking and auto travel lanes presents an unwelcoming pedestrian environment.

The annual Strava data for pedestrians indicates the highest frequency of walking occurs within or immediately adjacent the city boundaries of Dayton and Liberty, followed by Hardin and Cleveland. There is limited user-reported pedestrian activity outside of these four cities, but hotspots include the Eastgate community, the Tarkington School campuses, and the Chain-O-Lakes Resort (see Exhibit 4.1.3b).

Bicycle Infrastructure

Although there are no designated on-street bicycle facilities anywhere within Liberty County, there are several shared biking and walking trails within natural areas: the Butler Tract Trail, the Brierwood Tract-Gaylor Lake Loop, the Paige Trail, and the McGuire Tract-Greens Bayou Loop in or near the Trinity River National Wildlife Refuge.

According to bicycle recreationalists and advocates, the lack of route options other than major auto thoroughfares presents one of the biggest challenges for cycling in Liberty County. One suggestion is to use bike and shared use paths as a floodplain management strategy to prohibit additional development in environmentally sensitive, natural areas. There is a lack of funding and governmental interest for bike routes and paths, especially regarding the expense of planning, implementing, and maintaining bike lanes, according to bicycle advocates. A pressing concern is the repaving of older roadways with larger aggregate materials that create rough and uneven surfaces that are not suited for bike travel; repaved roadways which once had smoother gutter and shoulder areas for biking are becoming inaccessible to bicycle riders and are not adequately swept or maintained.

The annual Strava data for bicyclists indicates a demand for cycling between the county's cities and communities along major routes such as US 90 and SH 146, with the highest demand along SH 146 between Liberty, Hardin, and Big Thicket Estates and within Plum Grove along Plum Grove Road. There is also moderate demand between Cleveland and Big Thicket Estates along FM 787 (see ***Exhibit 4.1.3b***).

In sum, opportunities and challenges for implementing active transportation improvements in Liberty County were identified through quantitative and qualitative analysis of available data and stakeholder interviews.

OPPORTUNITIES

- A confluence of civic uses, restaurants, services, and tourist destinations and accommodations in the downtown areas of Cleveland, Dayton, and Liberty offer opportunities for implementing sidewalk networks.
- School campuses lack sidewalk connections to surrounding residential neighborhoods, representing opportunities to serve existing and new schools with pedestrian infrastructure.
- Environmentally sensitive areas, such as floodplains near natural amenities, may provide a major north-south trail route across most of the county that could also potentially reduce or prevent development pressures.

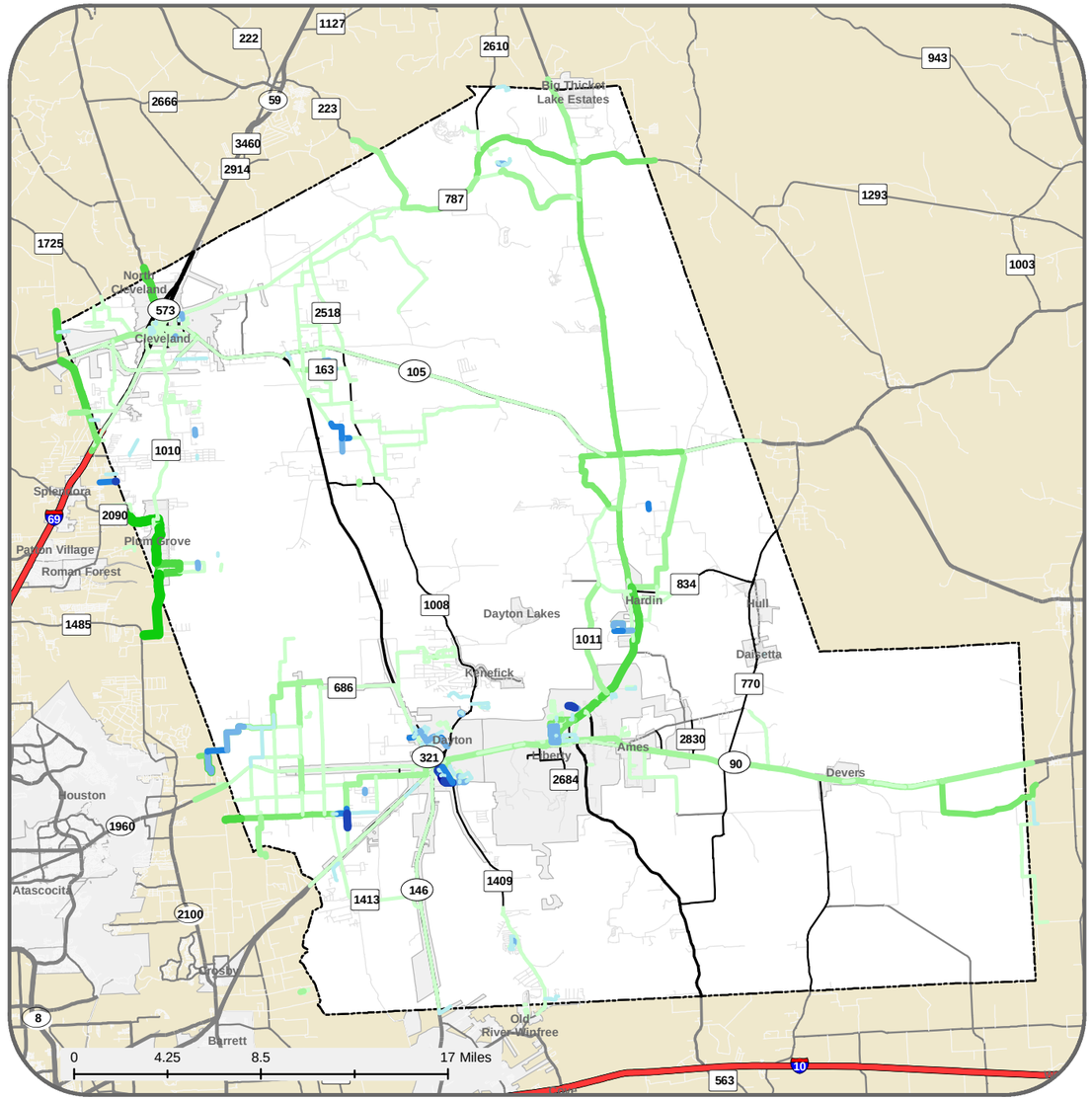
CHALLENGES

- There is a lack of connected sidewalks and sidewalk networks; where sidewalks do exist, these segments are partial, discontinuous, lack ADA accessible curbs and widths, and have deteriorating pavement, concrete, and/or asphalt conditions.
- There are limited funding sources for improvements at the local and county levels.

RECOMMENDATIONS

- Many of the intersection and corridor recommendations contained in this study include active transportation improvements including pedestrian elements, sidewalks and shared use paths. These recommendations are intended to address safety and mobility concerns specific to that intersection or corridor, and do not constitute a countywide active transportation network.
- The County and the Cities of Cleveland, Dayton, and Liberty should coordinate with TxDOT regarding bicycle and pedestrian modes as part of any future TxDOT widening or upgrade project. TxDOT has mandated that non-motorized travel modes be included in all projects; this would facilitate developing a county-wide active transportation network as major roads are upgraded to accommodate continuing growth in Liberty County. TxDOT's Transportation Alternatives Set Aside (TASA) programs could cover active transportation projects as well.
- The County and Cities should also apply through H-GAC for Local Active Transportation Studies which focus on developing bicycle and pedestrian networks for cities and districts within the region. Municipalities may also apply for federal funding for active transportation projects through H-GAC's Transportation Alternatives Set Aside (TASA) and Congestion Mitigation and Air Quality Improvement program (CMAQ) programs.
- Additionally, each city should investigate applying for a H-GAC Livable Centers Study. H-GAC's Livable Centers program includes non-motorized travel modes as a focus. This program has led to participating cities and districts implementing improvements to enable people to live, work, and play with less reliance on automobiles.

Exhibit 4.1.3b - Liberty County Combined Bicycle and Pedestrian Strava Activity



Source: Strava, TxDOT Roadway Inventory

Strava Activity Counts

Pedestrian Strava Activity

- 5 - 20
- 21 - 60
- 61 - 120
- 121 - 215
- 216 - 330

Bicycle Strava Activity

- 5 - 60
- 61 - 150
- 151 - 270
- 271 - 475
- 476 - 875

TRANSIT

The Brazos Transit District (BTD) provides public transportation services in Liberty County and the surrounding area. Cleveland, Liberty and Dayton are served by fixed bus routes. Additionally, shared-ride, curb-to-curb ADA Paratransit and Demand Response service is provided within the City of Cleveland. ADA Paratransit is a service for people with disabilities who desire to be picked up from and dropped off at locations within 3/4 of a mile from one of the established fixed route in Cleveland. Demand Response is available to any person regardless of disability and may pick up or drop off riders anywhere within the city.

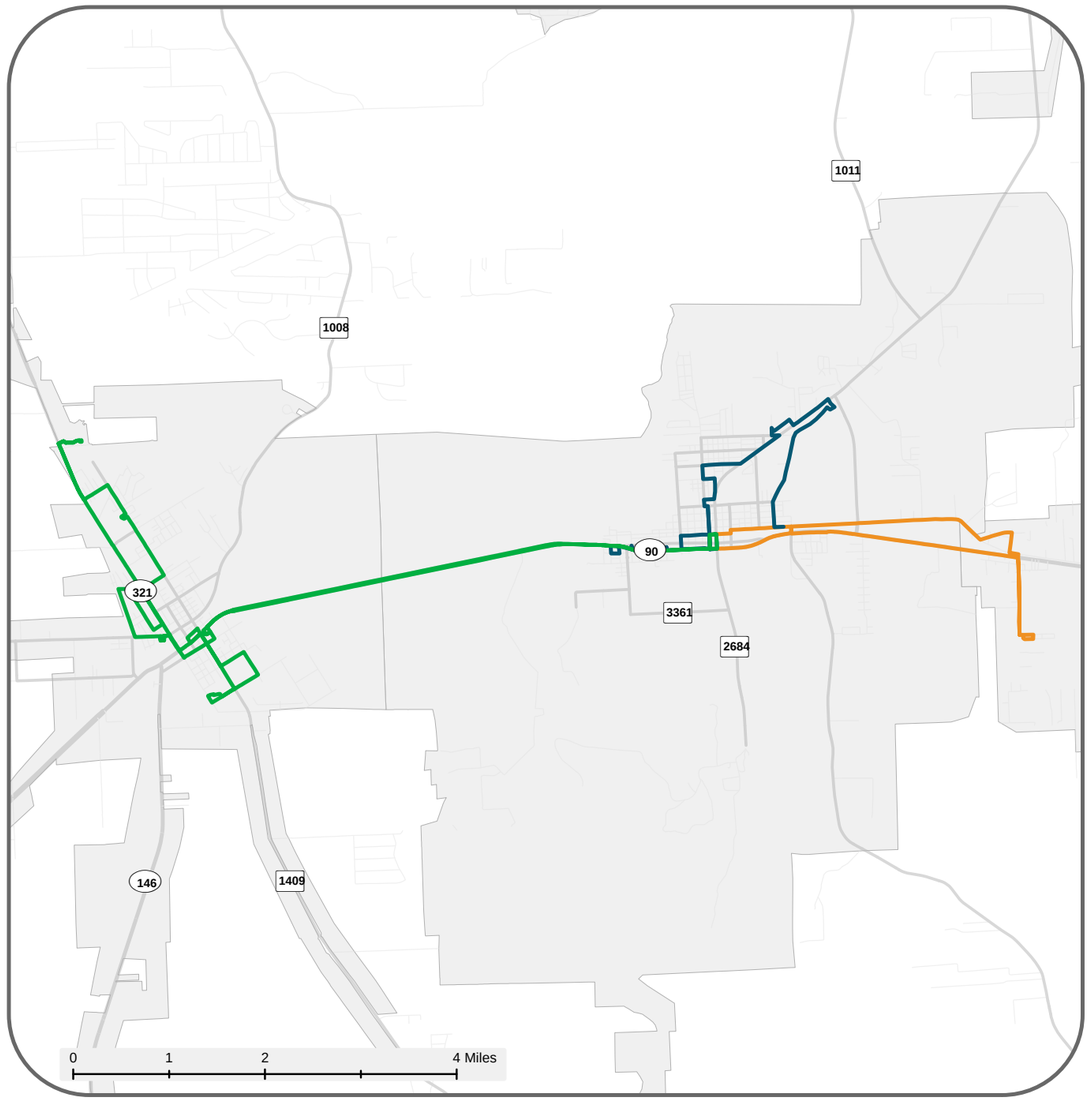
Two fixed routes serve Liberty County (see ***Exhibit 4.1.3c*** and ***d***): the City of Cleveland has one fixed circular route that runs at 60-minute frequencies, and the cities of Dayton and Liberty share one fixed route that circulates around each city and provides transportation between both cities' core areas four times per day. The fixed routes operate on weekdays from 9:00 am to 4:00 pm and service is not available on major federally-recognized holidays. One-way fixed route rides cost $1.00 for the public and are $0.50 for seniors, people with disabilities, individuals covered by Medicare, and children aged 6-12 years of age. Rides are free for children under 6 years of age with a paying customer. Neither fixed route has established bus stops; riders flag down buses along the route to board and communicate to the driver where they would like to disembark. Currently, no funding is dedicated to bus stops. The agency has considered that "flex zone" service may better serve patrons with on-demand services. Other transit providers in the region, such as Fort Bend County Transit, have reported success with this type of service.

Both ADA Paratransit and Demand Response services in Cleveland require an appointment for service. Riders are able to book trips on the same day based on availability. However, The BTD recommends booking at least a day in advance. BTD reports that Demand Response service cannot accommodate all requests; all time slots a week out are typically booked within 15 minutes of opening the schedule. Service operates on weekdays from 6 to 10 am and 2 to 6 pm, and is not available on major federally-recognized holidays.

Ridership data for the two fixed routes shows that there was a decline in ridership from 2018 to 2020, with ridership numbers for Cleveland remaining depressed into 2021 but Liberty-Dayton route ridership numbers tracking consistently with 2019 and 2020 figures. During this time, the Cleveland fixed route's total annual ridership varied from 11,800 to 16,500 passengers. The Liberty-Dayton fixed route experiences far less ridership than the Cleveland fixed route with a total annual ridership ranging between 4,000 and 7,600 passengers. Cleveland's higher fixed route ridership may be explained by its higher frequencies as well as the high incidence of trips to necessary grocery and retail service areas such as Walmart and H-E-B.

These routes have experienced minimal changes since service became operational, and stakeholder feedback suggested that there may be a need for a fixed stop at the courthouse in Liberty as well as service extensions from Dayton to Downtown Houston, a major employment destination. One suggestion may be the inclusion of park and ride facilities, which would require coordination with other service providers.

Exhibit 4.1.3c - Fixed Transit Routes in Cities of Davton and Libertv



Source: H-GAC Open Data, TxDOT Roadway Inventory, Brazos Transit District

A high-level review of existing plans highlights the level of effort related to bicycling, pedestrian, and transit improvements in Liberty County.

- The **Liberty County Transit Plan** suggests service and operations improvements, including park-and-ride options, interagency collaboration, and improving on-demand services. Proposed park-and-ride routes include service between Cleveland and METRO's Townsen Park and Ride, Liberty-Dayton to Baytown, Liberty-Dayton to Beaumont, and Liberty-Dayton to Cleveland. Public comments requested better integration between last mile connections to the transit system and bike racks on buses.
- The **High-Capacity Transit Task Force Priority Network**, which is the transit component of the current 2045 Regional Transportation Plan (RTP), recommends a future park and ride bus service between Dayton and downtown Houston and the Texas Medical Center, as well as regional bus routes linking Cleveland to the Townsen Park and Ride and Dayton to Mont Belvieu and Baytown.

In sum, opportunities and challenges for implementing transit improvements in Liberty County were identified through quantitative and qualitative analysis of available data and stakeholder interviews with Brazos Transit District.

CHALLENGES

- Transit demand exceeds on-demand supply, highlighting capacity challenges; there are no formal bus stops with shelters, benches, signage, or other amenities; a lack of a dedicated funding source, such as a sales or ad valorem tax or impact fees, limits the ability for the Brazos Transit District to supply additional service.

OPPORTUNITIES

- Serve areas of frequent transit fixed route boardings and alightings "hotspots" with improved pedestrian infrastructure and dense mixed development.

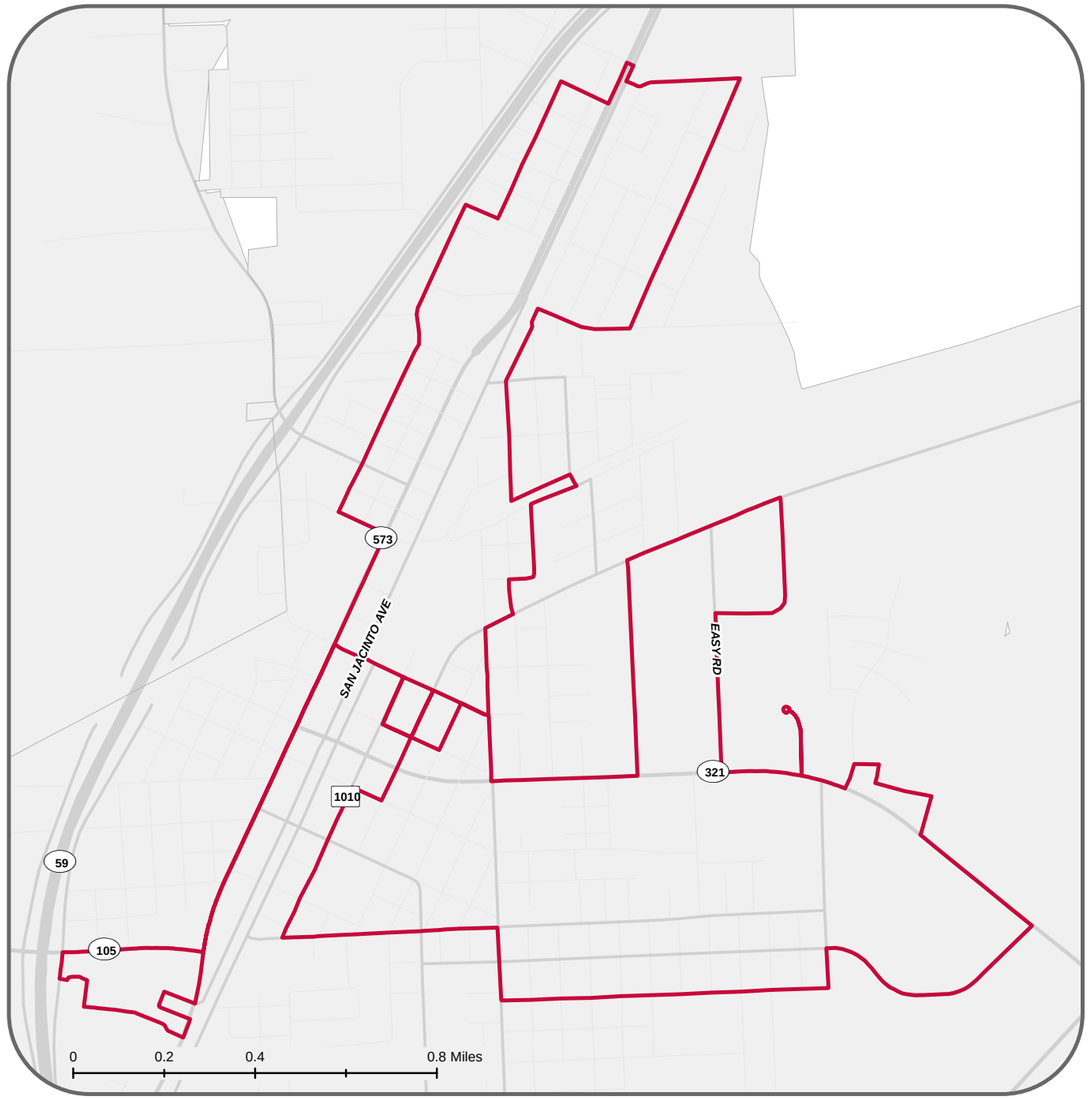
RECOMMENDATIONS

Liberty County and the cities of Cleveland, Dayton and Liberty should work with the Brazos Transit District and H-GAC to participate in future studies and consider future transit improvements as the county's population continues to grow. Specific elements could include:

- Flex Zone Operations
- A Park-and-Ride lot near Dayton to serve commuter bus service into downtown Houston and the Texas Medical Center
- Countywide rural demand response service
- A Park-and-Ride lot near Cleveland to serve trips connecting to services provided by Houston METRO and The Woodlands Transit

H-GAC and the City of Dayton have partnered to conduct a Dayton-specific transit study, which should begin in late 2022 or early 2023. Additionally, H-GAC is planning to conduct a regional connector bus study, which will explore the feasibility of bus routes that connect the region's outlying communities to each other as well as the urban core. Such services could enhance Liberty County's connectivity to the rest of the region.

Exhibit 4.1.3d - Fixed Transit Routes in Citv of Cleveland



Source: H-GAC Open Data, TxDOT Roadway Inventory, Brazos Transit District

FREIGHT

Three major rail lines run through Liberty County:

1. UPRR-owned mainline, the Lafayette Subdivision, that runs east-west through Dayton, Liberty, Ames, and Devers
2. UPRR-owned track, the Beaumont Subdivision, that runs east-west through Hardin and Hull
3. BNSF-owned track, the Conroe Subdivision, that runs through Cleveland
4. UPRR-owned track, the Baytown Subdivision, that runs north-south from Dayton (where it ties into the Lafayette Subdivision) and Baytown

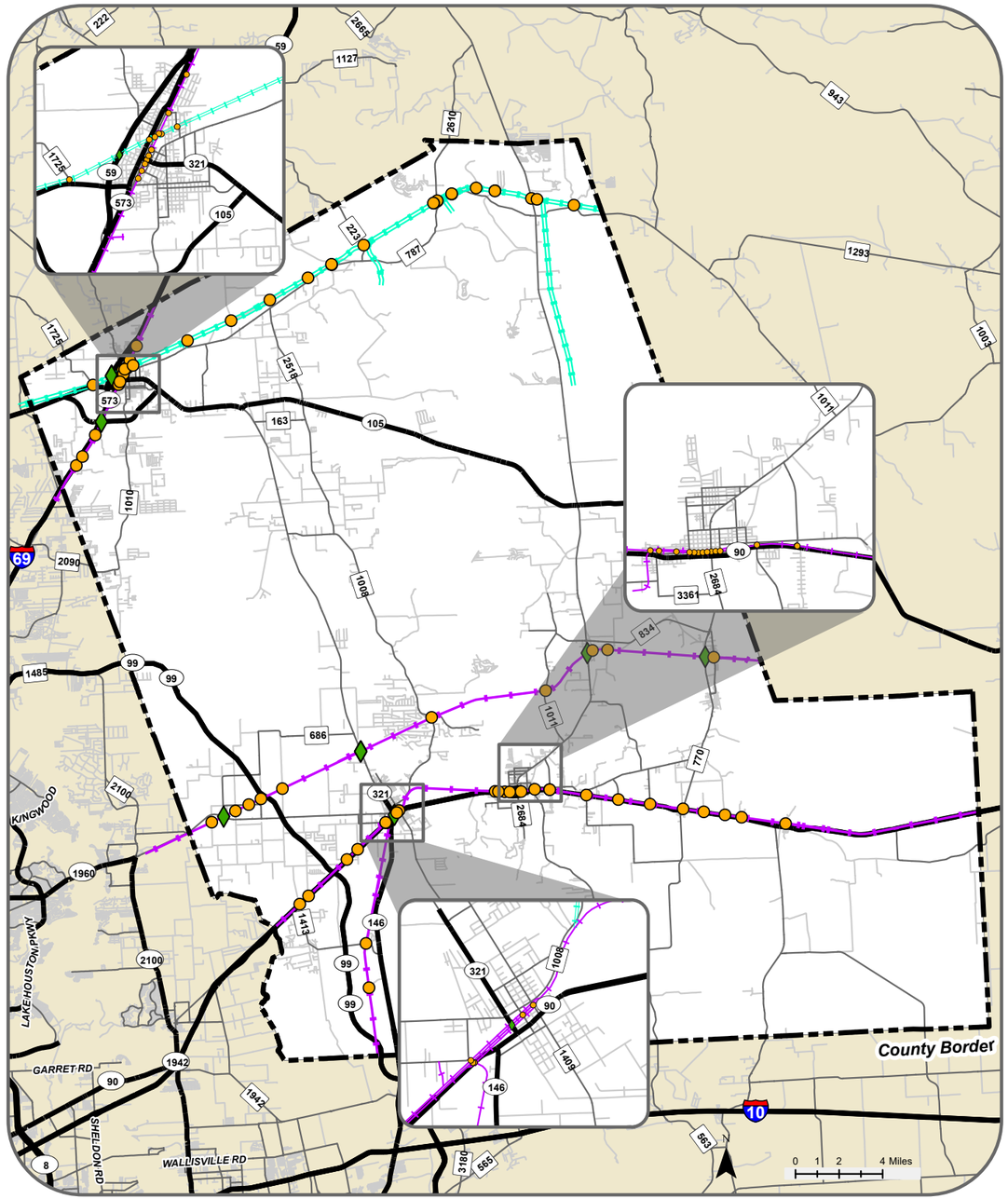
Additionally, a small portion of a the UPRR-owned Lufkin Subdivision runs north-south through Cleveland in the northwest corner of Liberty County.

CMC Railroad is a class III Railroad that owns and operates within Gulf Inland Logistics Park, where a CMC railyard adjacent to the Baytown Subdivision is located. The Gulf Inland Logistics Park has access to 5 of the Texas ports: Beaumont, Freeport, Galveston, Houston, and Port Arthur. The general freight that moves through the Gulf Inland Logistics Park includes:

- Plastic
- Steel & pipe
- Aggregates & minerals
- Petrochemical

Exhibit 4.1.3e illustrates all heavy rail facilities – lines and crossings – existing in Liberty County.

Exhibit 4.1.3e – Heavy Rail Facilities in Liberty County



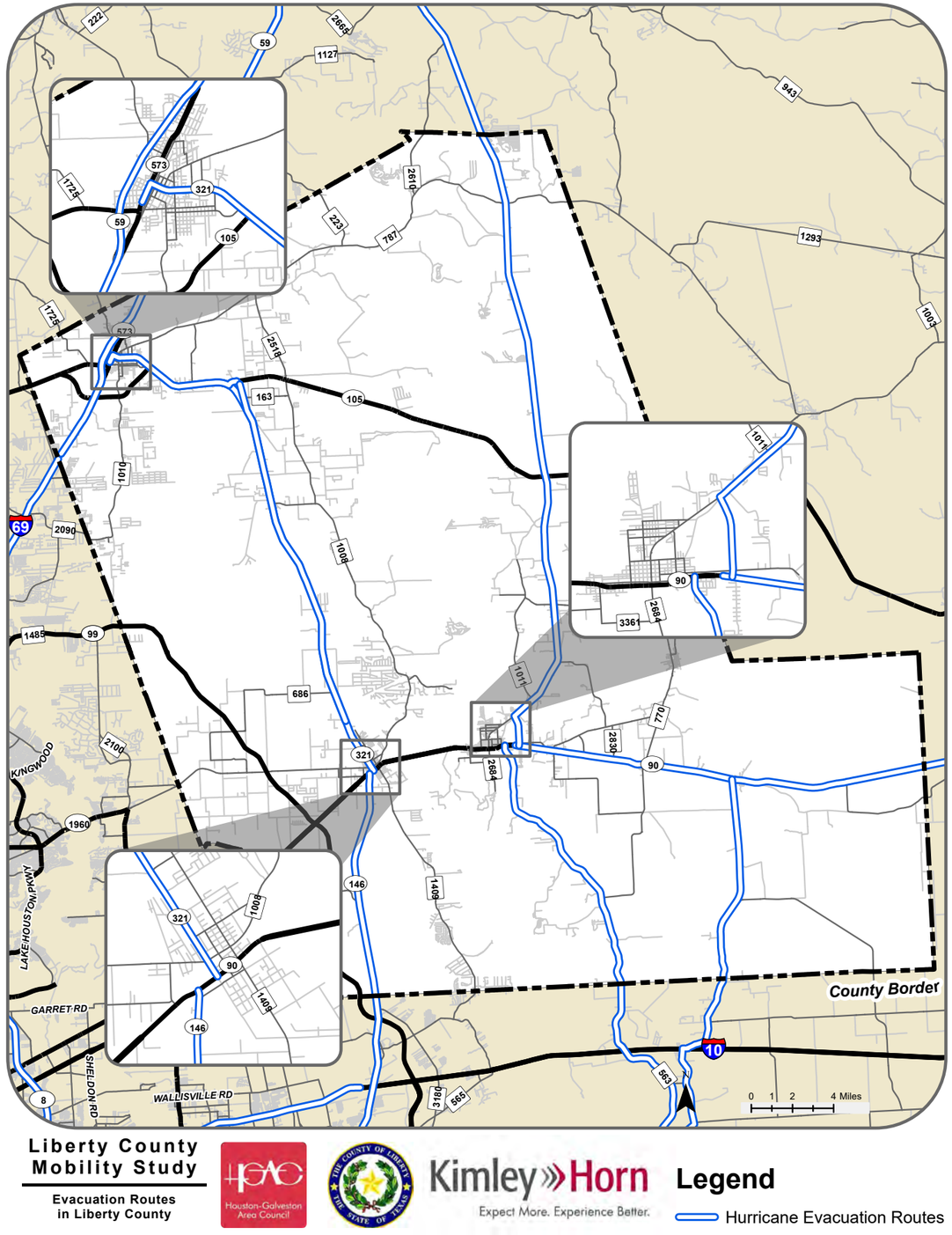
EVACUATION ROUTES

Due to its location near the Texas Gulf Coast, hurricane evacuation is a key concern for Liberty County. Evacuation routes designated by TxDOT within the study area are illustrated in ***Exhibit 4.1.3f*** and include:

- Interstate 69/US Highway 59
- US Highway 90
- State Highway 61
- State Highway 105
- State Highway 146
- State Highway 321

The 100-year floodplain is projected to expand into crucial junctions by year 2100. New evacuation routes should be created to allow alternative routes to circumvent flooded junctions.

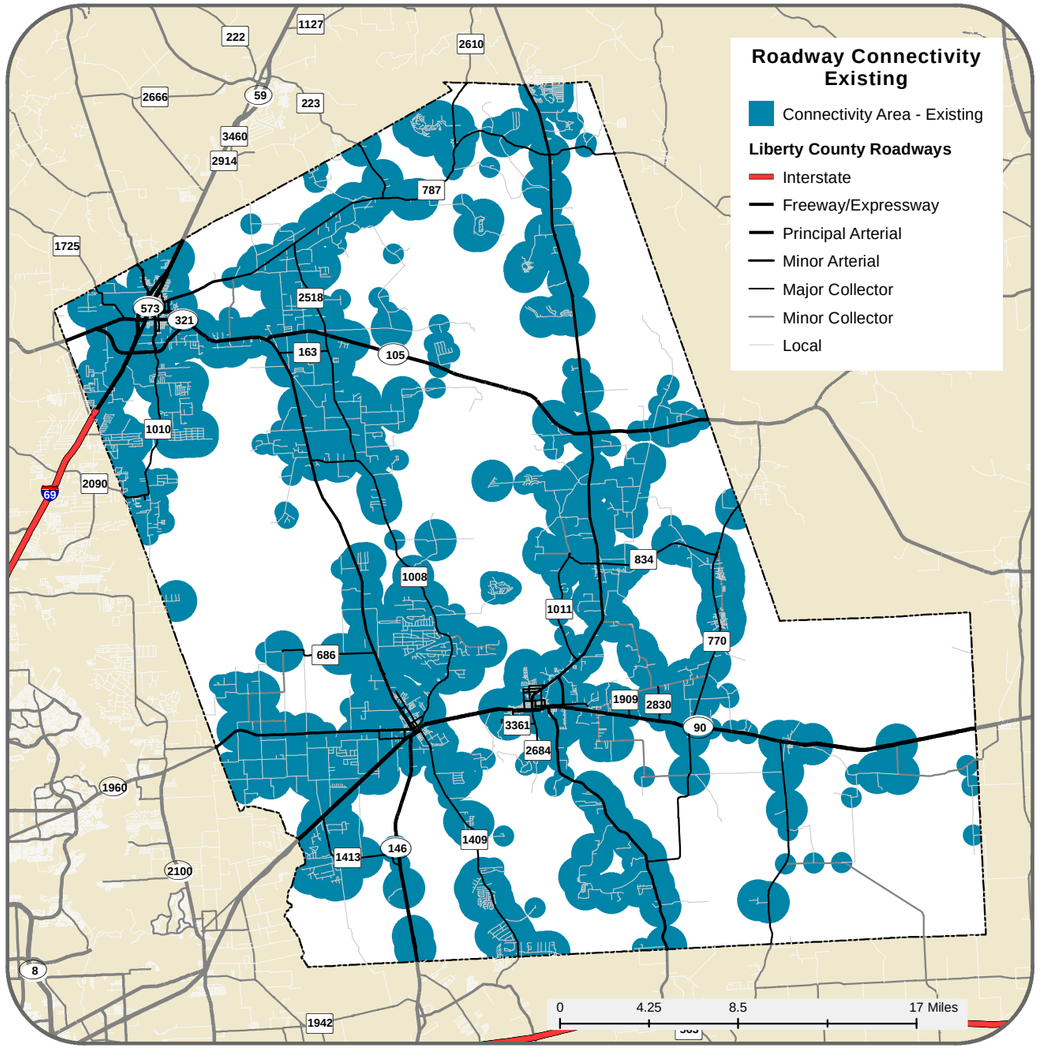
Exhibit 4.1.3f – Evacuation Routes in Liberty County



4.1.4 CONNECTIVITY

A connectivity analysis was performed to determine how connected the existing roadway network is. As connectivity of the roadway network increases, roadway travel becomes more efficient, decreasing travel times for the roadway user. This ultimately provides many subsequent benefits including reduced traffic-related air pollution, among others. The result of the connectivity analysis is shown in ***Exhibit 4.1.4a***, with the blue areas indicating existing mobility within the County. All intersections with a minimum of four legs were considered to provide a minimum of one-mile connectivity. All intersections with fewer than four legs were considered to provide a half-mile. Therefore, a one mile and half-mile buffer were created for all intersections, depending on the number of legs within the intersection. Limited corridor opportunities were deemed as restrictive in that it would not be easy to construct a roadway through the area, but that it would not be impossible to do so. Barriers to corridors were seen as very restrictive in that it would be highly unlikely to obtain right-of-way or to construct a future roadway in the area.

Exhibit 4.1.4a – Connectivity Analysis Results

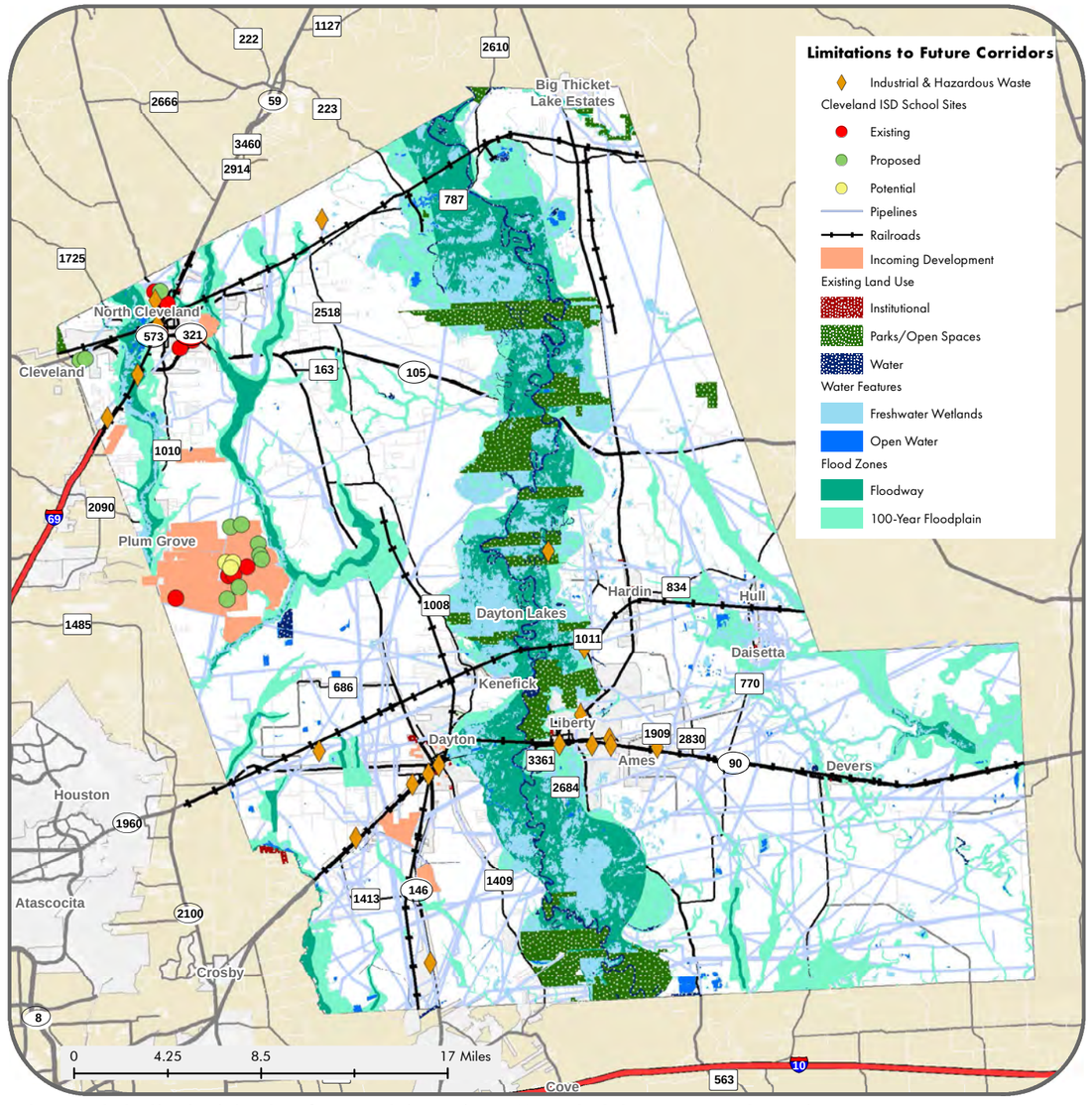


Source: H-GAC Open Data, TxDOT Roadway Inventory

Using this analysis, 47.8% of the land area within the County is within the connectivity area. The areas outside of the buffers were considered to be unserved by a connected network of roadways, or "unconnected."

With more than half of the County being outside of a connected roadway network, the next step was to determine where future roadway construction might be possible within the unconnected areas. Given the physical and environmental barriers that currently exist within the County, not all areas are suitable for future roadway construction. ***Exhibit 4.1.4b*** shows the existing limitations to future roadway construction.

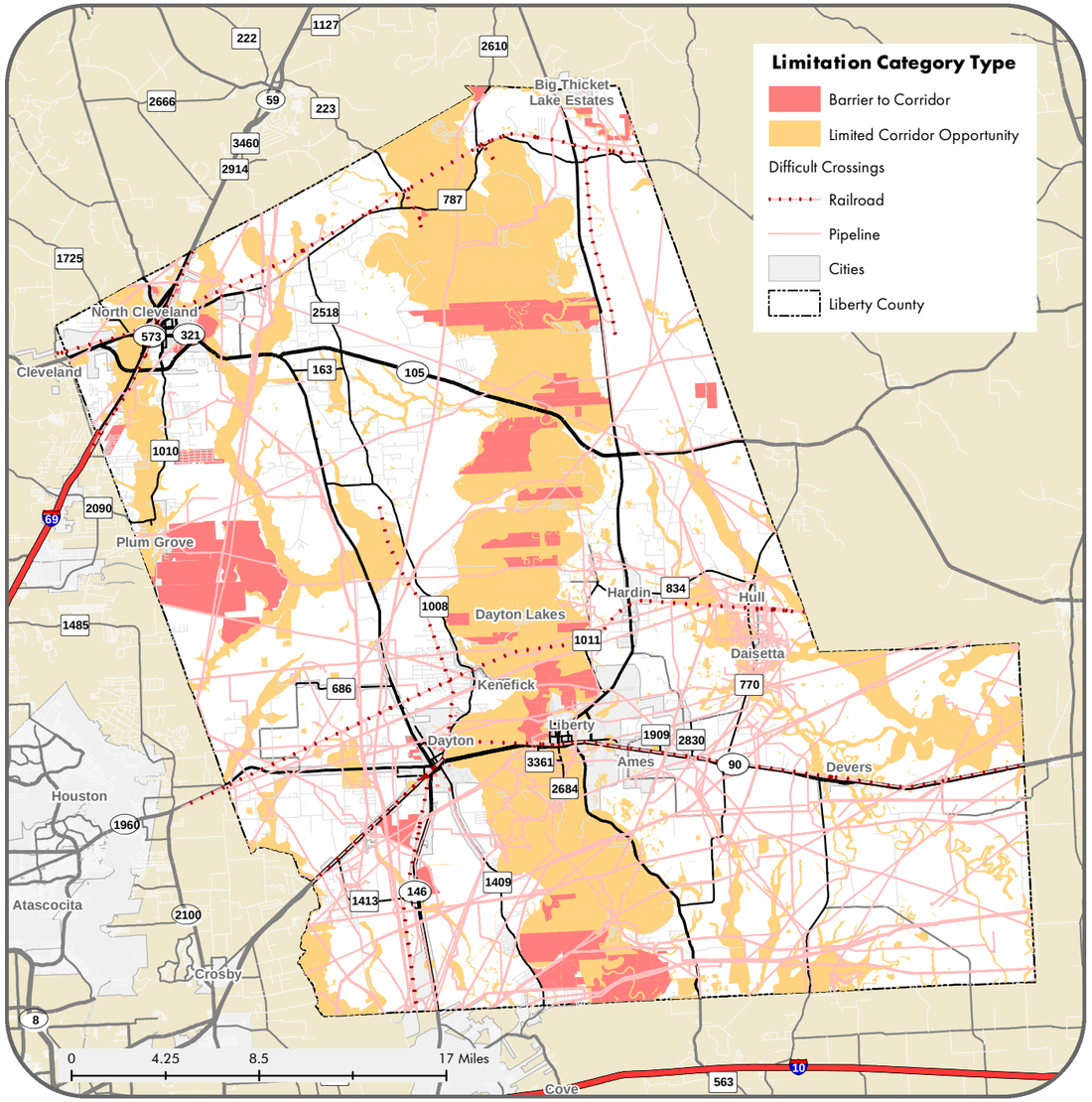
Exhibit 4.1.4b – Connectivity Limitations



Source: TCEQ, Cleveland ISD, City of Dayton, Colony Ridge, FEMA, H-GAC Open Data, TxDOT Roadway Inventory

Using the methodology described in Section 8.2.3, these limitations were categorized into either barriers (areas considered to be impassable), or corridors with limited opportunities (areas that would require mitigation but would not completely prevent future roadways). The result of the categorization is shown in ***Exhibit 4.1.4c***.

Exhibit 4.1.4c – Limitation Categories

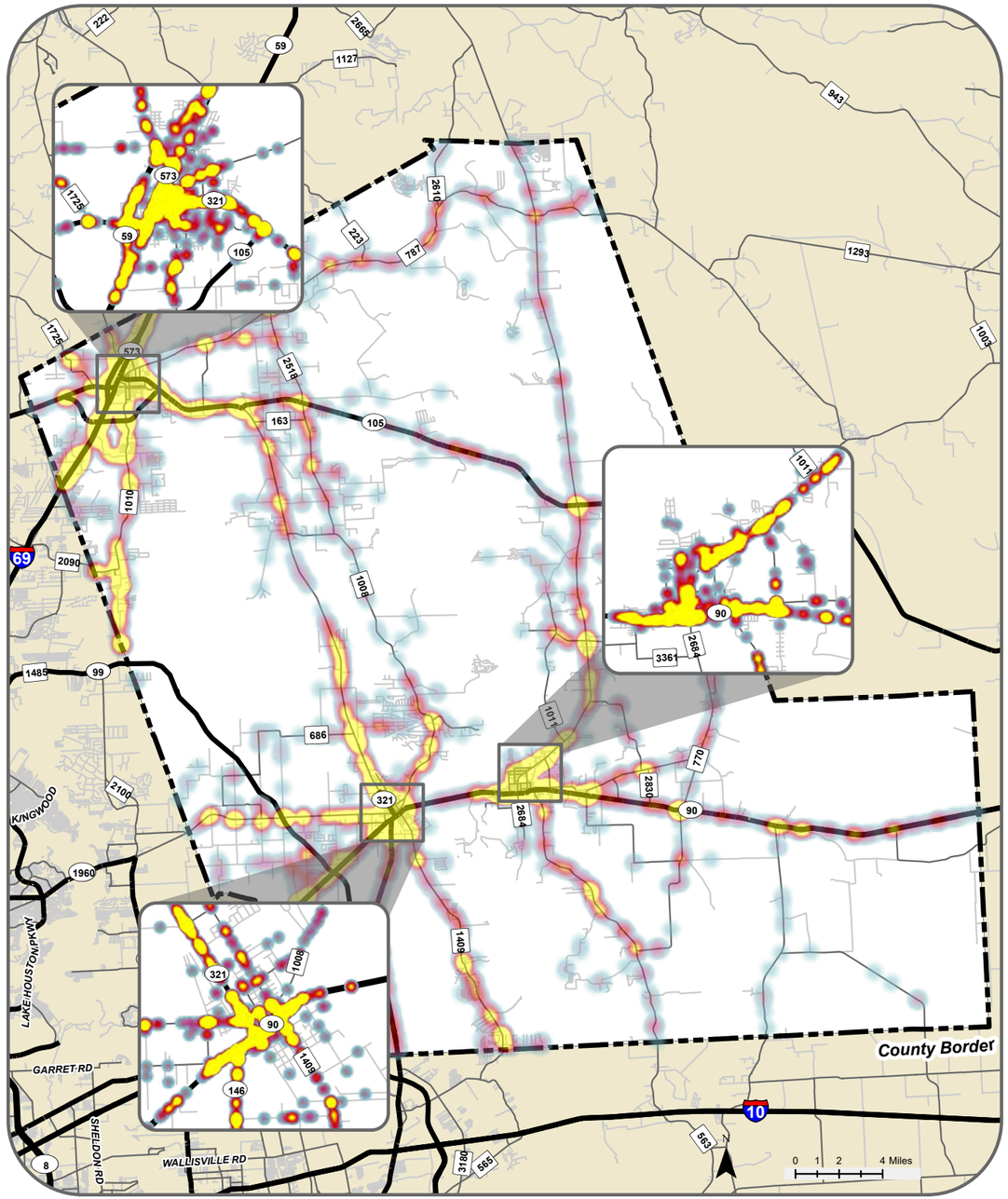


Source: TCEQ, Cleveland ISD, City of Dayton, Colony Ridge, FEMA, H-GAC Open Data, TxDOT Roadway Inventory

4.1.5 SAFETY

Crash data was collected throughout Liberty County using TxDOT CRIS data for the years 2016 through 2020 during years 2016 through 2020. Most crashes during that time happened at major junctions of US Highways and State Highways within cities. ***Exhibit 4.1.5a*** illustrates the density of all crashes in the county.

Exhibit 4.1.5a – Crash Density in Liberty County



Liberty County Mobility Study

Vehicle Crashes in Liberty County

Houston-Galveston Area Council

Kimley»Horn Expect More. Experience Better.

Legend

Crashes

Sparse

Dense

While freeways make up only 2% of the miles of roadways in the study area, 7% of all crashes take place on them as do 18% of all fatalities. Alternatively, local roadways make up 67% of all roadways in the study area, but only 14% of all crashes and 11% of fatalities take place on them.

Table E shows the classifications of each roadway, what percentage (by length of roadway) of the roadway network they account for, what percentage of overall crashes take place on that classification of roadway, and percent of total fatalities occur on that classification of roadway.

Table E – Crash Percentage by Roadway

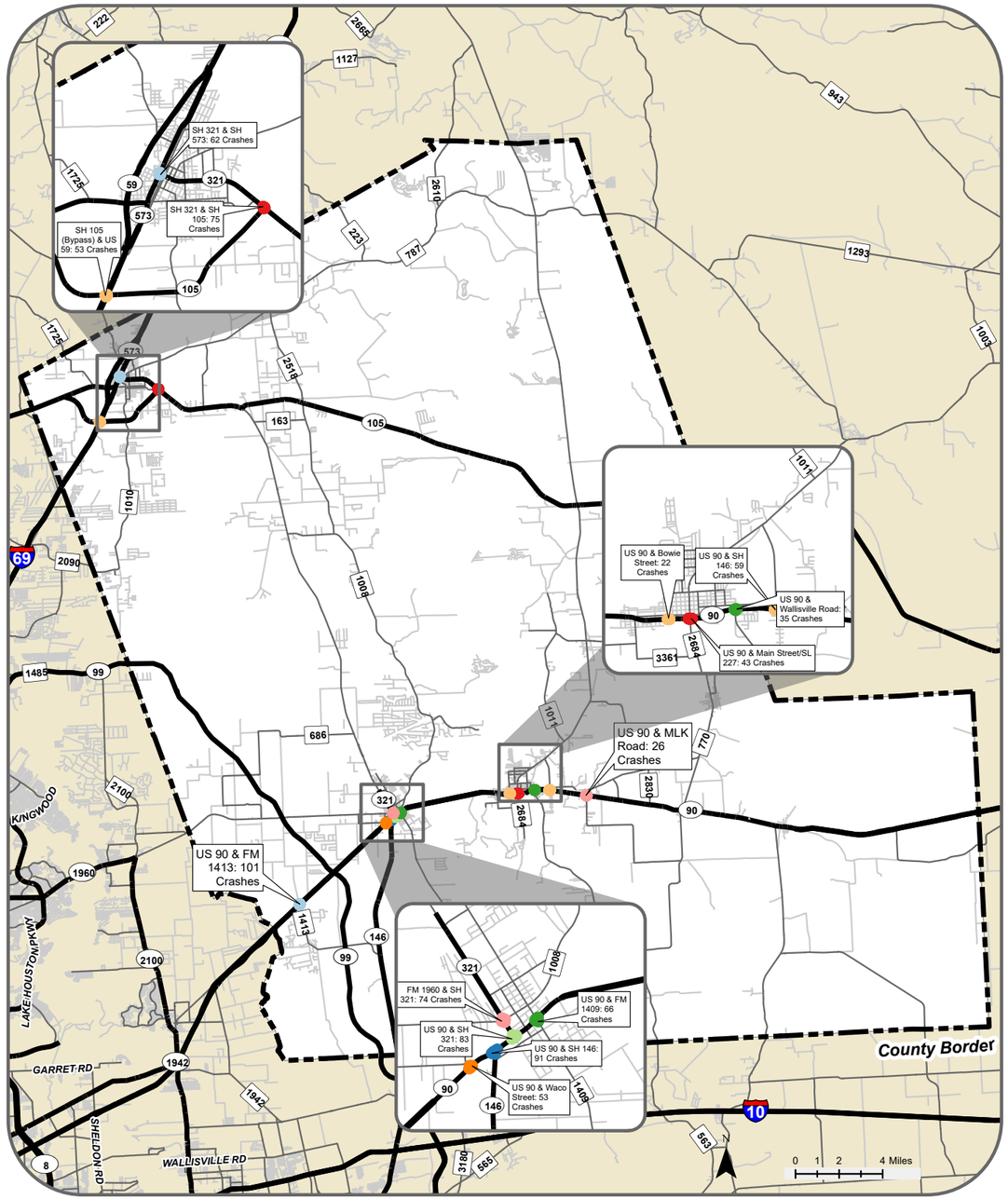
Roadway Classification	Length of Roadway (miles)	Percent of Total Roadway Network	Number of crashes	Percent of Total Crashes	Number of Fatalities	Percent of Total Fatalities
Interstate	0.84	0.1%	13	0.2%	0	0%
Freeway/Expressway	24	2%	472	7%	7	6%
Principal Arterial	134	9%	2,585	37%	32	28%
Minor Arterial	87	6%	1,360	20%	22	19%
Major Collector	175	12%	1,392	20%	37	32%
Minor Collector	50	4%	144	2%	4	3%
Local	954	67%	1003	14%	13	11%
Total	**1,428**		**6,969**		**115**	

Exhibit 4.1.5b illustrates the locations with the highest crash concentrations within a 100-foot radius. The highest concentration of crashes occurred on the edge of Dayton's city limits, at the intersection of US 90 and FM 1413: 101 crashes occurred within a 100-foot radius of the intersection.

Most crashes were recorded as resulting in no injury, with only 1.6% of car crashes ending in fatalities. The majority of fatal crashes occur in Dayton (19.8%), followed by Cleveland (9.5%), and Liberty (7.8%).

All crash data is included in ***Appendix A.***

Exhibit 4.1.5b – Highest Crash Concentration Locations in Liberty County



Liberty County Mobility Study

Highest Crash Concentration (Crashes Within 100 ft Radius) in Liberty County

**Colors are used only to differentiate location of crash sites.*

4.2 POLICY AND PRACTICES ASSESSMENT

As Liberty County continues to grow, local and countywide policies should be continually evaluated to ensure that future growth is implemented in a way that is beneficial for all residents and stakeholders. This section outlines recommendations of revisions to existing policies within the County and the cities.

4.2.1 PLAT SUBMITTAL REQUIREMENTS

The County should implement ordinances that require a subdivision plat be submitted for all subdivision applications. There should be different categories of plats depending on the complexity of the subdivision request, including the request for new utilities or roadways, revision of existing deed restrictions, and any other pertinent information that may require more review time by the County or its review partners.

Owners should be required to submit an affidavit indicating all their contiguously owned property. If the owner requests to plat one portion of their property at a time, a General Plan application should be required prior to any one segment of the property being subdivided. The General Plan should include any proposed street plans for the entire area. Should any subsequent plat applications within the General Plan change the previously approved street pattern, a new General Plan should be required to be submitted for review and should show the newly proposed street pattern for the entire area. This will assist the County in successfully implementing any long-term thoroughfare plans by ensuring no one portion of the roadway will not be accounted for.

To assist applicants and County reviewers, a digital submission process should be implemented. This will reduce long-term costs to both parties and will make the plat review process more efficient.

As these recommendations are implemented, the plat submittal checklist should be updated to account for all the changes. Communication with applicants about these changes should begin in advance of the implementation so that the transition is easier and more amenable to both parties.

4.2.2 GENERAL SUBDIVISION REQUIREMENTS

The County's existing platting regulations do not have provisions that increase street connectivity and circulation throughout the County. Common platting requirements and general street requirements should be included in the platting regulations to account for:

- **Points of access** – these standards should include a minimum requirement of access points to a public road for residential developments over a certain number of lots and major commercial developments. This can assist in the general circulation pattern of an area, but can also provide relief during an emergency or natural event
- **Block length** – a minimum spacing between the different roadway classifications should be provided so that general connectivity is maintained and improved over time as the County continues to grow. Plat submittal requirements should accommodate for a review of the block length for every application and require the provision of roadways when the block length is exceeded. The roadways provided should provide connectivity
- **Cross-sections** – as new roadways are required, all parties should know what will be required within that roadway segment. For each classification of roadway, there should be a cross-section standard that indicates how wide the right-of-way should be and what should be provided within the right-of-way. This can include sidewalks, bicycle facilities, through travel lanes, parking lanes, medians, etc.
- **Mobility** – more specific recommendations are provided in ***Appendix E***

As subdivision plat applications are submitted, they should be reviewed for their proximity to any alignments shown on the Liberty County Major Thoroughfare Plan (MTP). If a plat application is submitted where a proposed alignment is shown on the MTP, the application should be required to show dedication of right-of-way for that alignment in accordance with the correct cross-section design. The review and requirement of these dedications, as well as the process to record that dedication should be consistent across all applications and well documented so that expectations are clearly communicated across all parties.

4.2.3 DESIGN AND CONSTRUCTION MANUAL

To ensure quality roadway construction and safety of roadway users, a Design and Construction Manual should be created for all roadways and utilities within the County. This will ensure the longevity of newly built roadways and utilities, saving the County money in long-term maintenance costs. This Manual should be thorough and contain details on all aspects of design and construction for everything within the County-owned rights-of-way. The Manual should be clearly visible online and shared with all contractors doing work within the County.

4.2.4 COUNTYWIDE APPLICATION

These recommendations should be implemented throughout the entire County. All incorporated cities should adopt these regulations and standards as a baseline but can apply more restrictive requirements if desired.

4.3 ANALYSIS AND RECOMMENDATIONS

4.3.1 CONNECTIVITY AND CIRCULATION

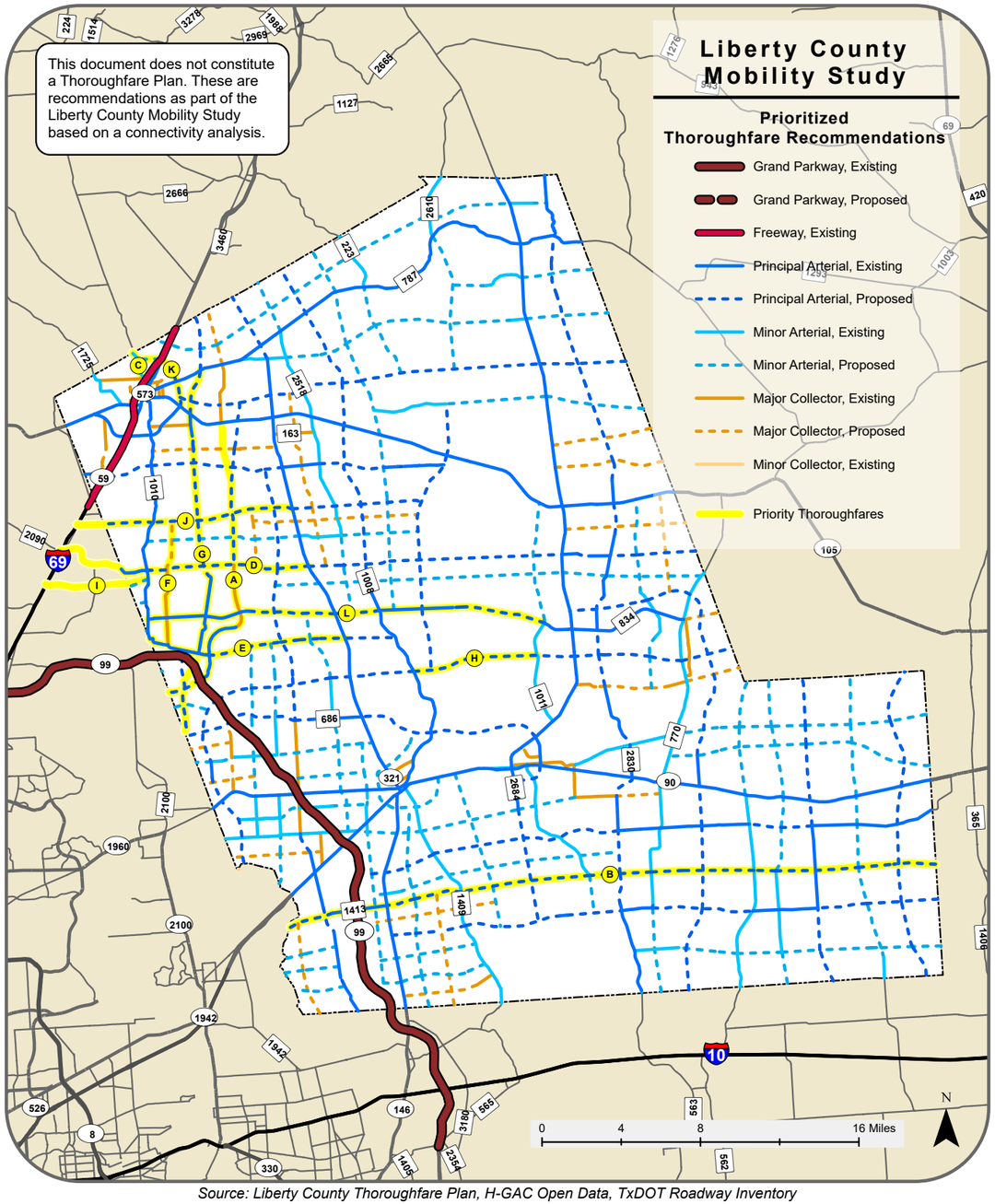
Using the connectivity analysis and the gap / barrier analysis, recommendations were made for future roadway connections, as shown on ***Exhibit 4.3.1a***. The methodology for these analyses can be found in ***Section 8.2.3***. These recommendations were made solely based on these analyses, along with recommendations from staff within the city and county agencies. A series of meetings was held with the County Judge, Engineer, and each City individually to discuss corridors that are likely to play a critical role in future mobility as the County continues to develop. These Priority Thoroughfares are illustrated as the highlighted proposed roadway corridors in ***Exhibit 4.3.1a***. A similar meeting was also held with major developers within the county.

Priority Thoroughfares in Exhibit ***4.3.1a*** include the following:

A. **Community Drive / FM 2243**
B. **FM 1413 Extension**
C. **FM 2025 Widening - proposed River Ranch Parkway**
D. **FM 2090 Extension - over US 59/69**
E. **FM 3549 (E-W)**
F. **FM 3549 (N-S)**
G. **FM 3570**
H. **Proposed connection through Dayton Lakes**
I. **Proposed connection to US 59**
J. **Proposed connection to US 59**
K. **SH 105 Bypass Extension, Connection to US 59 and FM 2025 (Northside Boulevard)**
L. **W Hardin Road (FM 834)**

The designated roadway "classification" in ***Exhibit 4.3.1a*** is generally based on the length of the connection, with the higher roadway classifications serving longer distances. Roadways were generally spaced using a ½ - 1 mile grid, depending on the classification. **A full Major Thoroughfare Plan (MTP) update should be done by the County to analyze future development and traffic and to designate roadway widths and appropriate cross-sections.** At that time, these recommendations should be reevaluated.

Exhibit 4.3.1a – Recommendations from Connectivity Analysis

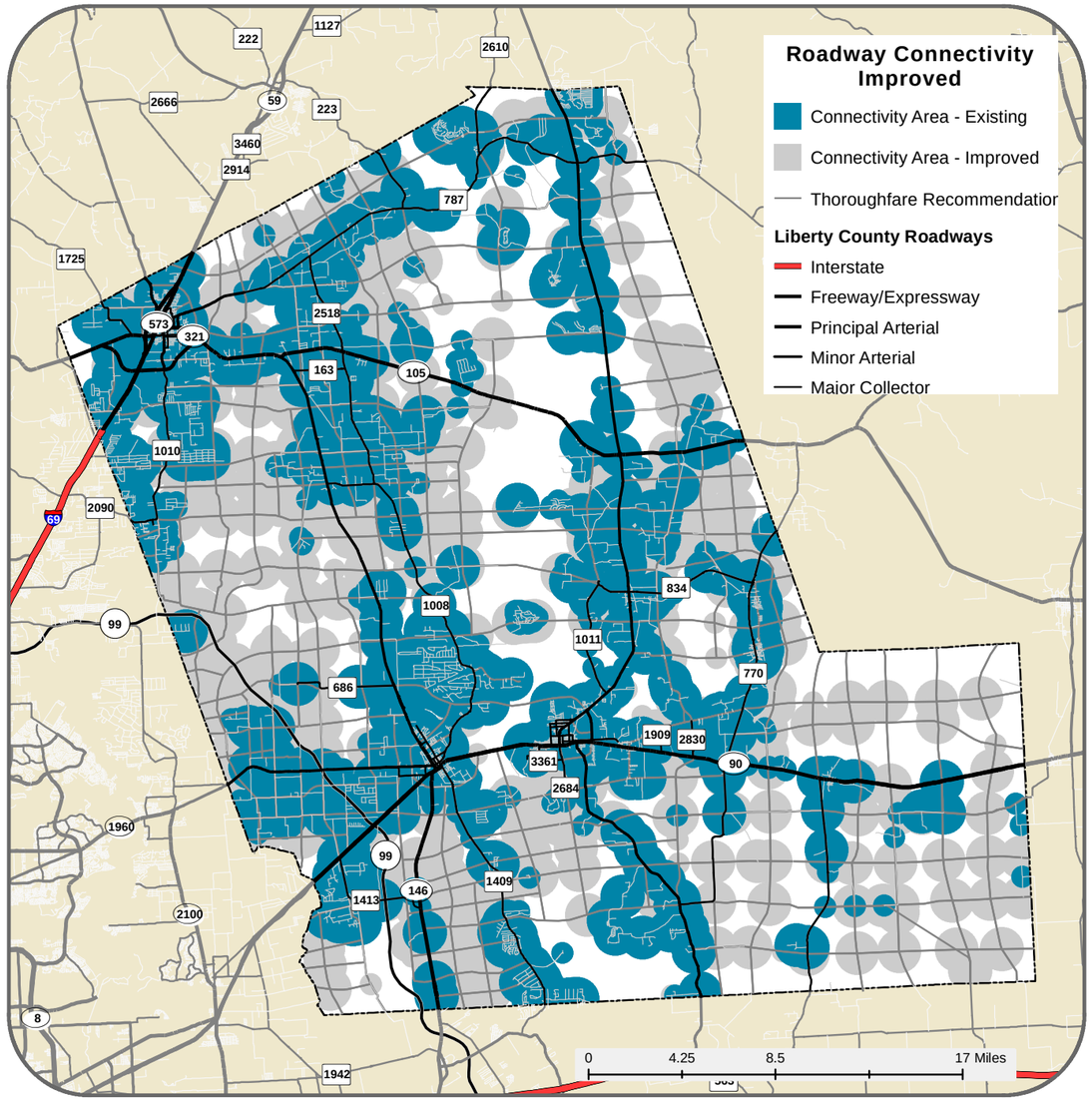


Source: Liberty County Thoroughfare Plan, H-GAC Open Data, TxDOT Roadway Inventory

Using these recommendations, the resulting roadway network was re-analyzed to determine improved connectivity. The same methodology for the existing connectivity analysis, as described in ***Section 8.2.3***, was performed using the potential future roadway network. The resulting connectivity area is shown in gray in ***Exhibit 4.3.1b***.

The analysis shows that if all recommended roadways were constructed, 77.8% of the land area within Liberty County would be served by a connected roadway network. This represents a significant increase from the existing conditions of 47.8% connectivity.

Exhibit 4.3.1b – Improved Connectivity in Liberty County



Source: H-GAC Open Data, TxDOT Roadway Inventory

5

City of Cleveland

- 5.1 Existing Conditions
- 5.2 Analysis and Recommendations

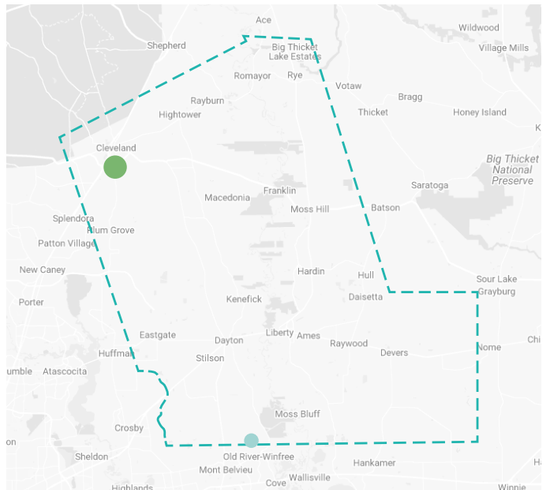
City of Cleveland

5.1 EXISTING CONDITIONS

5.1.1 DEMOGRAPHICS

POPULATION

Based on data from the US Census Bureau, the population in the City of Cleveland was 7,471 in 2020, 8.2% of the total population in Liberty County.



CITY OF CLEVELAND TOTAL POPULATION: **7,471**

POPULATION DENSITY

CITY OF CLEVELAND	LIBERTY COUNTY
459	**79**
PERSONS PER SQ. MILE	*PERSONS PER SQ. MILE*

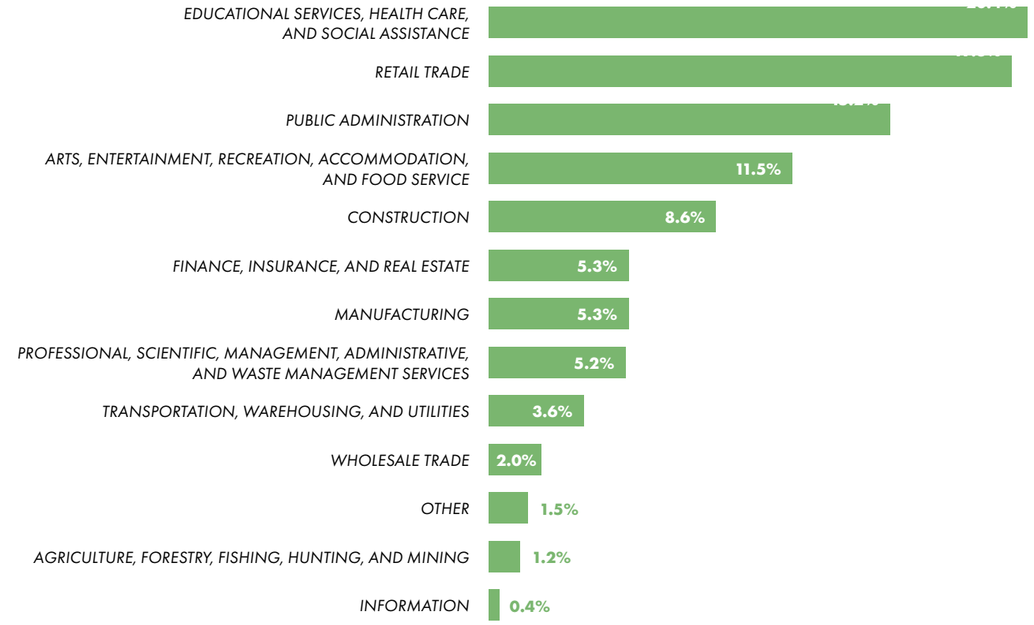
Relative to the county, Cleveland is densely populated. The population density of the city is 459 persons per square mile, whereas the county's is 79 persons per square mile.

Liberty County is facing significant growth due to expanding residential, commercial and industrial development. According to US Census estimates, Cleveland's population increased by 7.2% between April 2020 and July 2021, showing the greatest amount of growth of the county's three largest cities.

EMPLOYMENT

Employment opportunities in Cleveland are available in a variety of industries. The construction industry is expected to grow over the next twenty years due to increased development along and near the Grand Parkway (SH 99). Cleveland ISD is the fastest-growing school district in the state, which is creating a demand for jobs in the educational field. Additionally, Cleveland has its own municipal airport along FM 787 and an industrial park adjacent to the BNSF railroad is being developed along SH 105.

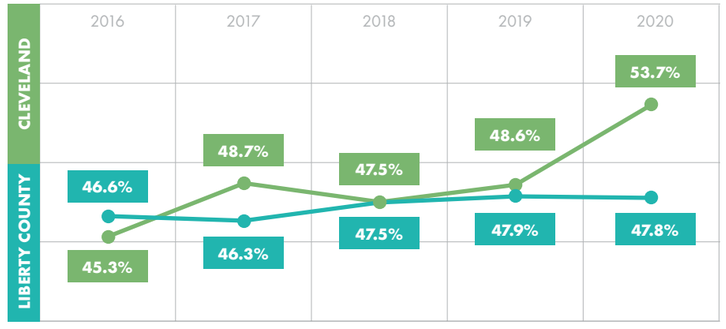
INDUSTRIES IN THE CITY OF CLEVELAND



Source: U.S. Census Bureau

EMPLOYMENT RATE (%)

The overall employment rate in Cleveland has been growing faster than that of the County overall since 2018.

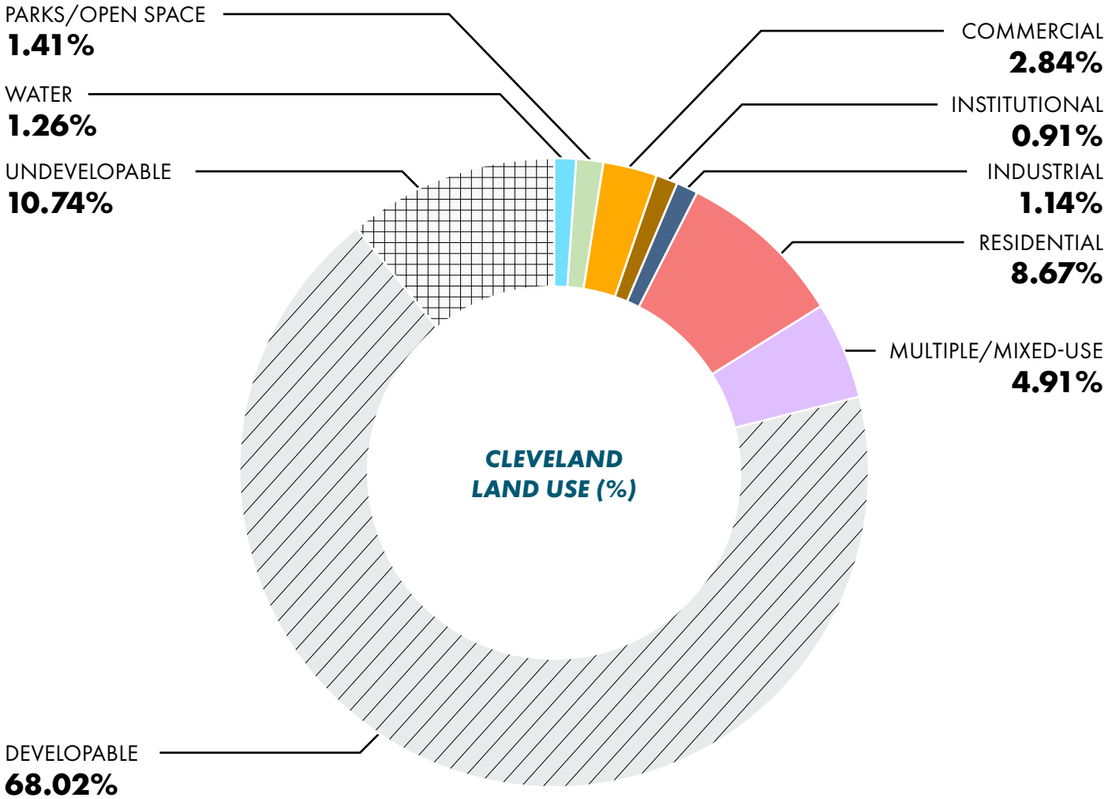


Source: U.S. Census Bureau

5.1.2 LAND USE

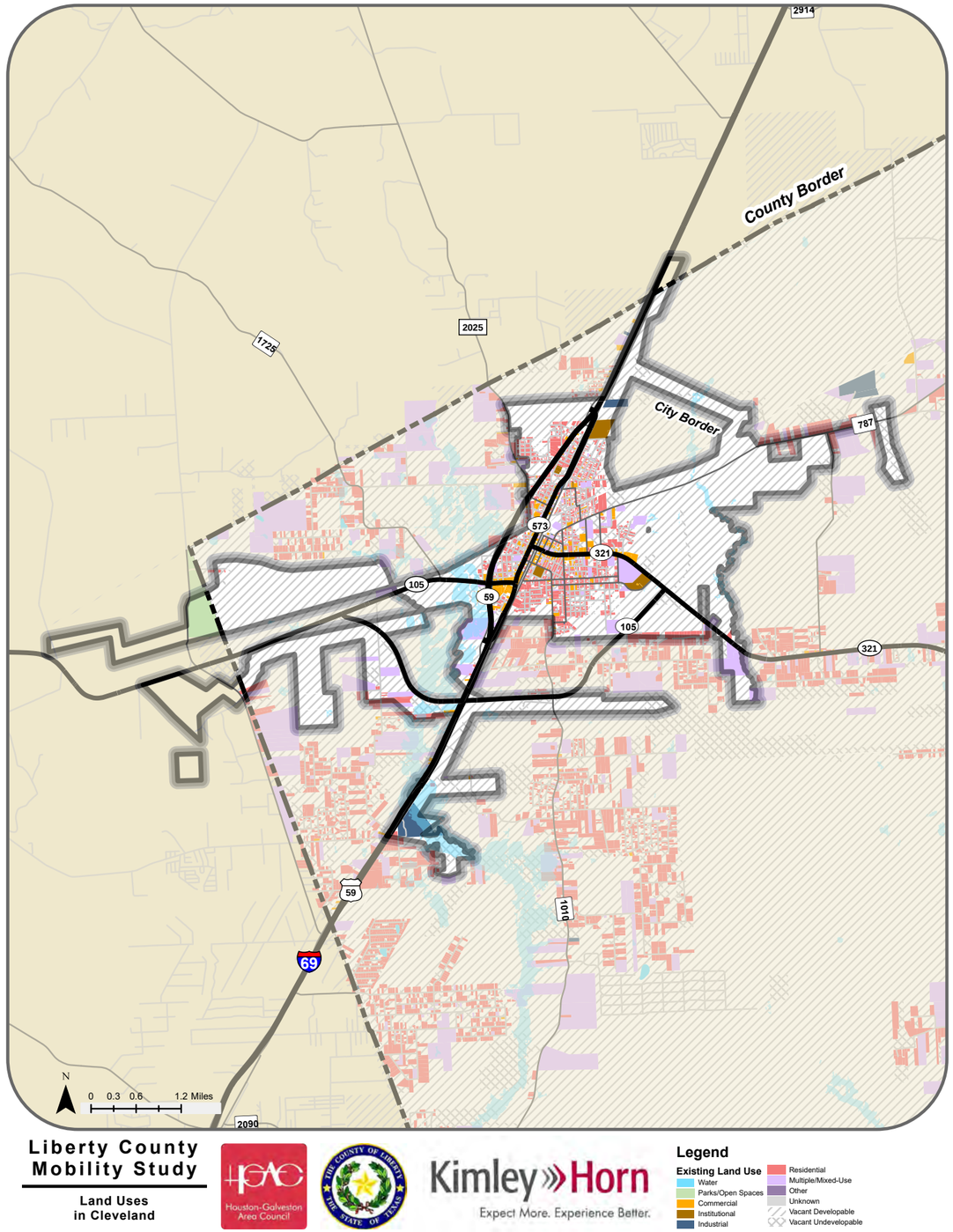
Cleveland is the closest major city to the large and rapidly growing Colony Ridge development. Colony Ridge is part of the Cleveland Independent School District. Residents of Colony Ridge travel to and from Cleveland for school, work, and entertainment. Development is limited in the east west direction but can occur along IH-69 to the north and Plum Grove Road to the south. Currently, residential and commercial development is concentrated within the downtown area.

Exhibit 5.1.2a illustrates the distribution of land use throughout the City of Cleveland.



Source: H-GAC R-LUIS data

Exhibit 5.1.2a – Land Uses in Cleveland

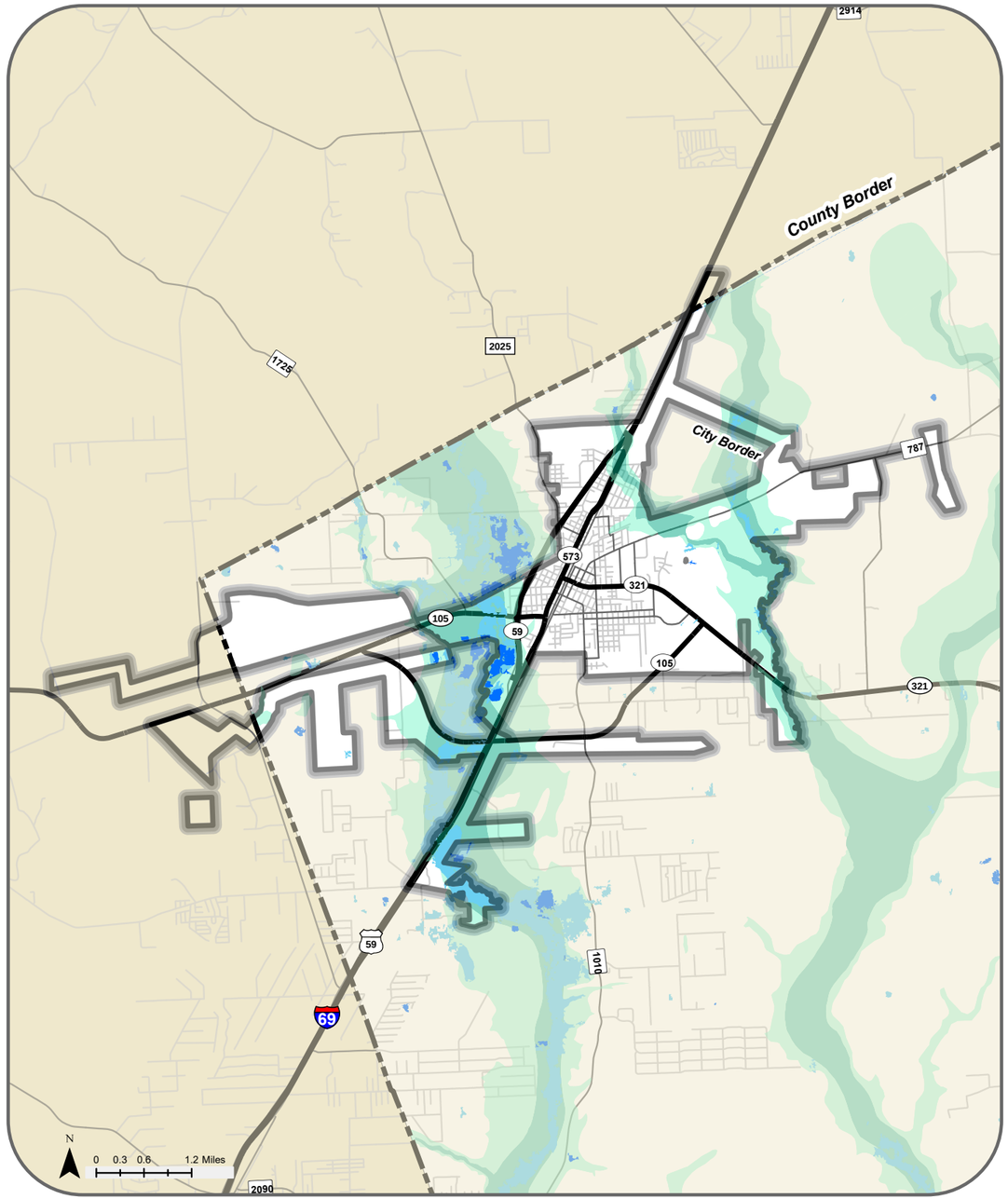


ENVIRONMENTAL FEATURES

The City of Cleveland is located farthest from the Trinity River but is flanked by two bodies of water: the East Fork of the San Jacinto River and Tarkington Bayou. While the official city limits of Cleveland only contain 112 acres of open water and wetlands, both bodies of water extend north and south for miles on either side of the city, which may hinder Cleveland's development in the east west direction. See these waterways and their floodplains in ***Exhibit 5.1.2b***.

While these waterways pose the threat of flooding, they can also serve as potential recreational space and natural paths for hike and bike trails. Currently, there are 126 acres of park space in the City of Cleveland. See the location of parks and open spaces in ***Exhibit 5.1.2a***.

Exhibit 5.1.2b – Environmental Features in Cleveland



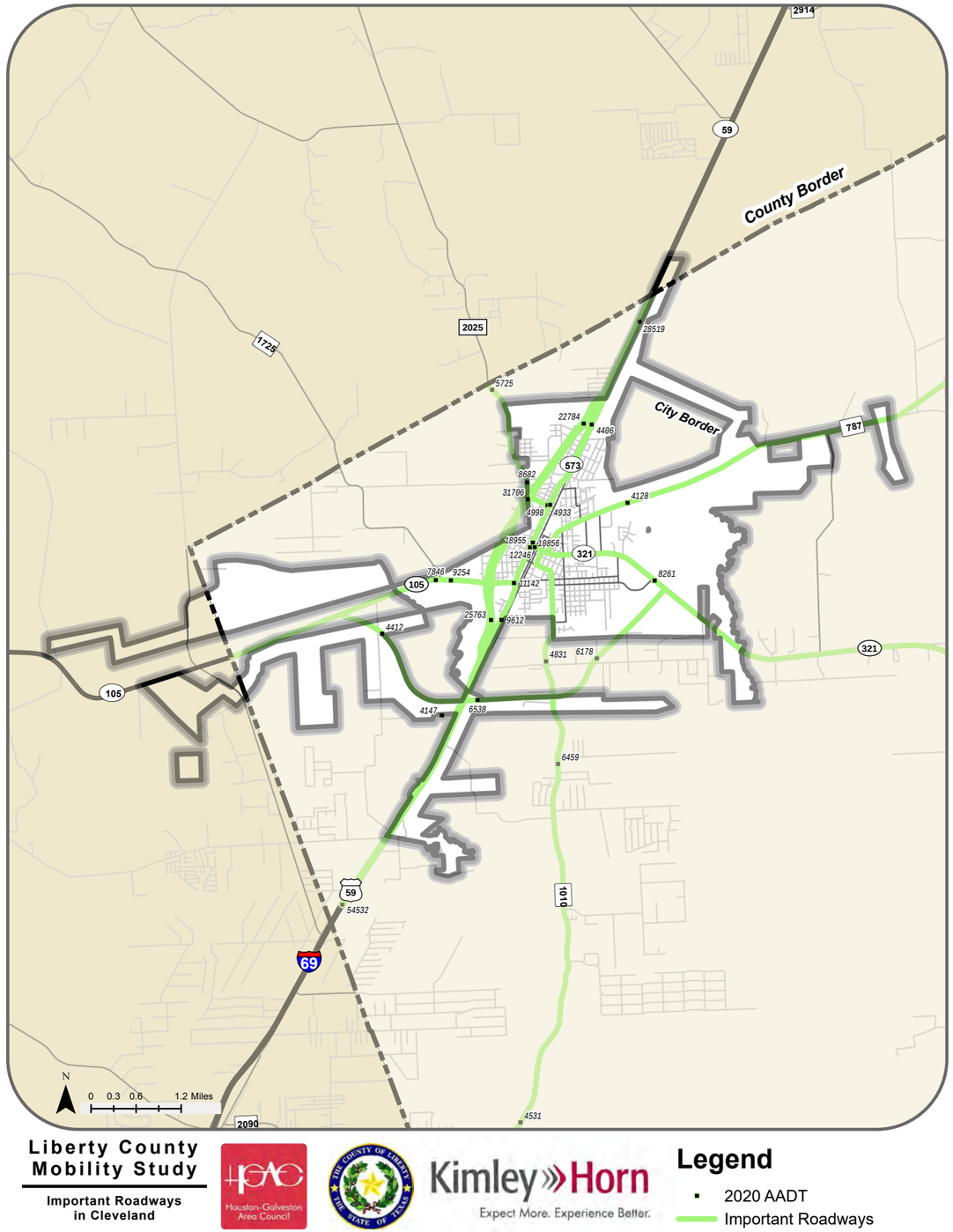
5.1.3 TRANSPORTATION

ROADWAYS

Important corridors in the City of Cleveland are illustrated in ***Exhibit 5.1.3a***. These include the following:

- **IH-69/US 59** connects Cleveland with Houston to the southwest and other cities to the north.
- **FM 573/Washington Avenue** runs through downtown Cleveland, allowing north-south traffic to permeate the city rather than passing it by along IH-69/US 59.
- **SH 105/Southline Street** runs into the core of Cleveland, providing access to the main north-south corridors in the city: IH-69/US 59 and FM 573. SH 105 extends west to Conroe and provides access to IH-45. SH 105 also has a section that bypasses Cleveland to the south, providing a route for heavy vehicles and long-distance commuters that avoids slower speeds and signalized intersections within Cleveland.
- **SH 321/Houston Street** connects Cleveland to Dayton in the south. It also acts as a "Main Street" in downtown Cleveland.
- **FM 1010/Plum Grove Road** connects Cleveland to the City of Plum Grove. Due to the expected explosive growth in the Colony Ridge development adjacent to Plum Grove, this is an up-and-coming major corridor in Liberty County. Currently, there is no direct interchange between FM 1010 and the Grand Parkway (SH 99).

Exhibit 5.1.3a – Important Roadways in Cleveland



ACTIVE MODES

The existing active transportation network in the City of Cleveland is limited. Data collected from H-GAC's Open Data portal indicates that there are approximately 3.6 miles of sidewalks and no designated on-street bikeway facilities within the city limits of Cleveland.

Denser areas with more concentrated land uses have the potential to generate more biking and walking trips. Major destinations include natural areas, parks, and schools. Cleveland ISD is the fastest growing school district in the state of Texas, so student transportation may increase demand for Safe Routes to School (SRTS) opportunities, especially for newly built schools.

A high-level review of existing plans reveals that there is varying interest in building and implementing active infrastructure among cities and the County.

- The **Liberty County Community Plan** prioritizes areas near schools for robust sidewalk networks, downtown areas with the County's three largest cities are prioritized for bike lane facilities, and undevelopable natural areas along creeks are prioritized for hike and bike trails to preserve floodplains.

Popular fitness and activity tracking apps are widely available on smartphones, smart watches, and bike computers. One such platform, Strava, allows its user data to be mapped by public agencies to highlight areas where there is bicycling and walking demand and better understand where infrastructure improvements may be desired. Although a useful database of information, one caveat with Strava data is that the data collected is user reported and not fully representative of a community's full demographics, especially for people who do not use Strava or other GPS tracking apps to share their data; Strava users tend to skew white, male, and median age.

Pedestrian Infrastructure

Apart from some blocks in and around the historic downtown area, sidewalks are not standard nor uniformly available in Cleveland. Newer subdivisions recently built outside of the city boundaries may have sidewalks due to growing family households moving to Cleveland ISD. School campuses may have limited sidewalks between buildings and outdoor play areas and fitness facilities. The Liberty County Community Plan specifically calls out the need to improve pedestrian safety and provide sidewalk connections for students walking and biking to schools.

Where there are sidewalks present, a variety of attributes creates an unwelcoming pedestrian environment, including short and discontinuous segments, a lack of ADA accessible curb cuts or curb ramps, narrow non-ADA compliant sidewalk widths, deteriorating concrete and other materials, unmarked crosswalks, a lack of trees and shade, and a lack of separation from parking and auto travel lanes.

Sidewalks within the City of Cleveland are concentrated within a ½ square mile of the historic downtown area radiating out from and along West and East Houston Street, mostly east of South Washington Street (see ***Exhibit 5.1.3b***). The annual Strava data for pedestrians indicates the highest frequency of walking occurs within or immediately adjacent the city limits of Cleveland. There is limited user-reported pedestrian activity outside of the city, but hotspots include the Tarkington School campuses and the Chain-O-Lakes Resort (see ***Exhibit 5.1.3c***).

Bicycle Infrastructure

There are no designated on-street bicycle facilities within Cleveland.

According to bicycle recreationalists and advocates, the lack of route options other than major auto thoroughfares presents one of the biggest challenges. One suggestion is to use bike and shared use paths as a floodplain management strategy to prohibit additional development in environmentally sensitive, natural areas. There is a lack of funding and governmental interest for bike routes and paths, especially regarding the expense of planning, implementing, and maintaining bike lanes, according to bicycle advocates. A pressing concern is the repaving of older roadways with larger aggregate materials that create rough and uneven surfaces that are not suited for bike travel; repaved roadways which once had smoother gutter and shoulder areas for biking are becoming inaccessible to bicycle riders and are not adequately swept or maintained.

he annual Strava data for bicyclists indicates that, within the Cleveland area, the highest cycling demand is along Old Cold Spring Road (FM 2025). Other continuous major routes under demand include West Southline Street (SH 105), Nevell Street (FM 787) between Cleveland and Big Thicket Estates, Hill Store Road (FM 1725), and SH 105/ SH 321 (see ***Exhibit 5.1.3c***) east of Cleveland. Generally, the street network grid east of South Washington Avenue experiences demand for biking.

In sum, opportunities and challenges for implementing active transportation improvements in Cleveland were identified through quantitative and qualitative analysis of available data and stakeholder interviews.

OPPORTUNITIES

- A confluence of civic uses, restaurants, services, and tourist destinations and accommodations in the downtown area of Cleveland offer opportunities for implementing sidewalk networks.
- School campuses lack sidewalk connections to surrounding residential neighborhoods, representing opportunities to serve existing and new schools with pedestrian infrastructure.
- Environmentally sensitive areas, such as floodplains near natural amenities, may provide opportunities for trail routes that could also potentially reduce or prevent development pressures.

CHALLENGES

- There is a lack of connected sidewalks and sidewalk networks; where sidewalks do exist, these segments are partial, discontinuous, lack ADA accessible curbs and widths, and have deteriorating pavement, concrete, and/or asphalt conditions.
- There are limited funding sources for improvements at the local and county levels.

RECOMMENDATIONS

- Refer to countywide active mode recommendations in ***Chapter 4***.

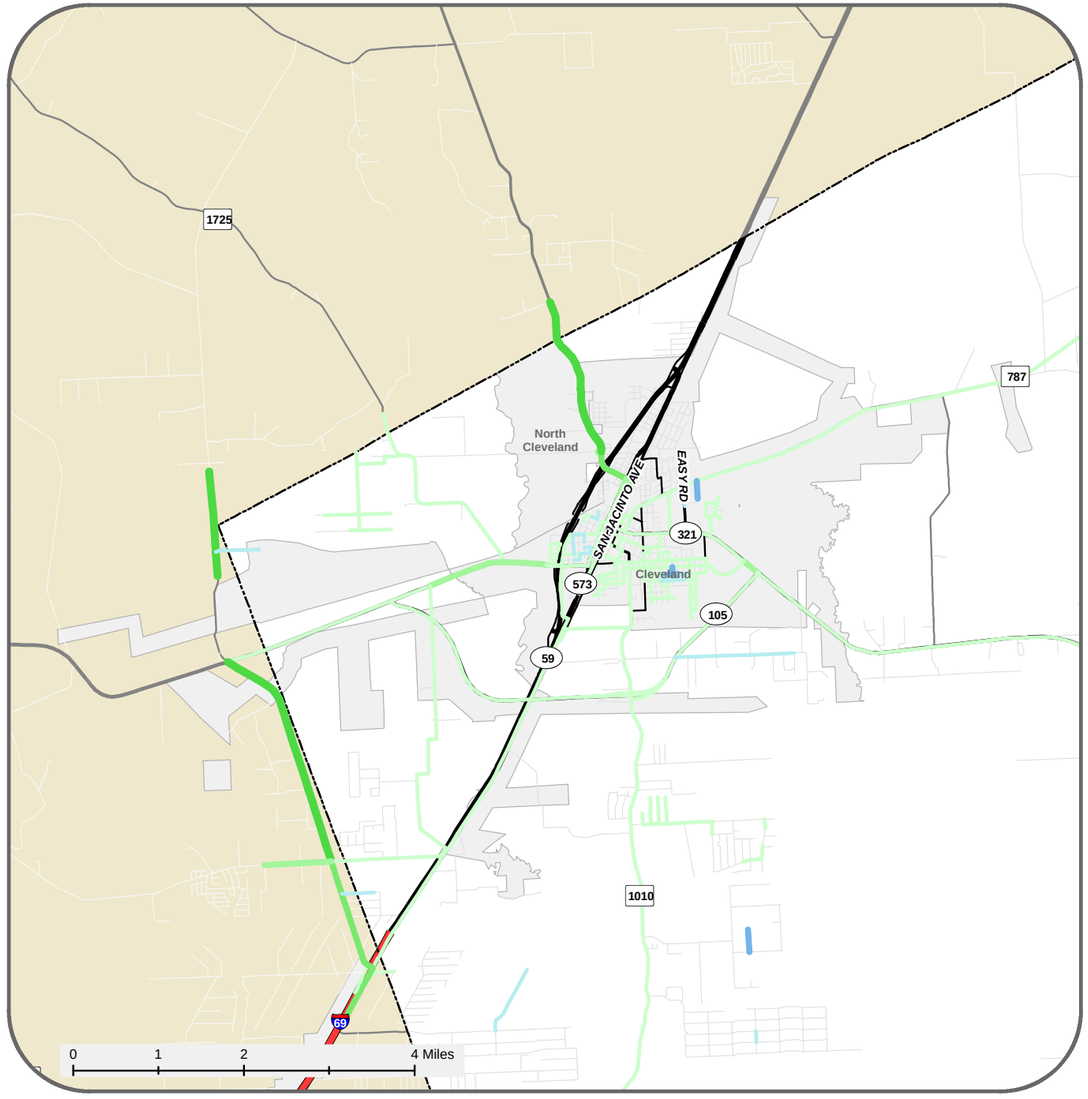
Exhibit 5.1.3b – Cleveland Sidewalks

Source: HGAC

Cleveland Sidewalks

- Existing Sidewalks
- City Limits

Exhibit 5.1.3c - Cleveland Combined Bicycle and Pedestrian Strava Activity



Source: Strava, TxDOT Roadway Inventory

Strava Activity Counts

Pedestrian Strava Activity

- 5 - 20
- 21 - 60
- 61 - 120
- 121 - 215
- 216 - 330

Bicycle Strava Activity

- 5 - 60
- 61 - 150
- 151 - 270
- 271 - 475
- 476 - 875

TRANSIT

The Brazos Transit District (BTD) provides public transportation services in Cleveland and the surrounding area. Cleveland is served by a fixed bus routes as well as shared-ride, curb-to-curb Demand Response and ADA Paratransit service. ADA Paratransit is a service for people with disabilities who desire to be picked up from and dropped off at locations within 3/4 of a mile from one of the established fixed route in Cleveland. Demand Response is available to any person regardless of disability and may pick up or drop off riders anywhere within the city.

The City of Cleveland is served by one fixed circular route that runs at 60-minute headways (see ***Exhibit 5.1.3d***). The fixed route operates on weekdays from 9:00 am to 4:00 pm and service is not available on major federally-recognized holidays. One-way fixed route rides cost $1.00 for the public and are $0.50 for seniors, people with disabilities, individuals covered by Medicare, and children aged 6-12 years of age. Rides are free for children under 6 years of age with a paying customer. This fixed route does not have established bus stops; riders flag down bus drivers along the route to board and communicate to the driver where they would like to disembark. Currently, no funding is dedicated to bus stops. The agency has considered that "flex zone" service may better serve patrons with on-demand services. Other transit providers in the H-GAC region, such as Fort Bend County Transit, have reported success with this type of service.

Both ADA Paratransit and Demand Response services require an appointment for service. Riders are able to book trips on the same day based on availability. However, The BTD recommends booking at least a day in advance. The agency reports that the Demand Response service cannot accommodate all requests; all time slots a week out are typically booked within 15 minutes of opening the schedule. Service operates on weekdays from 6 to 10 am and 2 to 6 pm, and is not available on major federally-recognized holidays.

Ridership data for the route shows that there was a decline in ridership from 2018 to 2020, with ridership numbers remaining depressed into 2021. This decline is likely related to decreased travel taken during the COVID-19 pandemic. During this time, the Cleveland fixed route's total annual ridership varied from 11,800 to 16,500 passengers. Cleveland's fixed route ridership sees a high incidence of trips to necessary grocery and retail service areas such as Walmart and H-E-B. A heat map (see ***Exhibit 5.1.3e***) shows the two densest concentrations of boardings and alightings on Cleveland's transit route occur near Crockett Street and North College Avenue and near Manjik Avenue and West Southline Street. Crockett Street and North College Avenue are in downtown Cleveland north of East Houston Street near many health services such as pharmacies and dental clinics, including Texas Emergency Hospital, and retail and restaurant destinations. Manjik Avenue and West Southline Street provide access to major retailers such as Walmart and H-E-B in addition to several fast-food restaurant locations.

The Cleveland BTD route has experienced minimal change since service became operational.

Exhibit 5.1.3d – Fixed Transit Route in Cleveland

Source: H-GAC Open Data, TxDOT Roadway Inventory, Brazos Transit District

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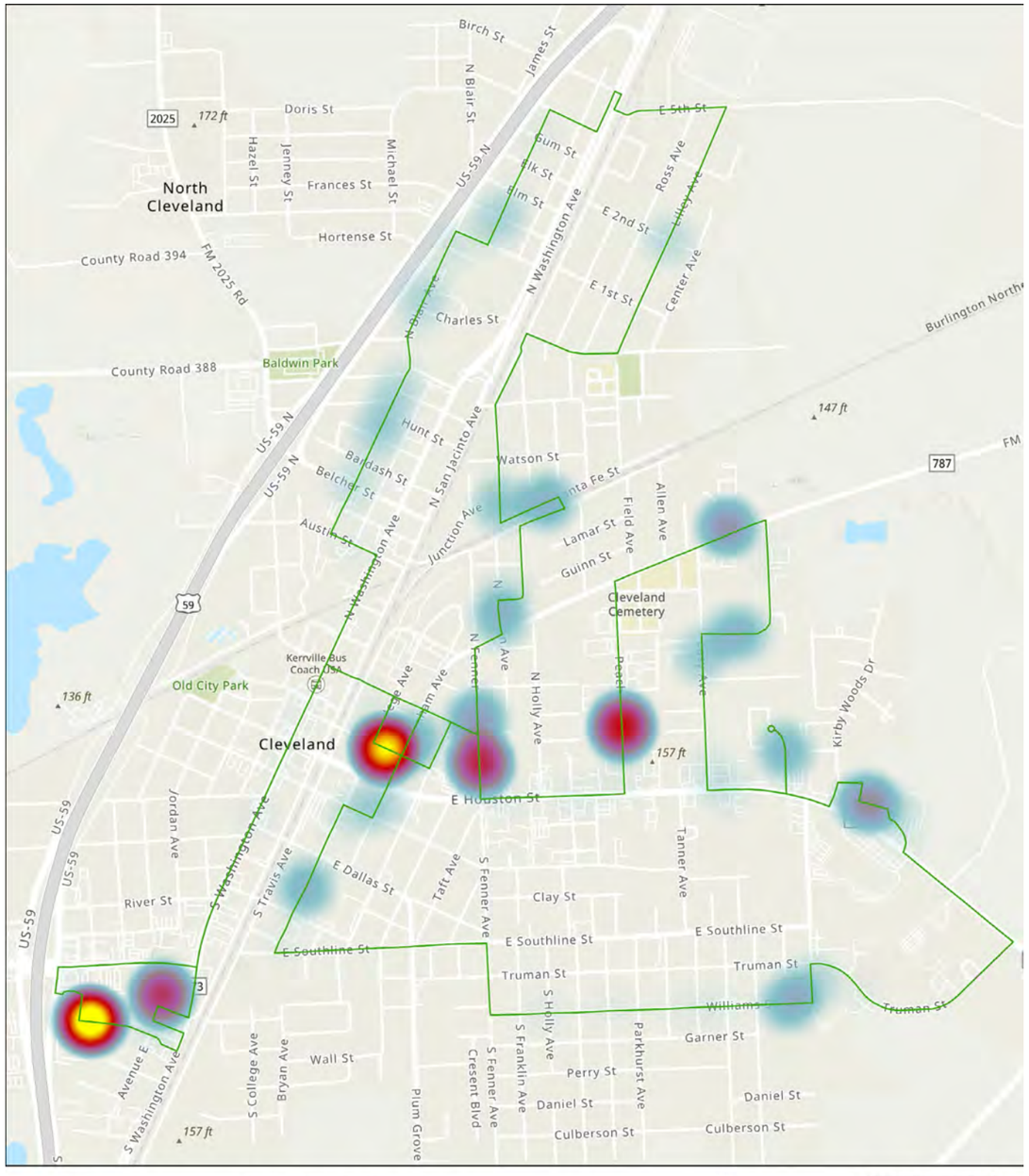
Exhibit 5.1.3e – Transit Boardings and Alightings in Cleveland



A high-level review of existing plans highlights the level of effort related to bicycling, pedestrian, and transit improvements in Cleveland.

- The **Liberty County Transit Plan** suggests service and operations improvements, including park-and-ride options, interagency collaboration, and improving on-demand services. Proposed park-and-ride routes include service between Cleveland and METRO's Townsen Park and Ride, and between Cleveland and Liberty-Dayton. Public comments requested better integration between last mile connections to the transit system and bike racks on buses.
- The **High-Capacity Transit Task Force Priority Network**, which is the transit component of the current 2045 Regional Transportation Plan (RTP), recommends a regional bus route linking Cleveland to the Townsen Park and Ride, from which riders could access METRO services.

In sum, opportunities and challenges for implementing transit improvements in Cleveland were identified through quantitative and qualitative analysis of available data and stakeholder interviews with Brazos Transit District.

CHALLENGES

- Transit demand exceeds on-demand supply, highlighting capacity challenges; there are no formal bus stops with shelter, benches, signage, or other amenities; a lack of a dedicated funding source, such as a sales or ad valorem tax or impact fees, limits the ability for the Brazos Transit District to supply additional service.

OPPORTUNITIES

- Serve areas of frequent transit fixed route boardings and alightings "hotspots" with improved pedestrian infrastructure and dense mixed development

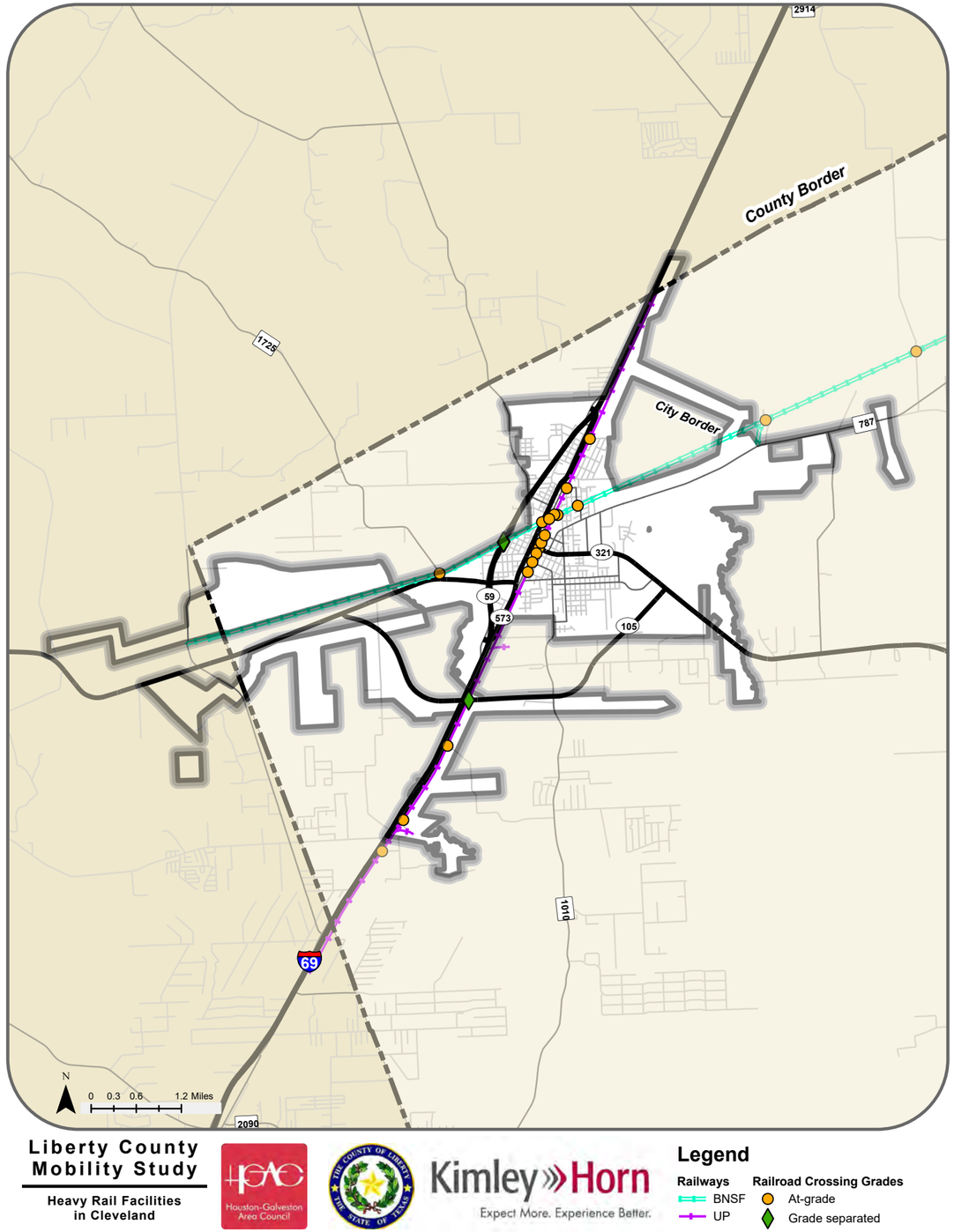
RECOMMENDATIONS

The City of Cleveland should work with the Brazos Transit District and H-GAC to participate in future studies and consider future transit improvements as the county's population continues to grow. Specific elements could include:

- Replacement of existing fixed route and Demand Response service with flex Zone Operations
- A Park-and-Ride lot near Cleveland to serve trips connecting to services provided by Houston METRO and The Woodlands Transit

H-GAC is planning to conduct a regional connector bus study, which will explore the feasibility of bus routes that connect the region's outlying communities to each other as well as the urban core. Such services could enhance Cleveland's connectivity to the rest of the region.

Exhibit 5.1.3f – Railroad Facilities in Cleveland



FREIGHT

Two rail lines run through the City of Cleveland:

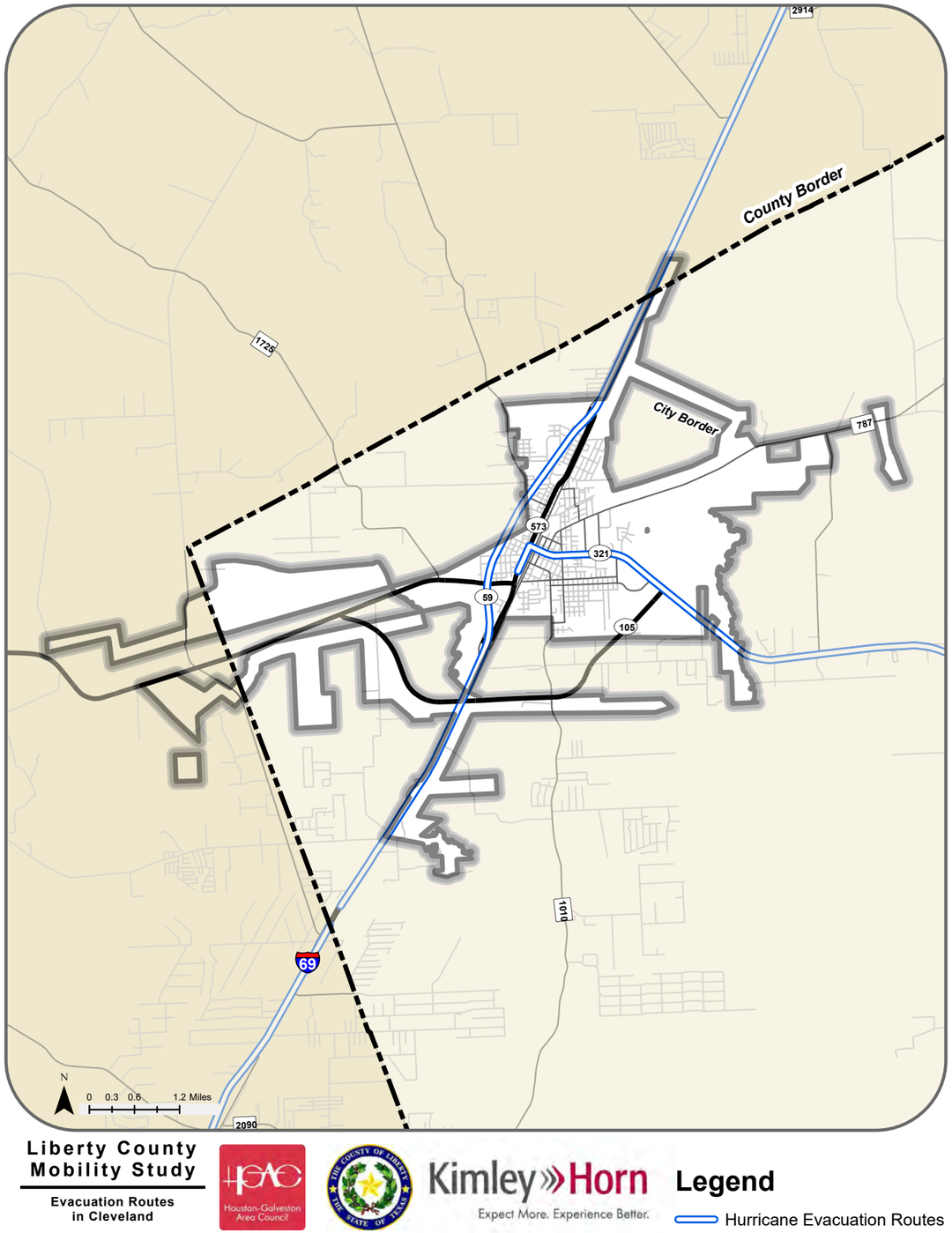
- UPRR-owned mainline, the Lufkin Subdivision, that runs north-south through Cleveland and connects Houston and Lufkin
- BNSF-owned mainline, the Conroe Subdivision, that runs east-west through Cleveland and connects Conroe to Silsbee

Exhibit 5.1.3f illustrates the railroad facilities–lines and crossings–existing in Cleveland.

EVACUATION ROUTES

Hurricane evacuation routes designated by TxDOT within the City of Cleveland are illustrated in ***Exhibit 5.1.3g***.

Exhibit 5.1.3g – Evacuation Routes in Cleveland



5.1.4 SAFETY

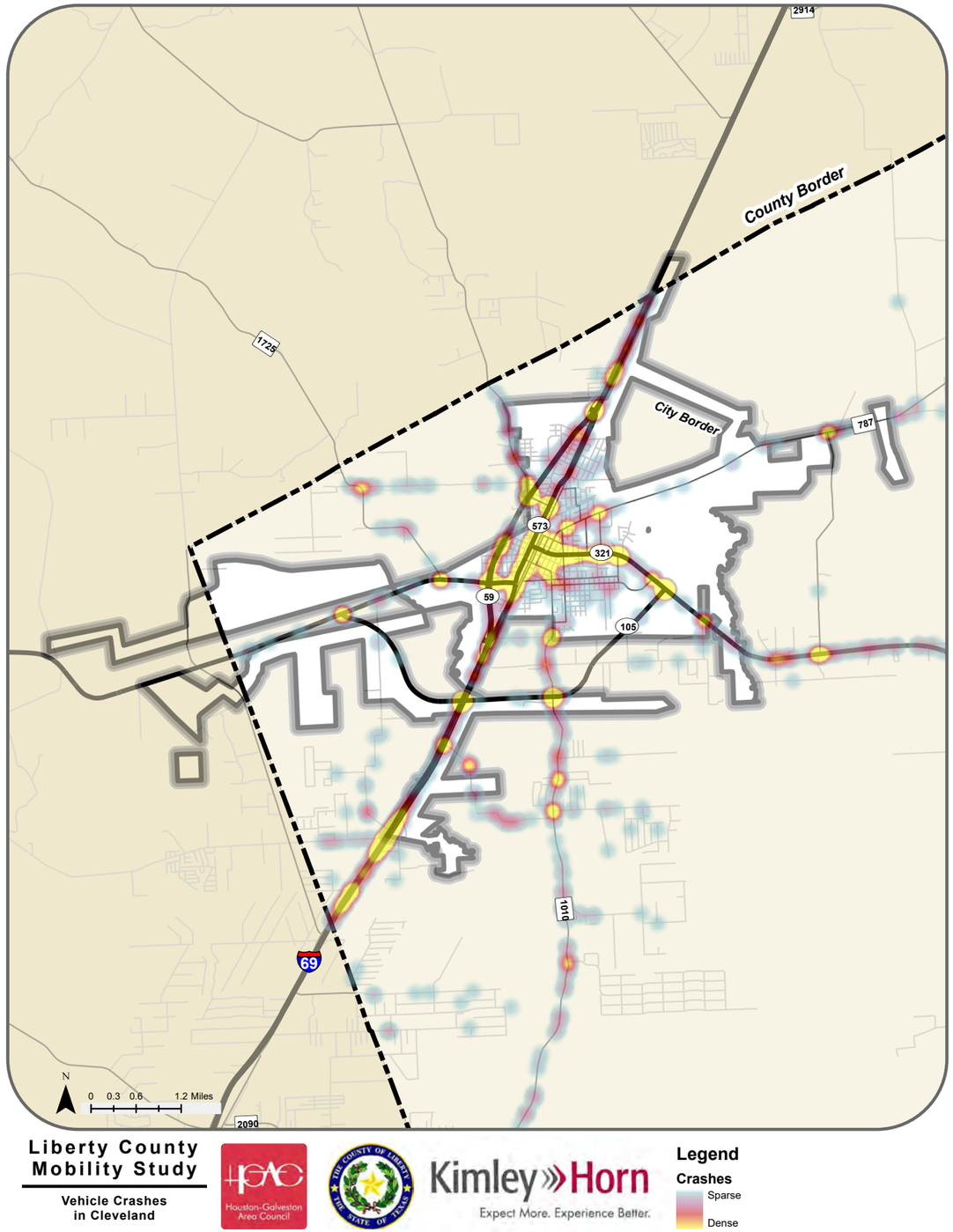
Crash data was collected in Cleveland during years 2016 through 2020. Most crashes during that time happened in downtown Cleveland and at junctions of major corridors. The top 3 highest concentrations of crashes are located at the following intersections:

1. SH 105 Bypass at SH 321/Houston Avenue (75 crashes)
2. FM 573/Washington Avenue at SH 321/Houston Avenue (62 crashes)
3. SH 105 Bypass at IH-69/US 59 (53 crashes)

Exhibit 5.1.4a illustrates the density of all crashes in and around the city.

Source: TxDOT CRIS

Exhibit 5.1.4a – Vehicle Crashes in the City of Cleveland



While crashes occur on all roadways, higher crash density typically occurs along higher capacity/speed roadways and at intersections of higher capacity/speed roadways. ***Table F*** shows the classifications of each roadway, what percentage (by length of roadway) of Cleveland's roadway network they account for, what percentage of overall crashes take place on that classification of roadway, and percent of total fatalities occur on that classification of roadway.

Table F – Cleveland Crash Percentage by Roadway

Roadway Classification	Length of Roadway (miles)	Percent of Total Roadway Network	Number of crashes	Percent of Total Crashes	Number of Fatalities	Percent of Total Fatalities
Interstate	-	-	-	-	-	-
Freeway/Expressway	152	31%	303	21%	4	40%
Principal Arterial	200	40%	707	49%	6	60%
Minor Arterial	56	11%	217	15%	-	-
Major Collector	27	6%	65	4%	-	-
Minor Collector	-	-	-	-	-	-
Local	61	12%	135	9%	-	-
Total	**497**	**100%**	**1427**	**100%**	**10**	**100%**

5.1.5 IDENTIFIED NEEDS

In a meeting held with Liberty County and City of Cleveland staff, the following needs were identified:

- Congestion at the intersection of FM 2025 and IH-69/US 59 is a critical concern for the city
- The City of Cleveland needs an updated Strategic Plan for Economic Development
- Members of the public are not aware that the City of Cleveland is served by the Brazos Transit District (BTD); an expanded marketing campaign is needed
- Elderly and infirm people use their wheelchairs on Houston Street and Peach Street; ADA-compliant pedestrian facilities are needed along these roads to improve safety and mobility
- BTD local buses currently have capacity for only one wheelchair; larger buses are needed
- The influx of young people – specifically families – will generate demand for expanded bicycle facilities
- School-age pedestrians require at least one safe crossing location along Houston Street (SH 321)
- A new thoroughfare - Northside Boulevard – is proposed to run from FM 2025 to Washington Street; this would serve incoming schools (opening in Fall 2022 and Fall 2023) to the north and would accommodate truck traffic
- Pelican Road (CR 2201/CR 2204), which connects FM 787 to SH 105 to accommodate the industrial park north of FM 787, needs to be paved
- There are many fatal crashes along the SH 105 bypass; improved lighting, signage, and other sight distance elements are needed
- There is significant truck traffic in the city; enforcement of truck routes (i.e., the SH 105 bypass) is needed
- The railroad crossing at Hanson Road is being closed; a new railroad crossing would improve east-west mobility

During both public meetings and through the online feedback tool, members of the public identified the following needs in Cleveland:

- The intersection of SH 105 and SH 321 by the new residential development is dangerous due to excessive truck volumes; this intersection should have a dedicated, channelized right-turn lane to accommodate; TxDOT owns the right-of-way there
- There are visibility issues along the SH 105 bypass and especially at the intersection of SH 105 and Southline Street.
- The intersection of FM 2025 and IH-69 is impassable during peak hours and will be much worse when the schools northwest of IH-69 open this and next fall
- A bridge is needed to connect the proposed Northside Boulevard to the east side of the city
- A loop should be created around the city, utilizing the existing SH 105 bypass and FM 787
- FM 787 should be improved to provide a safer, more comfortable route for cyclists
- Visibility issues exist at the intersection of FM 787 and CR 2212
- Signalization and other lane configuration changes should be considered at the intersection of CR 2243 and SH 321/SH 105
- SH 105 bypass should be expanded to accommodate future growth and to provide an additional hurricane evacuation route

Full details of public and Steering Committee comments are included in ***Appendix B***.

5.2 ANALYSIS AND RECOMMENDATIONS

5.2.1 SCENARIO COMPARISON

SHORT-TERM INTERSECTION ANALYSIS

Each study intersection was analyzed to better understand current operations before recommendations could be developed. Synchro™, a traffic analysis software, was used to create a model to analyze the operation of study intersections as they currently operate, in the "2021 Existing" scenario, during the weekday hours of highest use, or the PM peak hour (5:00-7:00 PM). A summary of the analysis results is illustrated in ***Exhibit 5.2.1a*** and the complete analysis results can be found in ***Appendix D***.

In the 2021 Existing scenario, the study intersections in the City of Cleveland appear stable but nearing capacity. Based on anecdotes from stakeholders and City staff, the conditions at these intersections may be worse than the analysis results indicate. One stakeholder described the intersection of FM 2025 at the IH-69/US 59 Frontage Road as "impassable" during both morning and afternoon commute times. This intersection is one of only three points to cross IH-69/US 59 in the City of Cleveland, so when this intersection becomes congested, mobility is severely limited throughout the city.

The results of the 2021 Existing analysis scenario helped determine potential improvements to the network that could be applied in the short-term. Short-term improvements are assumed to be constructed or implemented within five years of this study.

Another Synchro™ model was created to analyze the operation of study intersections with the addition of short-term improvements to the existing roadway network, also known as the "2021 Improved" scenario. Adjusted 2021 volumes were used. A summary of the analysis results is illustrated in ***Exhibit 5.2.1a*** and the complete analysis results can be found in ***Appendix D***.

Due to the implementation of short-term improvements, the analysis determined that there would be a 43% decrease in delay at the study intersections between the 2021 Existing and Improved scenarios.

LONG-TERM INTERSECTION ANALYSIS

Another Synchro™ model was created to analyze the operation of study intersections in the 2045 Existing analysis scenario. A summary of the analysis results is illustrated in ***Exhibit 5.2.1b*** and the complete analysis results can be found in ***Appendix D***.

Unlike the 2021 Existing scenario, all study intersections in the 2045 Existing scenario have a failing LOS, meaning they will need capacity improvements in addition to potential safety improvements. An increase in "failing" intersections is expected in 2045 due to background growth and development.

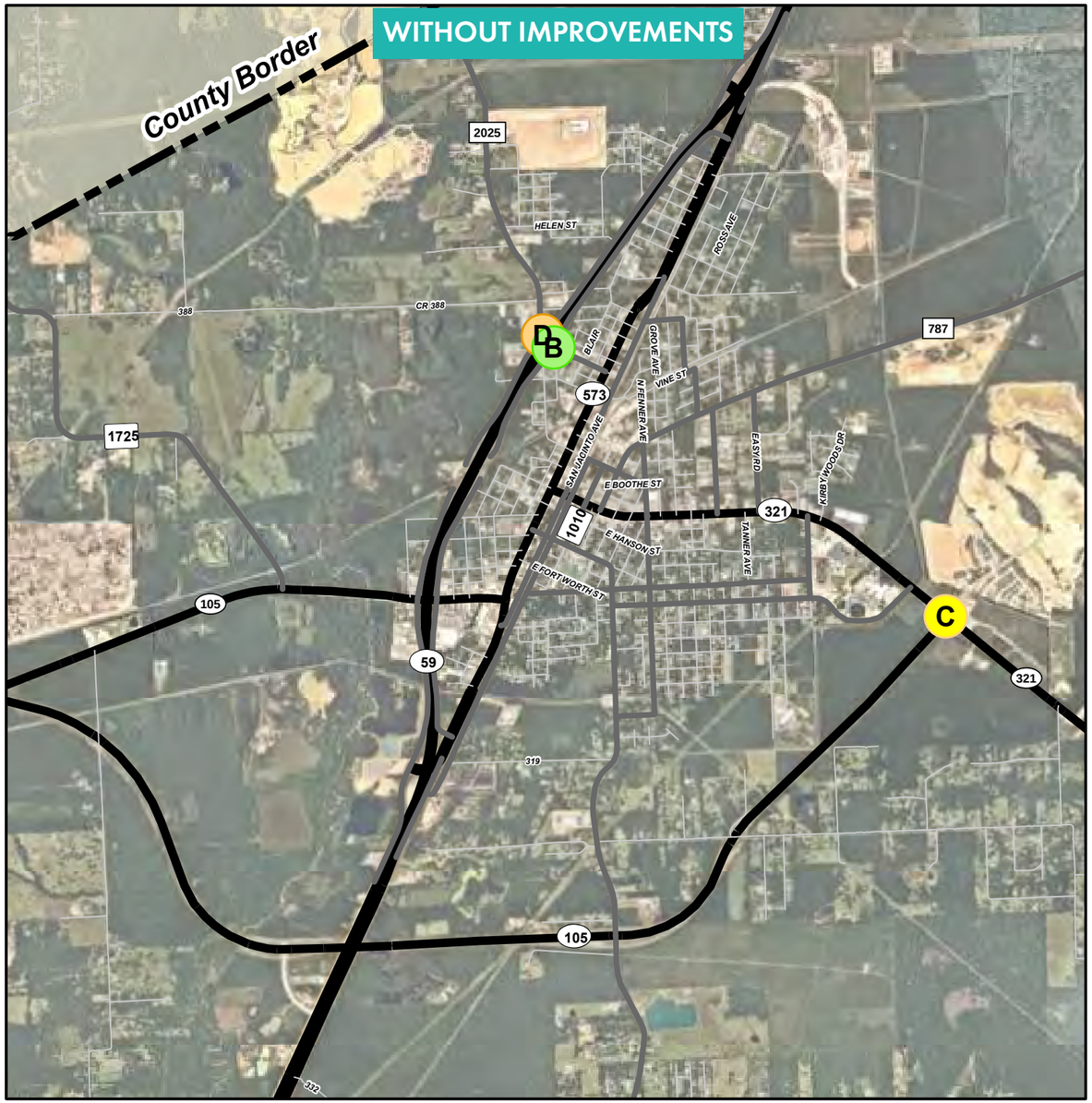
The results of the 2045 Existing analysis scenario helped determine potential improvements to the network that could be applied in the long-term. Long-term improvements are assumed to be constructed or implemented between five and twenty-five years after this study's completion, between years 2026 and 2046.

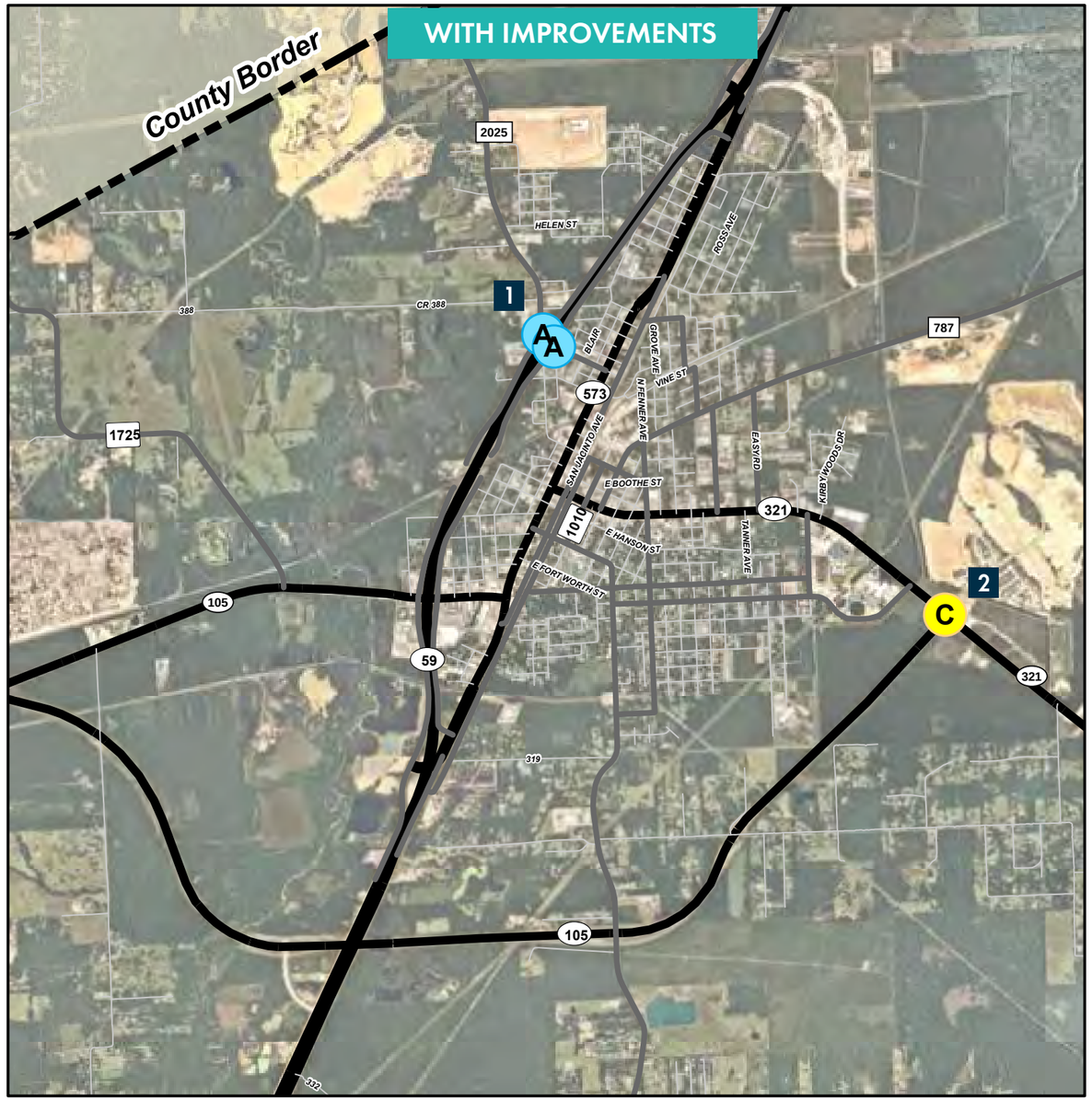
Another Synchro™ model was created to analyze the operation of study intersections with the addition of short-term and long-term improvements to the existing roadway network, also known as the 2045 Improved scenario. Projected 2045 volumes were used. A summary of the analysis results is illustrated in ***Exhibit 5.2.1b*** and the complete analysis results can be found in ***Appendix D***.

Due to the implementation of long-term improvements, the analysis determined that there would be an 83% decrease in delay at the study intersections between the 2045 Existing and Improved scenarios.

All the improvements recommended at study intersections are discussed in ***Section 5.2.2***.

Exhibit 5.2.1a – Short-Term Analysis Results and Improvements for City of Cleveland





Legend

Level-Of-Service

A
B
C
D
E
F

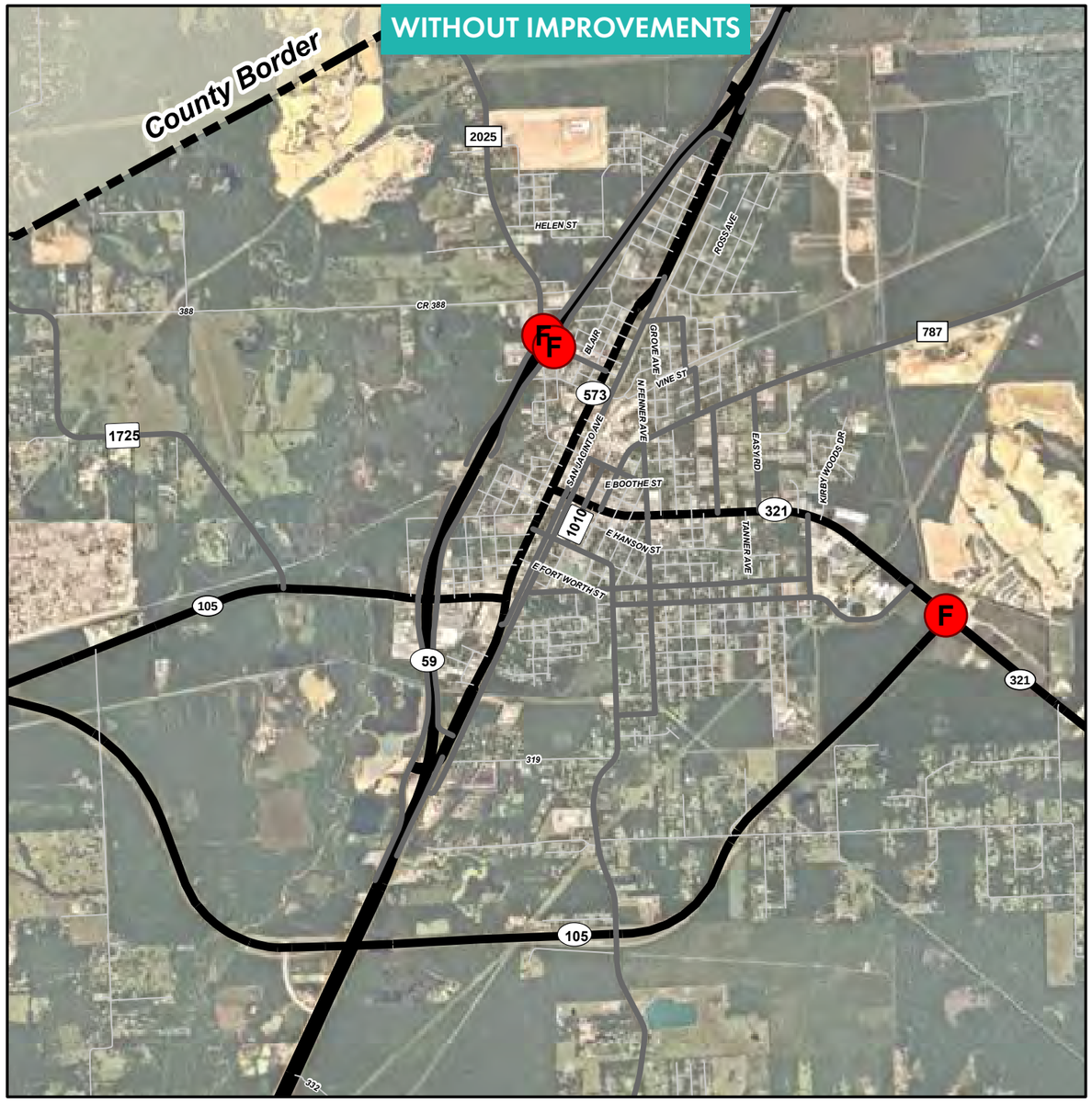
Liberty County Mobility Study

City of Cleveland
Corridor Performance
2021

1 Signalize; install sidewalks across bridge and pedestrian infrastructure (curb ramps, crosswalks, countdown signals, etc) at intersections

2 Optimize cycle length and phase splits; install shared use path on north and south sides of Houston Street, traveling west; install left-turn lane (northbound)

Exhibit 5.2.1b – Long-Term Analysis Results and Improvements for City of Cleveland



1 Optimize cycle length and phase splits; widen bridge to 4 lanes; install left-turn lane (northbound)

2 Install dual left-turn lanes (northbound and westbound); install through lane (eastbound and westbound); Protected Left-Turn (all approaches); Permissive+Overlap right-turn (eastbound, northbound)

Legend
Level-Of-Service
A
B
C
E
F
N/A

Liberty County Mobility Study
City of Cleveland
Corridor Performance
2045

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LONG-TERM CORRIDOR ANALYSIS

Each study corridor was analyzed to better understand current operations before recommendations could be developed. Volume-to-capacity ratio (V/C) was the metric used to analyze and evaluate operations under both "existing" and "improved" conditions. Refer to ***Section 3.1.4*** for an expanded explanation of how V/C was determined for each corridor.

In the City of Cleveland, because volume increases across all corridors between 2021 and 2045, V/C also increases and approaches capacity, as illustrated by V/C in red on ***Exhibit 5.2.1c***.

Table G - Long-Term Corridor Analysis

Corridor Name (ID)	2021 ADT/ Lane	2021 "Existing" (V/C)	2045 ADT/ Lane	2045 "Existing" (V/C)
SH B 105/Southline Street (A-1)	4,559	0.37	7,333	0.59
FM 2025/Fenner Avenue (B-2)	790	0.05	1,271	0.09
FM 1010/Plum Grove Road (B-4)	3,854	0.31	6,199	0.5
Houston Avenue (C-1)	7,447	0.52	11,978	0.83

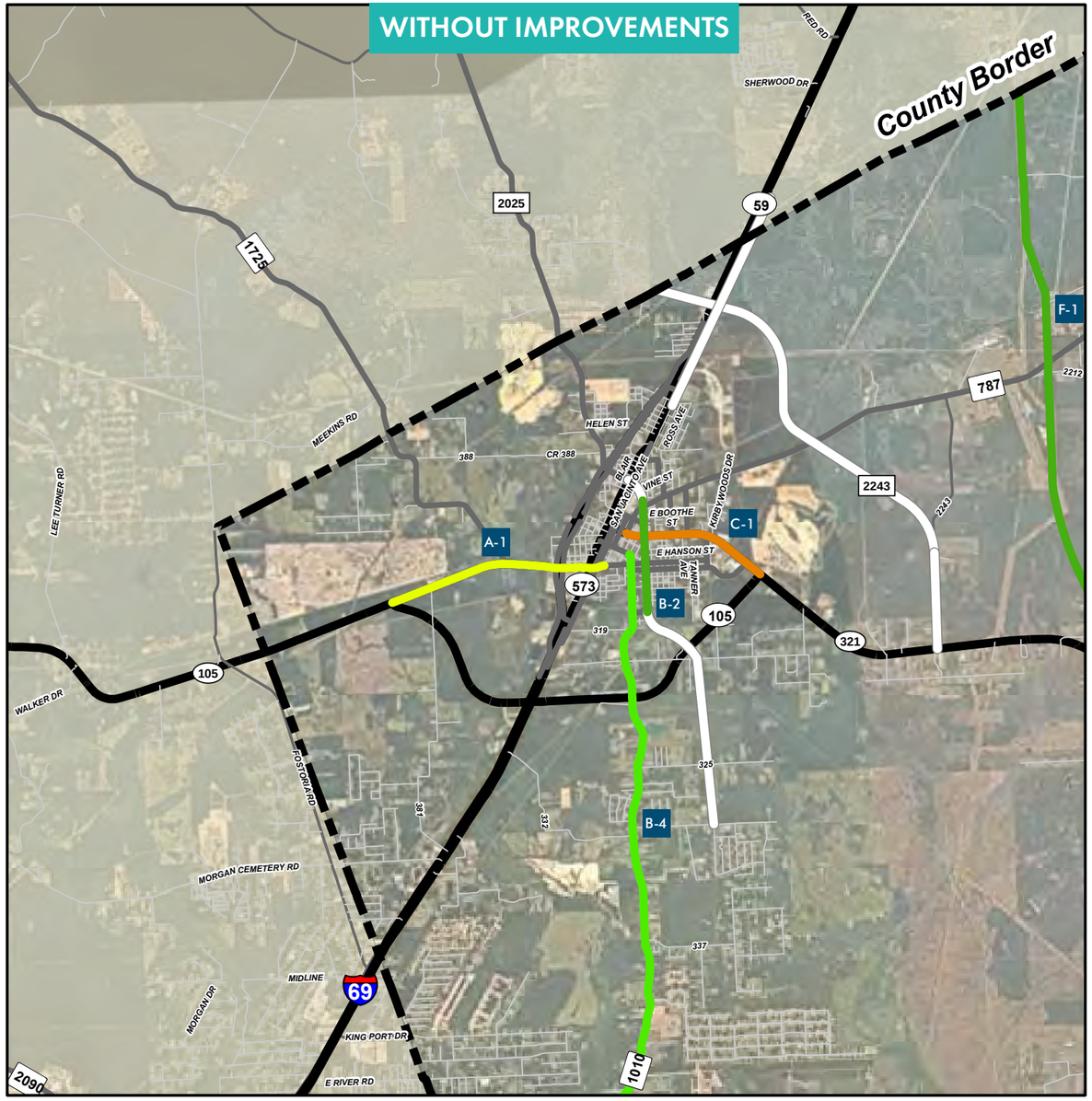
Where additional through lanes are recommended in the long-term (2045), capacity will increase.

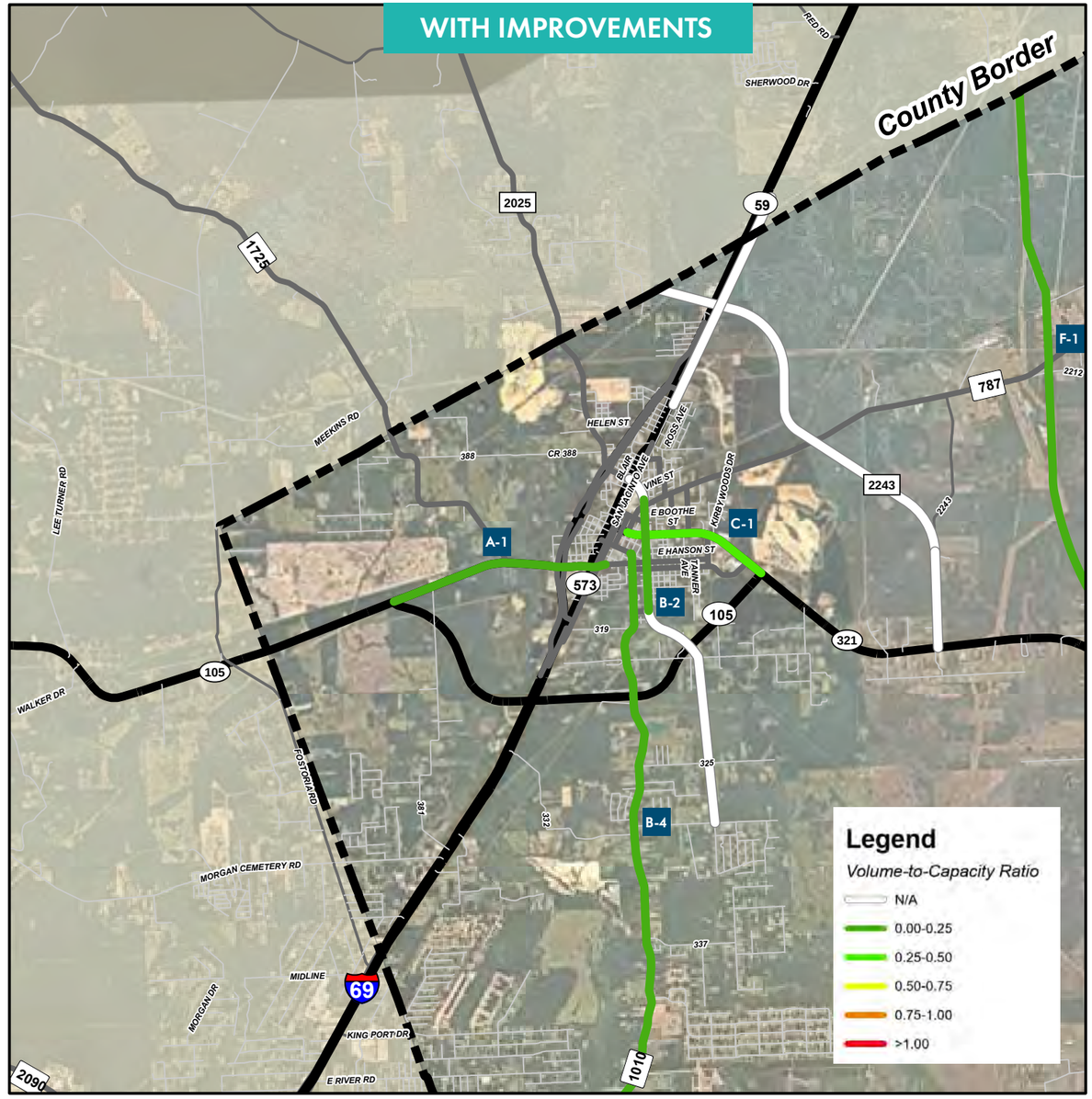
Table H - Long-Term Corridor Analysis Capacity Comparison

	2045 "Existing"		2045 "Improved"		% Change in Capacity
Corridor Name (ID)	ADT/Lane	V/C	ADT/Lane	V/C	
SH B 105/Southline Street (A-1)	7,333	0.59	3,666	0.25	57%
FM 2025/Fenner Avenue (B-2)	1,271	0.09	1,271	0.09	-
FM 1010/Plum Grove Road (B-4)	6,199	0.5	3,100	0.22	57%
Houston Avenue (C-1)	11,978	0.83	5,989	0.42	50%

See V/C illustrated in the City of Cleveland in ***Exhibit 5.2.1c***.

Exhibit 5.2.1c – Long-Term Corridor Analysis Results and Improvements for City of Cleveland





A-1 Widen to minimum 4-lane divided cross-section with center raised median and turn bays where appropriate

B-4 Widen to minimum 4-lane divided cross-section between E Dallas Street and SH 105 bypass

C-1 Widen to minimum 5-lane cross-section with 14-foot center two-way left-turn lane

Liberty County Mobility Study

City of Cleveland Corridor Performance 2045

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5.2.2 RECOMMENDATION MATRIX

Recommended improvements across all study locations in Cleveland – intersections and corridors – have been summarized in a Recommendation Matrix and Summary Sheets for easy review. Both documents can be found in ***Appendix E***.

Information provided in the Recommendation Matrix includes the total construction cost and expected monetary benefits of each recommended improvement, the score pertaining to each of the project's goals, and a brief description of each of the recommended improvements at the study location. See ***Section 8.2*** for a full explanation of how costs and benefits were determined and how recommendations were evaluated per the project goals.

Additionally, ***Table I*** outlines the number of occurrences of each recommended improvement in the City of Cleveland.

Table I – Recommendations in Cleveland

Recommended Improvement	Occurrences
Install pedestrian elements	4
Install shared use path	4
Install sidewalk	2
Install left-turn lane	2
Install through lane / widen road	5
Install / improve pavement markings	2
Realign intersection	1
Install / improve pavement	1
Construct roadway extension	1
Improve drainage	1
Signalize	1
Optimize/coordinate signal	2
Change left-turn phasing	1
Add right-turn overlap	1

All information which led to the development of recommended improvements for each study intersection and corridor, including its location within the study area, crash data, and capacity analysis results is organized in Summary Sheets. This provides a more visual snapshot of the study location as it is now and as it could be with the implementation of the recommendations. The Summary Sheets for study locations in the City of Cleveland are below and Summary Sheets for all study locations are included in ***Appendix E***.

Some summary sheets do not contain recommended improvements. In these cases, individual jurisdictions requested analysis, however it was determined that improvements were unnecessary.

Liberty County Mobility Study, Intersection Summary Sheets

US 59 Frontage Road & Old Cold Spring Road/Belcher Street

Intersection ID: Cleveland - 1

Existing Aerial View

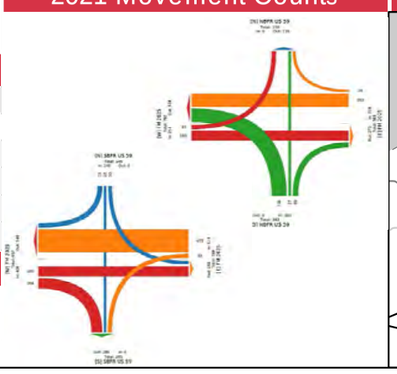
Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Signalize - Install sidewalks across bridge and pedestrian infrastructure (curb ramps, crosswalks, countdown signals, etc) at intersections	- Optimize cycle length and phase splits
Lane Configuration		- Widen bridge to 4 lanes - Install left-turn lane - northbound
Turn Types		

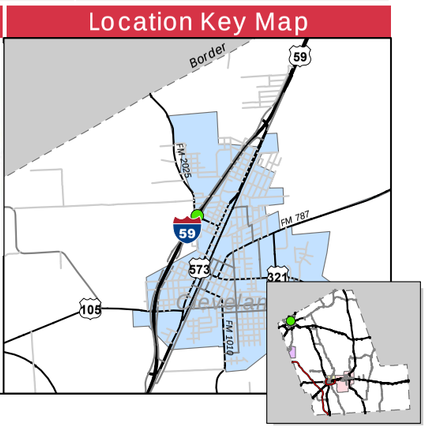
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	16.8 (15.3)	C (C)	7.9 (10.9)	A (B)
	2045	86.9 (76.0)	F (F)	9.9 (12.7)	A (B)
PM Peak	2021	25.6 (14.7)	D (B)	7.9 (7.3)	A (A)
	2045	160.3 (57.8)	F (F)	8.6 (9.4)	A (B)

2021 Movement Counts



Location Key Map



Crash Data (2016-2020)

Total	Fatal	Serious Injury
43	0	1

Liberty County Mobility Study, Intersection Summary Sheets

SH 105 & Houston Street

Intersection ID: Cleveland - 2

Existing Aerial View

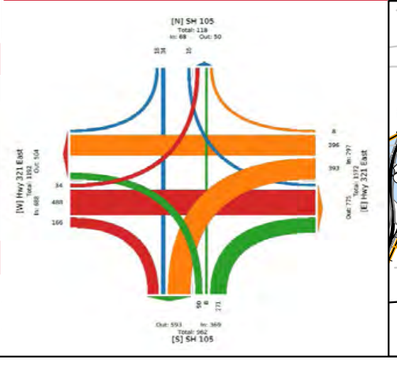
Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Optimize cycle length and phase splits - Install shared use path on north and south sides of Houston Street, traveling west	
Lane Configuration	- Install left-turn lane - northbound	- Install left-turn lanes (dual left) - northbound and westbound - Install through lane - eastbound and westbound
Turn Types		- Protected (Left-Turn) - all approaches - Permissive+Overlap (right-turn) - eastbound, northbound

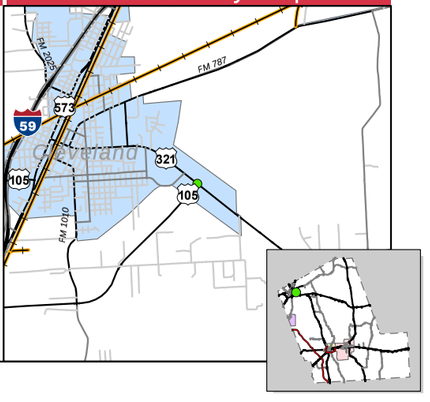
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	504.57	F	152.8	F
	2045	975.7	F	26.4	C
PM Peak	2021	24.5	C	24.8	C
	2045	143.1	F	28.1	C

2021 Movement Counts



Location Key Map



Crash Data (2016-2020)

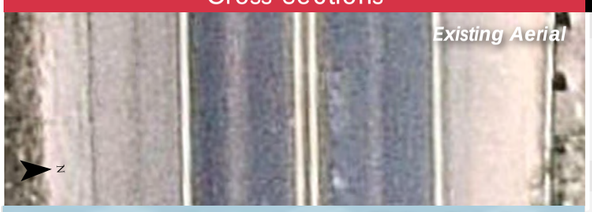
Total	Fatal	Serious Injury
80	0	6

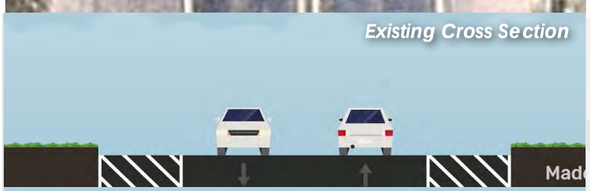
Liberty County Mobility Study, Corridor Summary Sheets

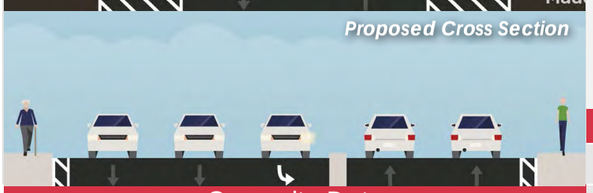
SH 105/W Southline Street

from SH 105 to Washington Avenue
Corridor-Segment ID: A-1

Cross-Sections







Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	11124	0.62
2045	17892	0.99

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
43	0	0	0	0

Recommended Improvements

General

Proposed Classification: Principal Arterial (4-6 lanes, Divided)

Short-Term

- Install pedestrian elements (marked crosswalks, countdown signals where applicable, curb ramps, etc) at intersections

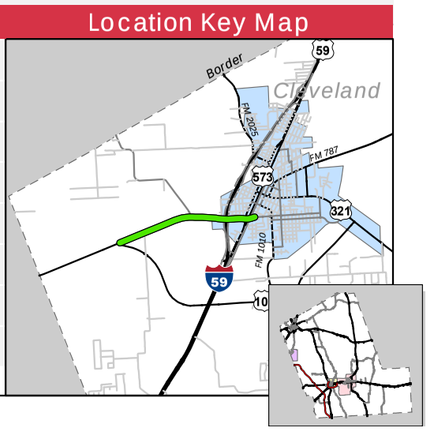
Long-Term

- Install 6-foot sidewalk along both sides of W Southline Street between Majnik Avenue and S Washington Avenue
- Install bikeway (shared use path or bike lanes) along the entire corridor
- Widen to minimum 4-lane divided cross-section with center raised median and turn bays where appropriate
- Extend W Southline Street from its existing terminus at S Washington Avenue to Southline Street or Truman Street on the east side of the railroad; install railroad crossing

Segment Characteristics

Segment Length (mi)	1.99
Posted Speed (mph)	65
ROW Width (ft)	110
Roadway Width (ft)	45
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map

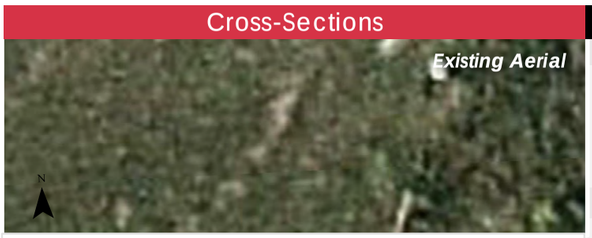


Liberty County Mobility Study, Corridor Summary Sheets

FM 2025/Fenner Avenue (Proposed Extension)

from Washington Avenue to Fenner Avenue/Nevell Street
Corridor-Segment ID: B-1

Cross-Sections



Existing Cross-Section

Proposed Cross-Section

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	N/A	N/A
2045	N/A	N/A

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
N/A	N/A	N/A	N/A	N/A

Recommended Improvements

General

Proposed Classification: N/A
None; do not construct
- This extension would require constructing two new railroad crossings, which is not feasible in Cleveland because of the amount of existing crossings. We would need to exchange an existing crossing to build a new one, which is not desirable at this location.

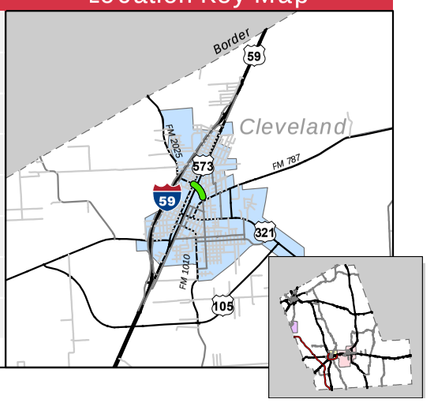
Short-Term

Long-Term

Segment Characteristics

Segment Length (mi)	2.77
Posted Speed (mph)	N/A
ROW Width (ft)	N/A
Roadway Width (ft)	N/A
Number of Lanes	N/A
Center Type	N/A
Center Width (ft)	N/A
Sidewalk Count	N/A

Location Key Map



Liberty County Mobility Study, Corridor Summary Sheets

FM 2025/Fenner Avenue

from Nevell Street to Issacks Street
Corridor-Segment ID: B-2

Cross-Sections

Proposed Cross-Section

Recommended Improvements

General

Proposed Classification: Collector
None; utilize FM 1010/ Plum Grove Road as major north-south route in the vicinity

Short-Term

- Upgrade pavement markings

Long-Term

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	1622	0.2
2045	2609	0.33

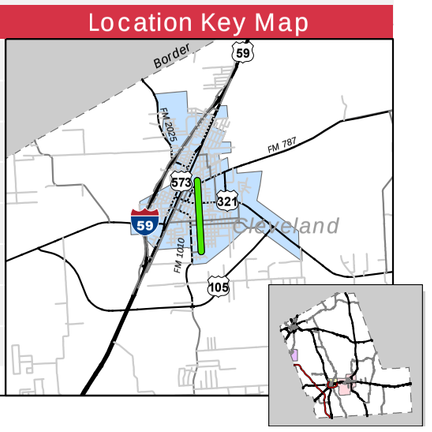
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
25	0	0	0	0

Segment Characteristics

Segment Length (mi)	0.3
Posted Speed (mph)	30
ROW Width (ft)	50
Roadway Width (ft)	24
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map

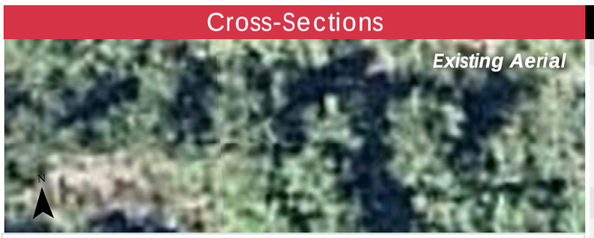


Liberty County Mobility Study, Corridor Summary Sheets

FM 2025/Fenner Avenue (Proposed Extension)

from Issacks Street to FM 331
Corridor-Segment ID: B-3

Cross-Sections



Existing Cross-Section

Proposed Cross-Section

Recommended Improvements

General

Proposed Classification: N/A
None; utilize FM 1010/ Plum Grove Road as major north-south route in the vicinity

Short-Term

Long-Term

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	N/A	N/A
2045	N/A	N/A

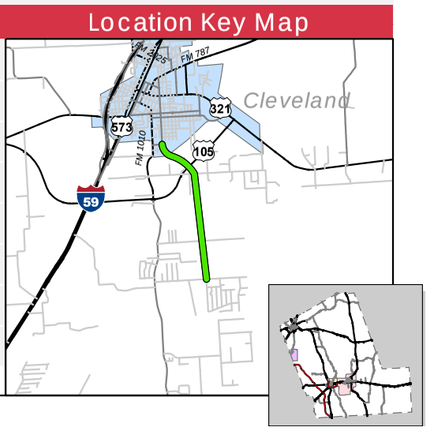
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
N/A	N/A	N/A	N/A	N/A

Segment Characteristics

Segment Length (mi)	1.3
Posted Speed (mph)	N/A
ROW Width (ft)	N/A
Roadway Width (ft)	N/A
Number of Lanes	N/A
Center Type	N/A
Center Width (ft)	N/A
Sidewalk Count	N/A

Location Key Map

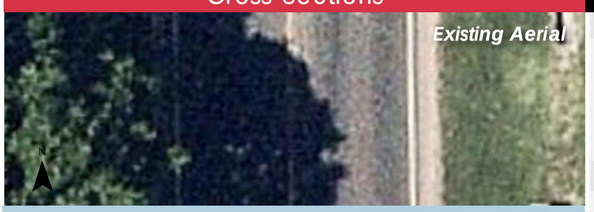


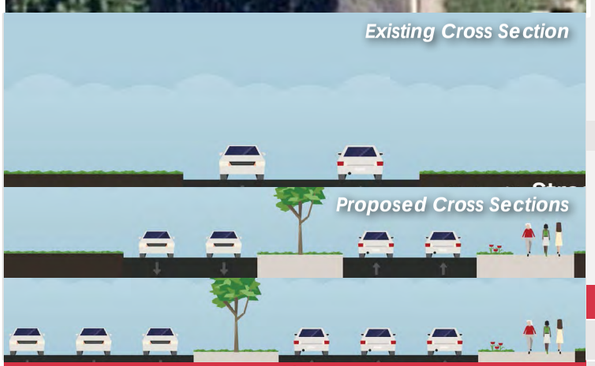
Liberty County Mobility Study, Corridor Summary Sheets

FM 1010/Plum Grove Road

from Southline Street to FM 2090
*Corridor-Segment ID: B-1**

Cross-Sections





Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	6459	0.36
2045	10389	0.58

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
200	3	39	1	1

Recommended Improvements

General

Proposed Classification: Principal Arterial (4-6 lanes, Divided)

Short-Term

- Install pedestrian elements (marked crosswalks, countdown signals where applicable, curb ramps, etc) at intersections
- Realign intersection with FM 2090 as a four-way instersection (see Intersection Plum Grove '- 1)

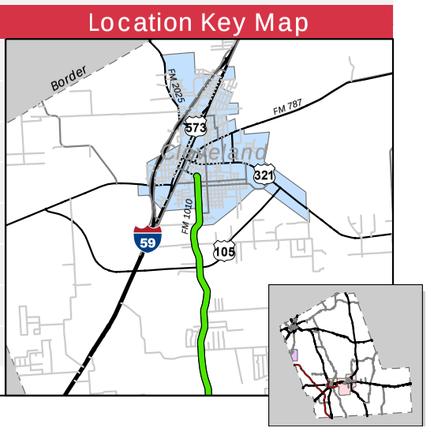
Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility between the cities of Cleveland and Plum Grove along the east side of FM 1010
- Widen to minimum 4-lane divided section between E Dallas Street and SH 105 bypass
- Widen to minimum 6-lane divided section between SH 105 bypass and terminus at future Grand Parkway

Segment Characteristics

Segment Length (mi)	8.67
Posted Speed (mph)	50
ROW Width (ft)	62
Roadway Width (ft)	30
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map



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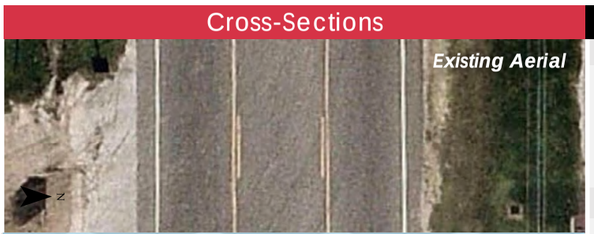
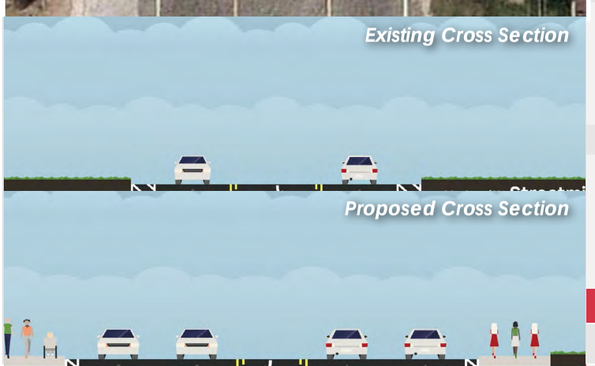
Liberty County Mobility Study, Corridor Summary Sheets

Houston Avenue

from FM 787 to SH 105
Corridor-Segment ID: C-1

Cross-Sections





Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	26427	1.47
2045	42506	2.36

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
307	1	5	2	3

Recommended Improvements

General

Proposed Classification: Principal Arterial (4-6 lanes, Divided)

Short-Term

- Install pedestrian elements (marked crosswalks, countdown signals where applicable, curb ramps, etc) at intersections

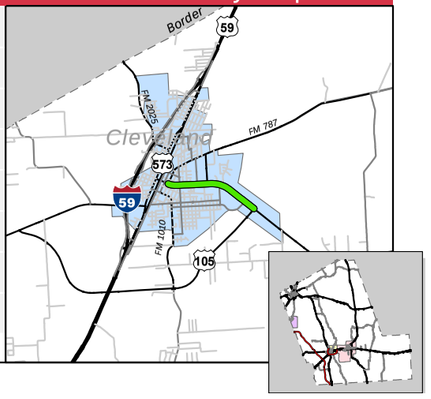
Long-Term

- Widen to minimum 5-lane cross-section with 14-foot center two-way left-turn lane
- Replace existing drainage with curb and gutter drainage
- Install 6-foot sidewalk along at least one side of the corridor
- Install bikeway (shared use path or bike lanes) along the entire corridor

Segment Characteristics

Segment Length (mi)	1.72
Posted Speed (mph)	50
ROW Width (ft)	80-100
Roadway Width (ft)	45
Number of Lanes	3
Center Type	TWLTL
Center Width (ft)	
Sidewalk Count	One Side

Location Key Map



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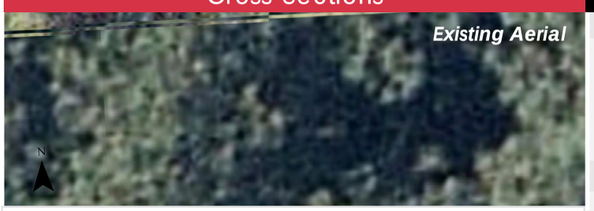
Liberty County Mobility Study, Corridor Summary Sheets

N Travis Avenue

from Travis Avenue/E 5th Street to Northern County Limits
Corridor-Segment ID: D-1

Cross-Sections



Existing Cross-Section

Proposed Cross-Section

Recommended Improvements

General

Proposed Classification: N/A
None; do not construct
- There is already a frontage road in this area

Short-Term

Long-Term

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	N/A	N/A
2045	N/A	N/A

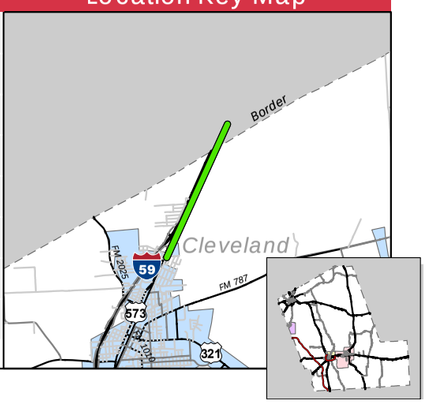
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
N/A	N/A	N/A	N/A	N/A

Segment Characteristics

Segment Length (mi)	2.68
Posted Speed (mph)	N/A
ROW Width (ft)	N/A
Roadway Width (ft)	N/A
Number of Lanes	N/A
Center Type	N/A
Center Width (ft)	N/A
Sidewalk Count	N/A

Location Key Map



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Liberty County Mobility Study, Corridor Summary Sheets

CR 2243

from Northern County Limits to CR 2243
Corridor-Segment ID: E-1

Cross-Sections

Existing Cross-Section

Proposed Cross-Section

Recommended Improvements

General

Proposed Classification: N/A
None; do not construct
- Re-examine east-west connectivity in updated countywide Thoroughfare Plan

Short-Term

Long-Term

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	N/A	N/A
2045	N/A	N/A

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
1	0	0	0	0

Segment Characteristics

Segment Length (mi)	4.88
Posted Speed (mph)	45
ROW Width (ft)	N/A
Roadway Width (ft)	N/A
Number of Lanes	N/A
Center Type	N/A
Center Width (ft)	N/A
Sidewalk Count	N/A

Location Key Map

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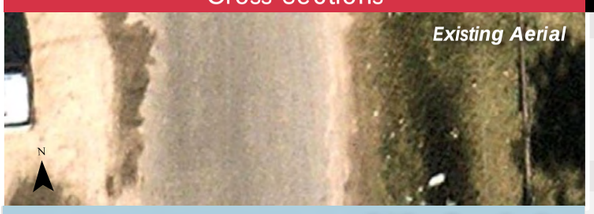
Liberty County Mobility Study, Corridor Summary Sheets

CR 2243

from CR 2243 to SH 105
Corridor-Segment ID: E-2

Cross-Sections



Proposed Cross-Section

Recommended Improvements

General

Proposed Classification: Minor Arterial

Short-Term

- Upgrade pavement
- Upgrade pavement markings

Long-Term

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	327	0.03
2045	526	0.04

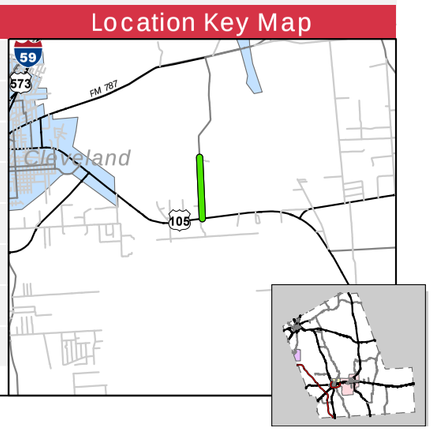
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
9	1	0	0	1

Segment Characteristics

Segment Length (mi)	1.12
Posted Speed (mph)	45
ROW Width (ft)	60
Roadway Width (ft)	18
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map



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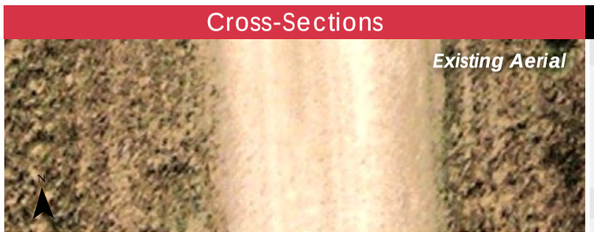
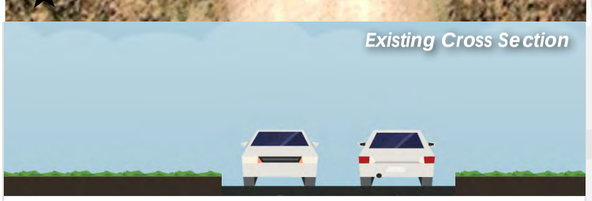
Liberty County Mobility Study, Corridor Summary Sheets

CR 2204/2201/2239

from Northern County Limits to SH 321
Corridor-Segment ID: F-1

Cross-Sections





Proposed Cross-Section

Recommended Improvements

General

Proposed Classification: N/A
- Re-examine north-south connectivity in updated countywide Thoroughfare Plan

Short-Term

Long-Term

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	364	N/A
2045	585	N/A

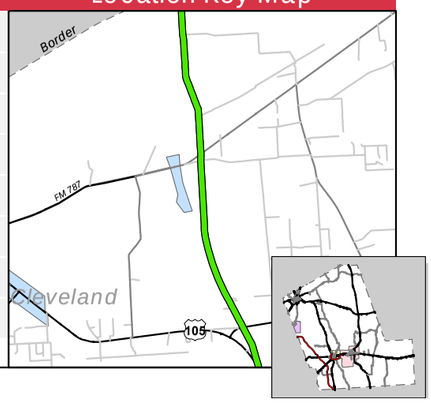
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
6	0	1	0	0

Segment Characteristics

Segment Length (mi)	7.32
Posted Speed (mph)	60
ROW Width (ft)	50
Roadway Width (ft)	20
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map



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5.2.3 IMPLEMENTATION PLAN

The City of Cleveland should program recommended improvements per its own priorities and should add them into its Capital Improvement Plan as appropriate. Implementation of recommended improvements may require coordination between municipal entities within Liberty County. Specifically, City of Cleveland may partner with Liberty County, TxDOT, and the City of Plum Grove. ***Table J*** below provides an outline of how many projects Cleveland may need to partner on, what the construction cost of those projects would be, and what potential monetary benefits would result from implementing those projects.

Table J – City of Cleveland Partnering Opportunities

	Number of Improvement Projects	Total Potential Benefits	Total Construction Cost
Cleveland + Liberty County	3	$15,957,353	$1,536,527
Cleveland + Plum Grove + Liberty County	4	-	$113,856,998
Cleveland + TxDOT + Liberty County	21	$61,490,803	$50,696,943

The local entities should partner together to create coordinated funding applications and apply to include projects within H-GAC's Regional Transportation Plan (RTP). Together, TxDOT and the local entities should coordinate with H-GAC to apply for Transportation Improvement Program (TIP) funding. Further discussion about the H-GAC TIP process can be found in ***Section 8.3.3***.

6

City of Dayton

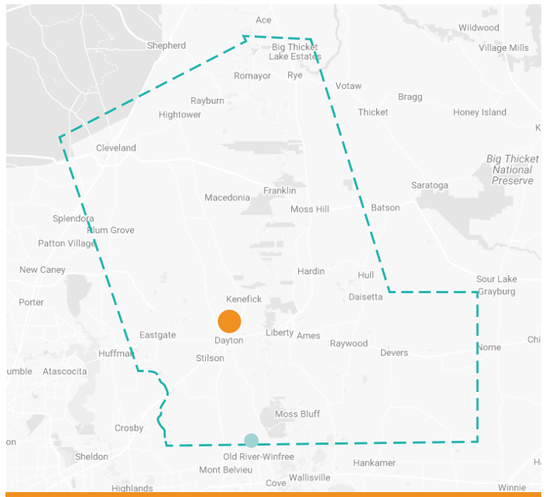
City of Dayton

6.1 EXISTING CONDITIONS

6.1.1 DEMOGRAPHICS

POPULATION

Based on data from the US Census Bureau, the population in the City of Dayton was 8,777 as of the 2020 Census, or 9.6% of the total population in Liberty County. Dayton is the most populous city in the county.



CITY OF DAYTON TOTAL POPULATION: **8,777**

POPULATION DENSITY

CITY OF CLEVELAND	LIBERTY COUNTY
360	**79**
PERSONS PER SQ. MILE	*PERSONS PER SQ. MILE*

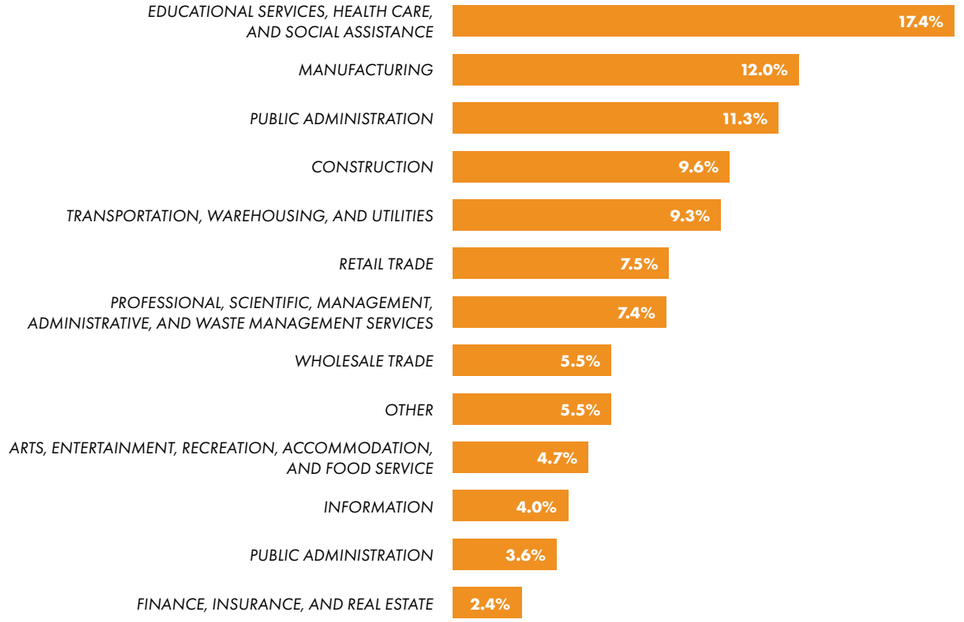
Relative to the county, Dayton is densely populated. The population density of the city is 360 persons per square mile, whereas the county's is 79 persons per square mile. Dayton is the second most densely populated city in the county after Cleveland.

Liberty County is facing significant growth due to expanding residential, commercial and industrial development. According to US Census estimates, the Dayton's population increased by 4.1% between April 2020 and July 2021.

EMPLOYMENT

Employment opportunities in Liberty County are available in a variety of industries. Relative to the county overall, the City of Dayton has a significantly greater portion of employees in Education/Health Care/Social Assistance and Agriculture/Fishing/Hunting/Mining. The construction industry is relatively small in Dayton but is expected to grow over the next twenty years due to increased development along and near the Grand Parkway (SH 99).

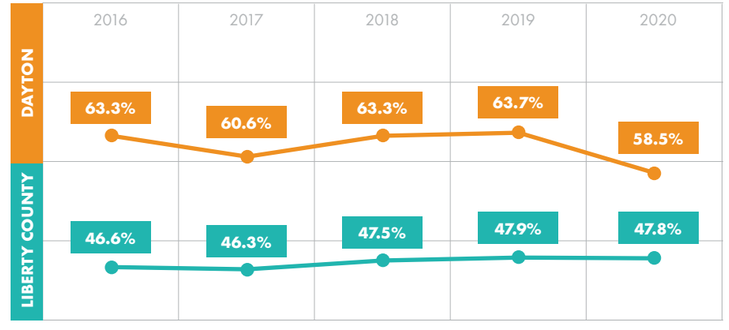
INDUSTRIES IN THE CITY OF DAYTON



Source: U.S. Census Bureau

EMPLOYMENT RATE (%)

The employment rate in the City of Dayton is comparable to that of neighboring Harris County and is overall greater than that in Liberty County. Dayton has the highest employment rate of cities in the County, despite experiencing a short decline during the COVID-19 pandemic in 2020. With the anticipated development and growth in the area, employment rate is expected to increase.



Source: U.S. Census Bureau

6.1.2 LAND USE

Dayton is located on US 90, west of the City of Liberty and the Trinity River. Currently, residential and commercial development is concentrated within the downtown area and along major roadways that extend outwards – SH 321 to the north, FM 1960 to the west, US 90 to the west, and FM 1409 to the south.

Exhibit 6.1.2a illustrates the distribution of land use throughout the City of Dayton.

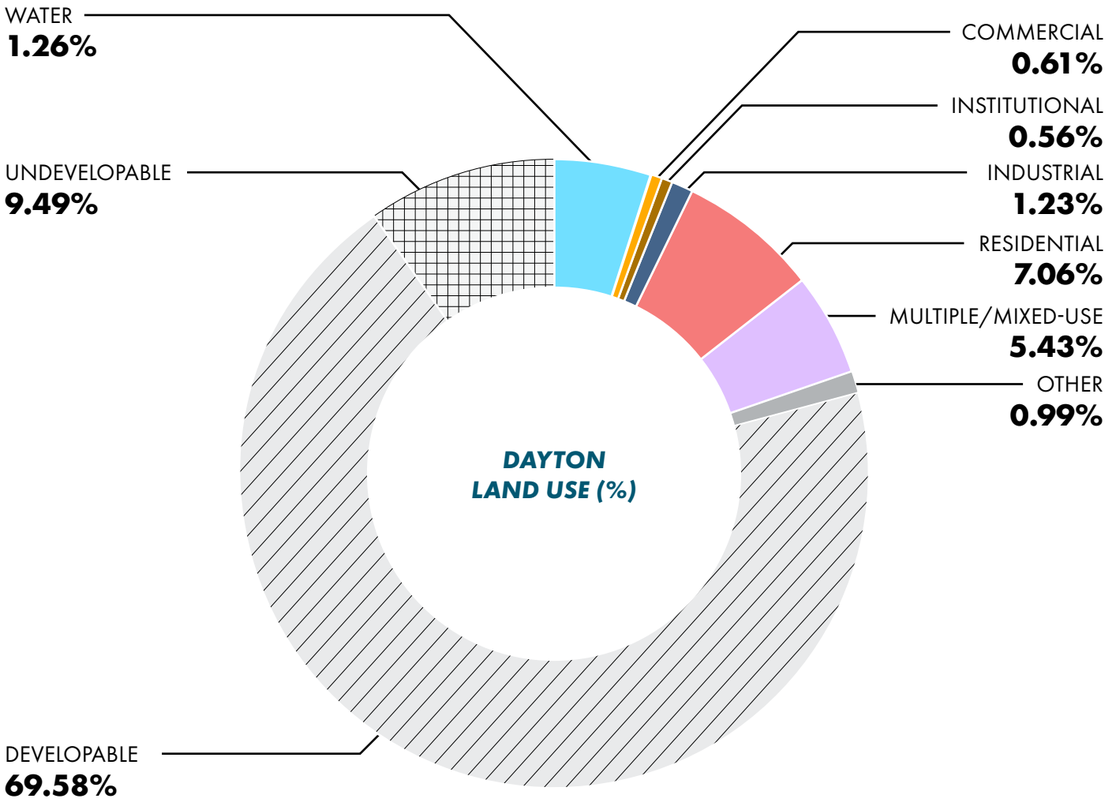
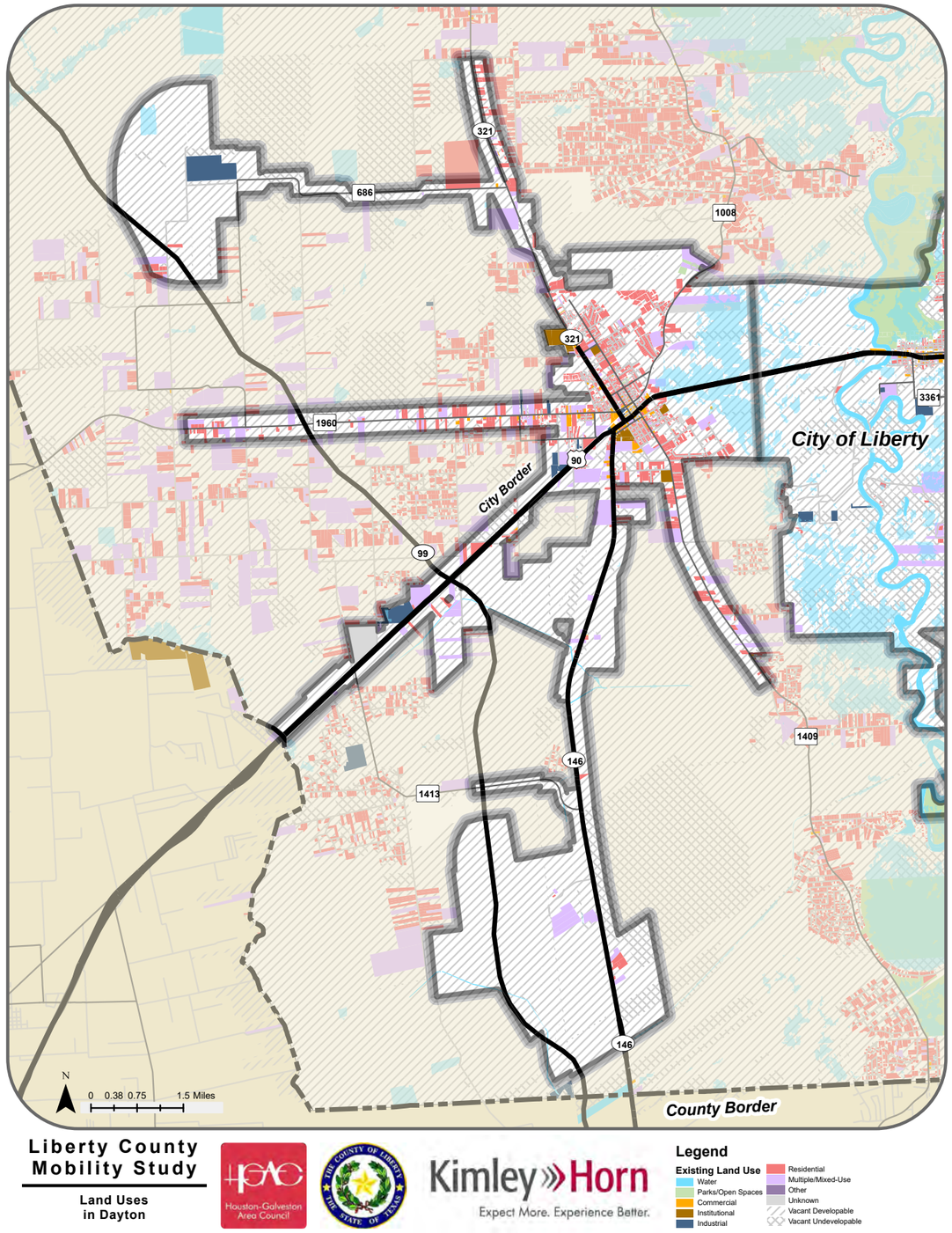


Exhibit 6.1.2a – Land Uses in the City of Dayton

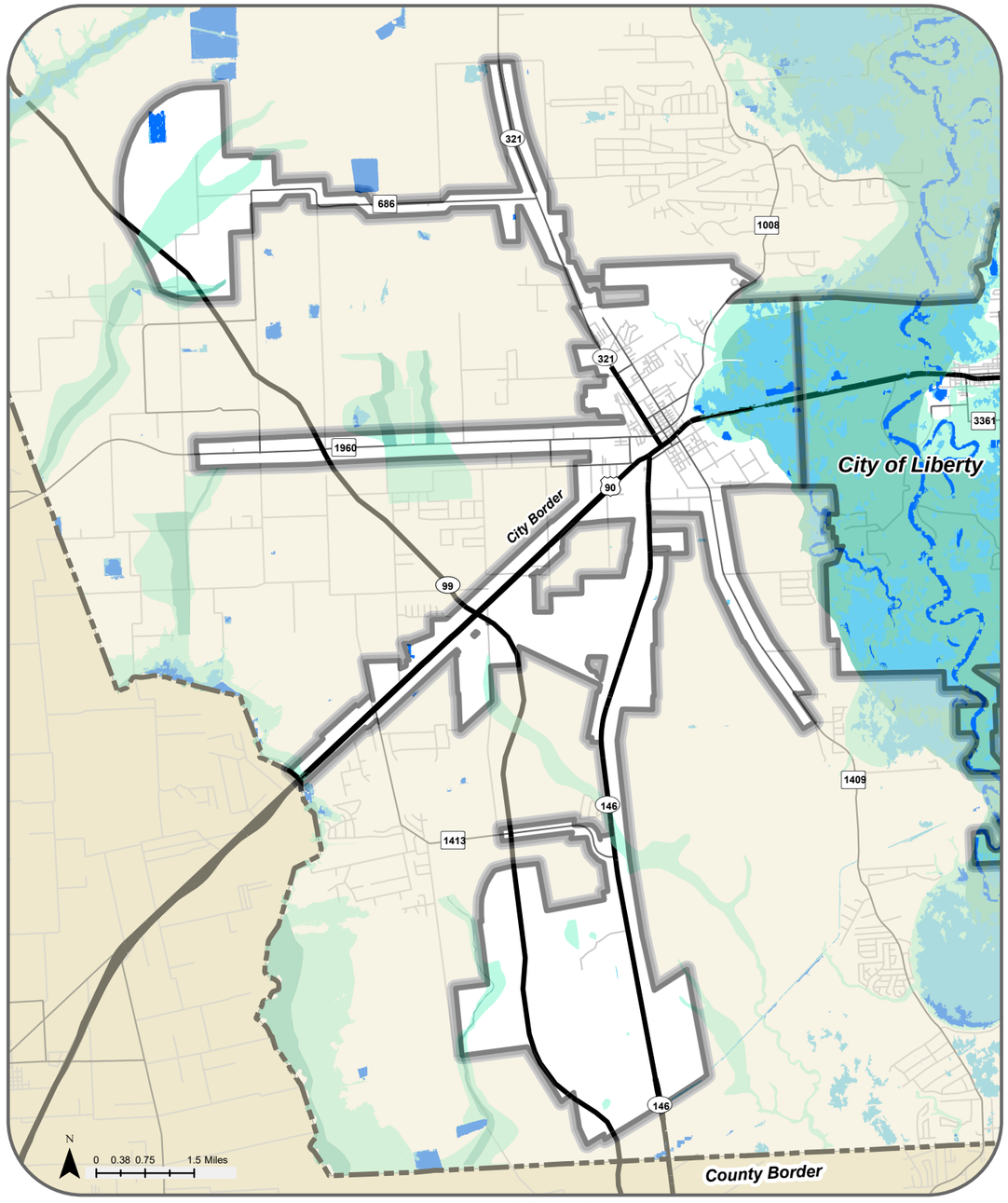


ENVIRONMENTAL FEATURES

There are 1,139 acres of open water and wetlands within the official city limits of Dayton. The Trinity River floodplain and wetlands to the east of Dayton hinder the city's growth in that direction. Currently, there is undevelopable wetland along the 3.8-mile stretch of US 90 between Dayton and Liberty. This area serves as an important habitat for local wildlife and likely will remain undeveloped. See these waterways in ***Exhibit 6.1.2b***.

While these waterways pose a threat of flooding, they can also serve as potential recreational space and natural paths for hike and bike trails. Currently, there are 23 acres of park space in the City of Dayton. See the location of parks and open spaces in ***Exhibit 6.1.2a***.

Exhibit 6.1.2b – Environmental Features in Dayton



Liberty County Mobility Study

Environmental Features in Dayton

Houston-Galveston Area Council

Kimley»Horn
Expect More. Experience Better.

Legend

Water Features
- Freshwater Wetlands
- Open Water

Flood Zones
- Floodway
- 100-Year Floodplain

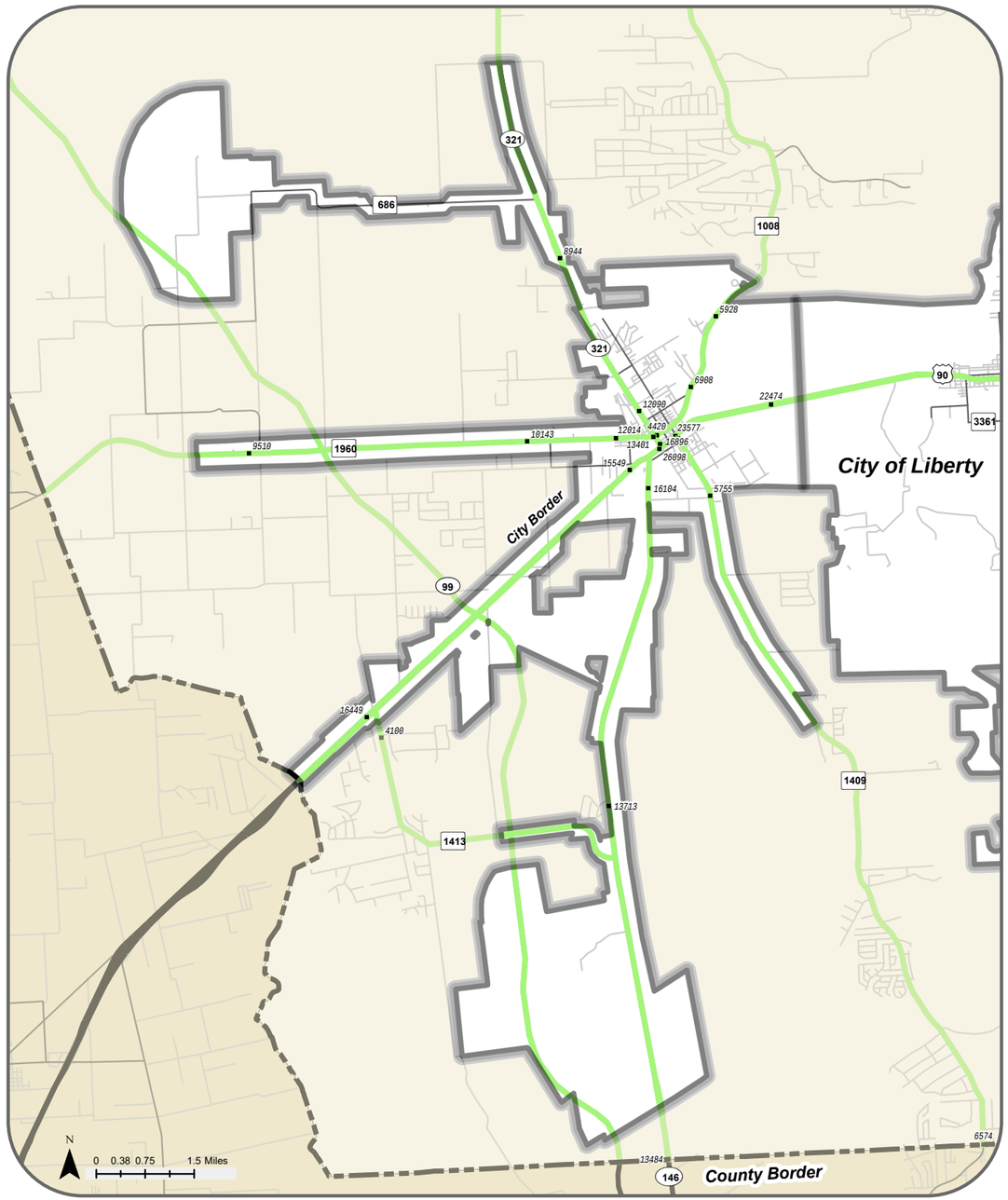
6.1.3 TRANSPORTATION

ROADWAYS

Important corridors in the City of Dayton are illustrated in ***Exhibit 6.1.3a***. In fact, many of the county's major roadways converge within the city's boundaries. These include the following:

- State Highway 146 (SH 146) runs north-south through the center of the county, connecting the cities of Dayton and Liberty with Baytown to the south.
- US Highway 90 (US 90) runs east-west through the southern third of the county, connecting Dayton and Liberty with Beaumont and Louisiana to the east and Houston to the west.
- SH 321 connects Dayton to Cleveland in the north. It also acts like a "Main Street" in downtown Dayton.
- FM 1960 runs east-west from west Houston, past Bush Intercontinental Airport and through Humble and Atascocita, into downtown Dayton.
- FM 1008 extends northeast out of downtown Dayton and may provide an alternative north-south route to SH 321, as it intersects with both SH 321 and SH 105 north of the city.

Exhibit 6.1.3a- – Important Roadways in Dayton



ACTIVE MODES

The existing active transportation network in the City of Dayton is limited. Data collected from H-GAC's Open Data portal indicates that there are approximately 4.4 miles of sidewalks and no designated on-street bikeway facilities within the city limits of Dayton.

Denser areas with more concentrated land uses have the potential to generate more biking and walking trips. Major destinations include natural areas, parks, and schools. There are seven independent school districts (ISD) within or partially within Liberty County, including Dayton ISD. Student transportation may increase demand for Safe Routes to School (SRTS) opportunities, especially for newly built schools.

A high-level review of existing plans reveals that there is varying interest in building and implementing active infrastructure among cities and the county.

- The **Liberty County Community Plan** prioritizes areas near schools for robust sidewalk networks, downtown areas with the county's three largest cities are prioritized for bike lane facilities, and undevelopable natural areas along creeks are prioritized for hike and bike trails to preserve floodplains.
- The **Dayton Tomorrow 2035 Comprehensive Plan**, completed in 2017, specifically recommends the City develop a Bicycle and Pedestrian Master Plan and proposes a multiuse sidewalk along SH 321 near Grand Parkway that could be the "spine" of such a plan. Not exclusively centered on bicycle and pedestrian improvements, the 2019 Dayton Mobility and Infrastructure Strategy focuses on needed investments to maintain the transportation network with the city, reduce traffic congestion, and improve pedestrian safety.

Popular fitness and activity tracking apps are widely available on smartphones, smart watches, and bike computers. One such platform, Strava, allows its user data to be mapped by public agencies to highlight areas where there is bicycling and walking demand and better understand where infrastructure improvements may be desired. Although a useful database of information, one caveat with Strava data is that the data collected is user reported and not fully representative of a community's full demographics, especially for people who do not use Strava or other GPS tracking apps to share their data; Strava users tend to skew white, male, and median age.

Pedestrian Infrastructure

Sidewalks are not standard nor uniformly available within Dayton except for newer subdivisions recently built outside of city limits. School campuses may have limited sidewalks between buildings and outdoor play areas and fitness facilities. Both the Liberty County Community Plan and Dayton Tomorrow 2035 Comprehensive Plan specifically call out the need to improve pedestrian safety and provide sidewalk connections for students walking and biking to schools.

Where there are sidewalks present, a variety of attributes creates an unwelcoming pedestrian environment, including short and discontinuous segments, a lack of ADA accessible curb cuts or curb ramps, narrow non-ADA compliant sidewalk widths, deteriorating concrete and other materials, unmarked crosswalks, a lack of trees and shade, and a lack of separation from parking and auto travel lanes.

Sidewalks within the City of Dayton are generally located along the parallel streets of South Cleveland Street (SH 321) and North Winfree Street, with few east-west sidewalk connections between these two local corridors. Residential sidewalks are present with the Fordland Estates neighborhood and the Oakwood subdivision (see ***Exhibit 6.1.3b***).

The Dayton Mobility and Infrastructure Strategy indicates that sidewalk improvements are planned by TxDOT along US 90 and SH 321. There is also a desire to improve pedestrian and traffic safety since 20% of all traffic fatalities occur in the City of Dayton, as many of the county's major roadways converge within the city's boundaries.

The annual Strava data for pedestrians indicates the highest frequency of walking occurs within or immediately adjacent the city limits of Dayton. Pedestrian Strava activity within Dayton aligns closely with the availability of sidewalks, particularly around the Dayton Community Center where there is the highest frequency of recorded walking trips. Another pedestrian hotspot outside of Dayton is near the CVD Church along Wolfe Island Road (see ***Exhibit 6.1.3c***).

Curb Cut and Discontinuous Sidewalk, Main Street, Dayton (Google Street View)

Bicycle Infrastructure

Although there are no designated on-street bicycle facilities anywhere within Dayton, there are several shared biking and walking trails within natural areas nearby: the Butler Tract Trail, the Brierwood Tract-Gaylor Lake Loop, the Paige Trail, and the McGuire Tract-Greens Bayou Loop in or near the Trinity River National Wildlife Refuge.

According to bicycle recreationalists and advocates, the lack of route options other than major auto thoroughfares presents one of the biggest challenges. One suggestion is to use bike and shared use paths as a floodplain management strategy to prohibit additional development in environmentally sensitive, natural areas. There is a lack of funding and governmental interest for bike routes and paths, especially regarding the expense of planning, implementing, and maintaining bike lanes, according to bicycle advocates. A pressing concern is the repaving of older roadways with larger aggregate materials that create rough and uneven surfaces that are not suited for bike travel; repaved roadways which once had smoother gutter and shoulder areas for biking are becoming inaccessible to bicycle riders and are not adequately swept or maintained.

The annual Strava data for bicyclists indicates a demand for cycling between the county's cities and communities along major routes such as US 90 and SH 146. Within Dayton, the highest cycling demand is US 90, East Houston Street, Waco Street, and Sawmill Road. The area west of Dayton, SH 321, and US 90 experiences moderate cycling demand across a geographically wider grid of roads to Huffman and Eastgate (see ***Exhibit 6.1.3c***).

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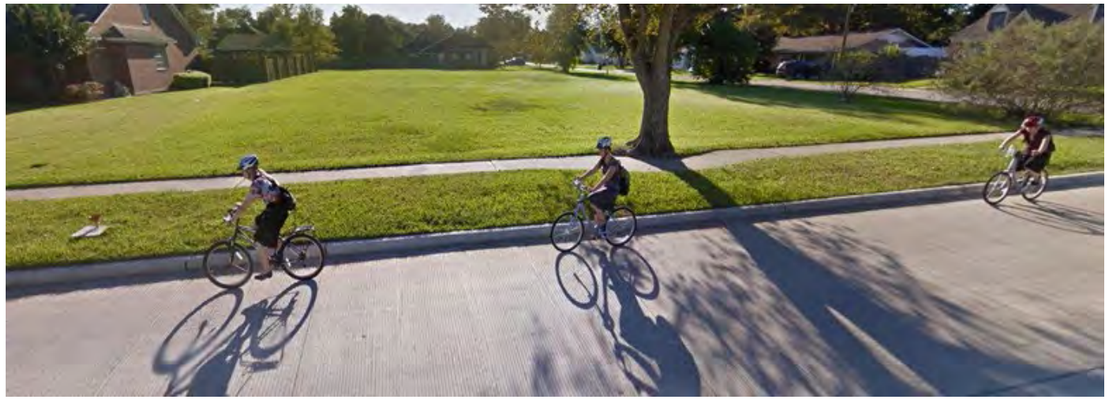


People Biking on Winfree Street, Dayton (Google Street View)

In sum, opportunities and challenges for implementing active transportation improvements in Dayton were identified through quantitative and qualitative analysis of available data and stakeholder interviews.

OPPORTUNITIES

- A confluence of civic uses, restaurants, services, and tourist destinations and accommodations in the downtown area of Dayton offer opportunities for implementing sidewalk networks.
- School campuses lack sidewalk connections to surrounding residential neighborhoods, representing opportunities to serve existing and new schools with pedestrian infrastructure.
- Environmentally sensitive areas, such as floodplains near natural amenities, may provide opportunities for trail routes that could also potentially reduce or prevent development pressures.

CHALLENGES

- There is a lack of connected sidewalks and sidewalk networks; where sidewalks do exist, these segments are partial, discontinuous, lack ADA accessible curbs and widths, and have deteriorating pavement, concrete, and/or asphalt conditions.
- There are limited funding sources for improvements at the local and county levels.

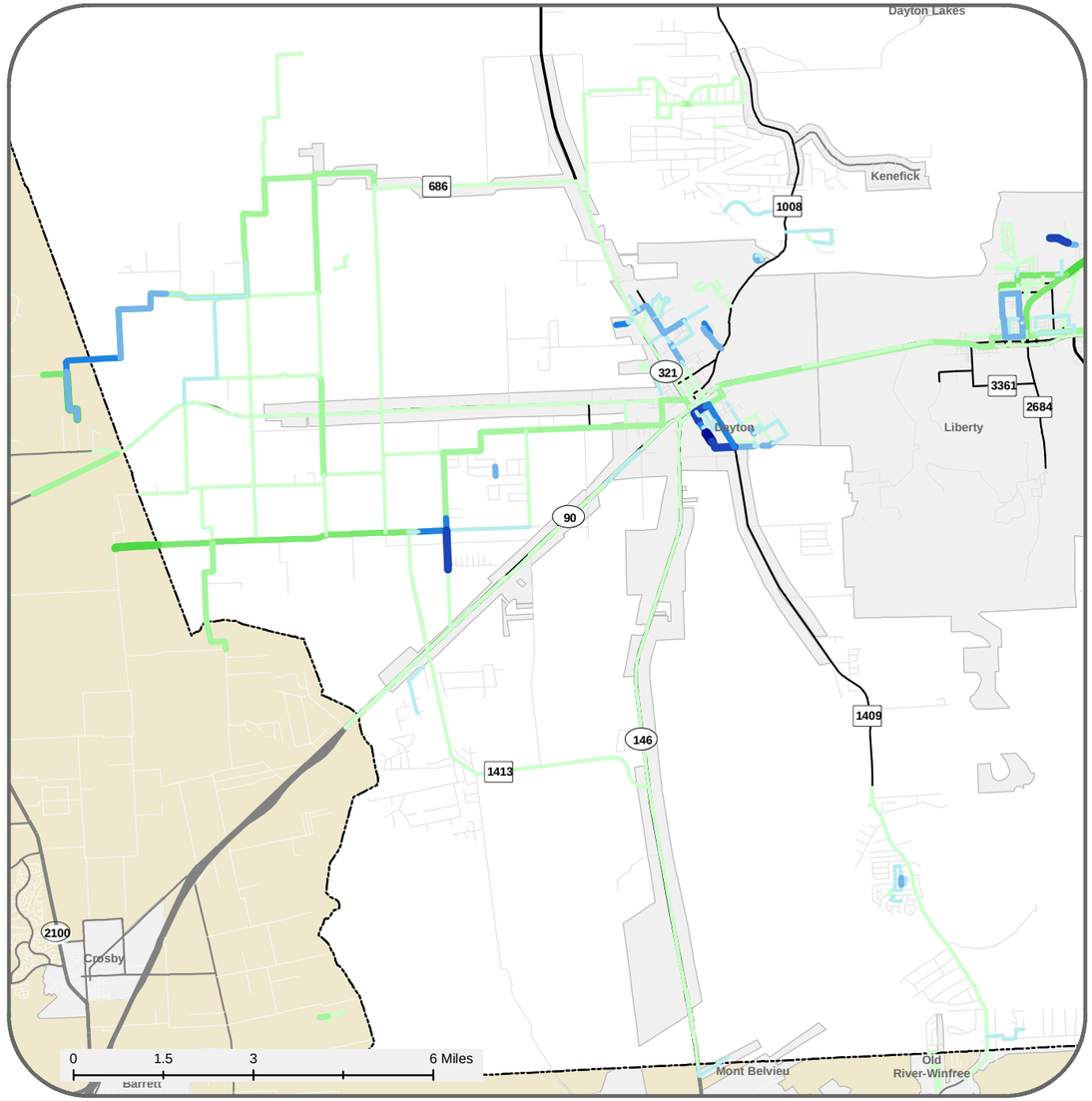
RECOMMENDATIONS

- Refer to countywide active mode recommendations in ***Chapter 4***.

Exhibit 6.1.3b – Dayton Sidewalks

Source: HGAC

Exhibit 6.1.3c - Dayton Combined Bicycle and Pedestrian Strava Activity



Source: Strava, TxDOT Roadway Inventory

TRANSIT

The Brazos Transit District (BTD) serves Dayton with one fixed circular route that also circulates within Liberty and Ames. It provides transportation between the cities' core areas four times per day (see ***Exhibit 6.1.3d***). Service operates on weekdays from 9:00 a.m. to 4:00 p.m. and is not available on major federally recognized holidays. One-way fixed route rides cost $1.00 for the public and are $0.50 for seniors, people with disabilities, individuals covered by Medicare, and children aged 6-12 years of age. Rides are free for children under 6 years of age with a paying customer. This fixed route does not have established bus stops; riders flag down bus drivers along the route to board and communicate to the driver where they would like to disembark. Currently, no funding is dedicated to bus stops. The agency has considered that "flex zone" service may better serve patrons with on-demand services. Other transit providers in the H-GAC region, such as Fort Bend County Transit, have reported success with this type of service.

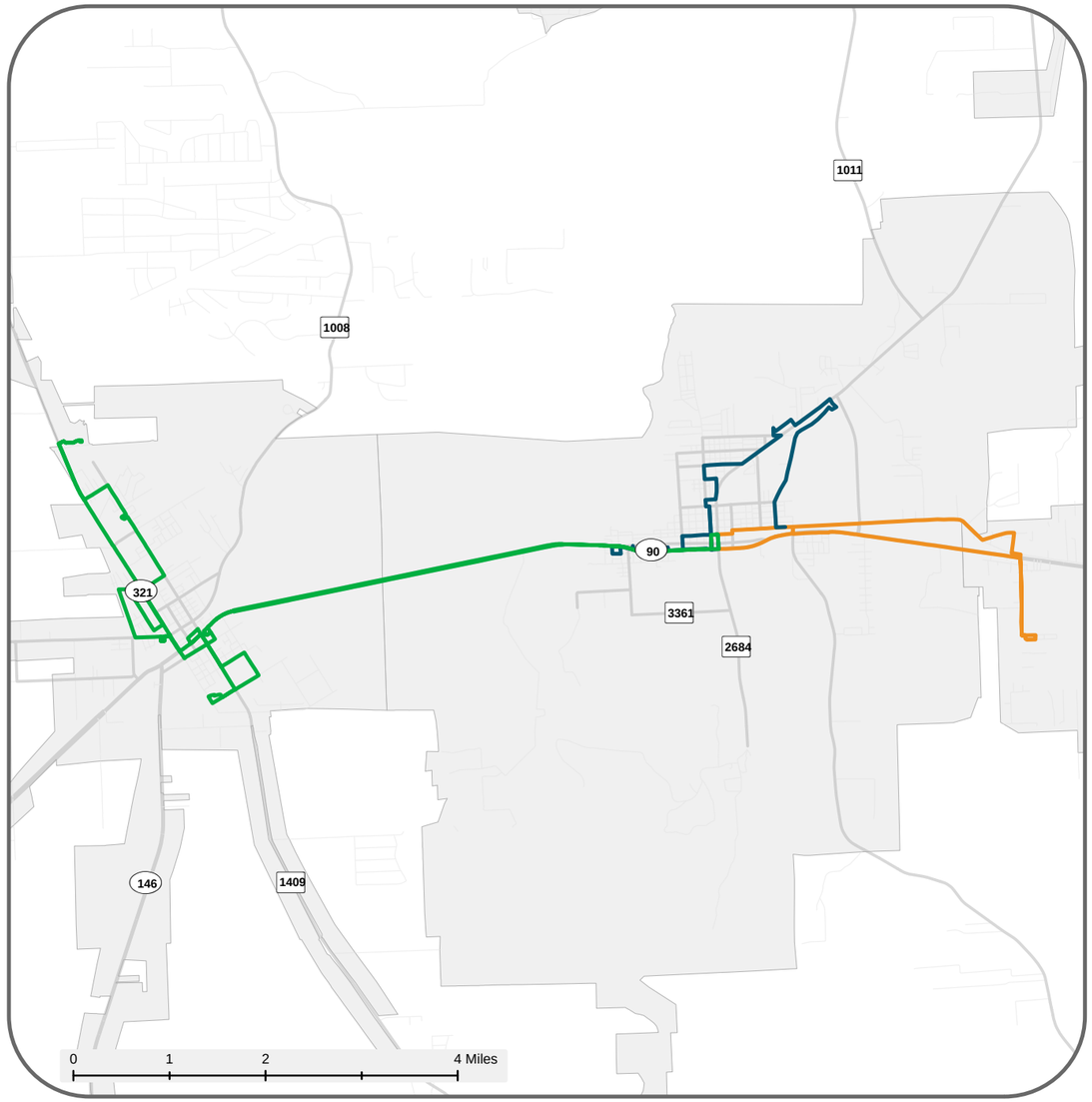
Demand Response and ADA Paratransit service is currently unavailable in Dayton.

Ridership data for the route shows that there was a decline in ridership from 2018 to 2020 due to the COVID-19 pandemic but that 2021 ridership numbers tracked consistently with 2019 and 2020 figures. The Liberty-Dayton fixed route experiences a total annual ridership ranging between 4,000 and 7,600 passengers.

The route has experienced minimal changes since service became operational, and stakeholder feedback suggested that there may be a need for a fixed stop at the courthouse in Liberty as well as service extensions from Dayton to Downtown Houston, a major employment destination. One suggestion may be the inclusion of park and ride facilities, which would require coordination with other service providers.

According to data provided by BTD, in Dayton there are frequent boardings at Dayton Park Apartments, the Dayton Housing Authority and the adjacent multifamily housing units along North Winfree Street, the commercial area on the west side of the North Cleveland and West Clayton Streets intersection, and the commercial strip along SH 146 east of South Winfree Street.

Exhibit 6.1.3d - Libertv-Davton Fixed Route



Source: H-GAC Open Data, TxDOT Roadway Inventory, Brazos Transit District

A high-level review of existing plans highlights the level of effort related to bicycling, pedestrian, and transit improvements in Liberty County.

- The **Liberty County Transit Plan** suggests service and operations improvements, including park-and-ride options, interagency collaboration, and improving on-demand services. Proposed park-and-ride routes include service between Liberty-Dayton and Baytown, Liberty-Dayton and Beaumont, and Liberty-Dayton to Cleveland. Public comments requested better integration between last mile connections to the transit system and bike racks on buses.
- The **High-Capacity Transit Task Force Priority Network**, which is the transit component of the current 2045 Regional Transportation Plan (RTP), recommends a future park and ride bus service between Dayton and downtown Houston and the Texas Medical Center that the Liberty-Dayton route would tie into, as well as regional bus routes linking Dayton to Humble and Atascocita and to Mont Belvieu and Baytown.

In sum, opportunities and challenges for implementing transit improvements in Dayton were identified through quantitative and qualitative analysis of available data and stakeholder interviews with Brazos Transit District.

CHALLENGES

- Transit demand exceeds on-demand supply, highlighting capacity challenges; there are no formal bus stops with shelter, benches, signage, or other amenities; lack of a dedicated funding source, such as a sales or ad valorem tax, or impact fees, limits the ability for the Brazos Transit District to supply additional service.

OPPORTUNITIES

- Serve areas of frequent transit fixed route boardings and alightings "hotspots" with improved pedestrian infrastructure and dense mixed development.

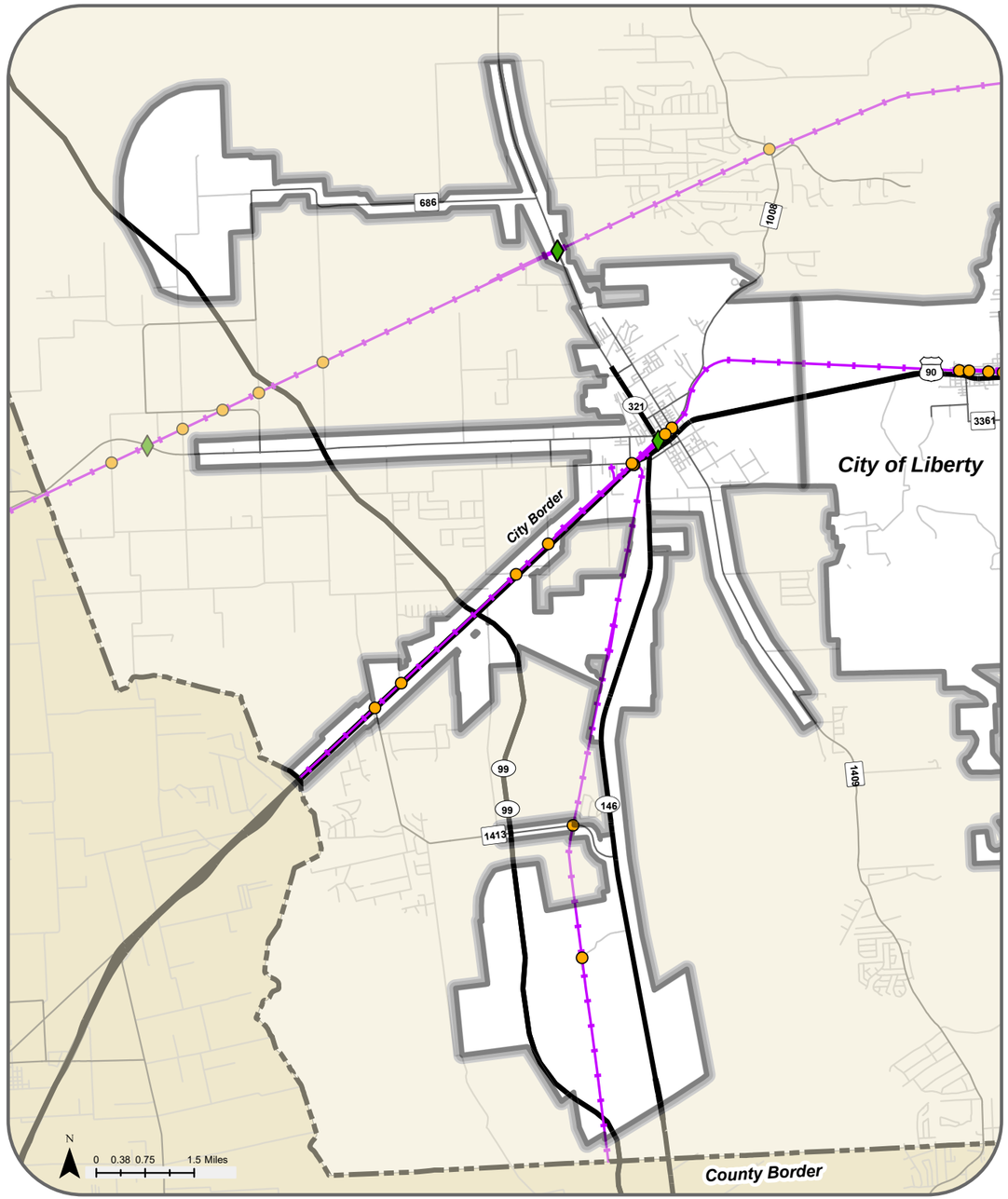
RECOMMENATIONS

The City of Dayton should work with the Brazos Transit District and H-GAC to participate in future studies and consider future transit improvements as the county's population continues to grow. Specific elements could include:

- Flex Zone Operations
- A Park-and-Ride lot near Dayton to serve commuter bus service into downtown Houston and the Texas Medical Center

H-GAC and the City of Dayton have partnered to conduct a Dayton-specific transit study, which should begin in late 2022 or early 2023. Additionally, H-GAC is planning to conduct a regional connector bus study, which will explore the feasibility of bus routes that connect the region's outlying communities to each other as well as the urban core. Such services could enhance Dayton's connectivity to the rest of the region.

Exhibit 6.1.3e – Railroad Facilities in Dayton



FREIGHT

Several rail lines run through the City of Dayton:

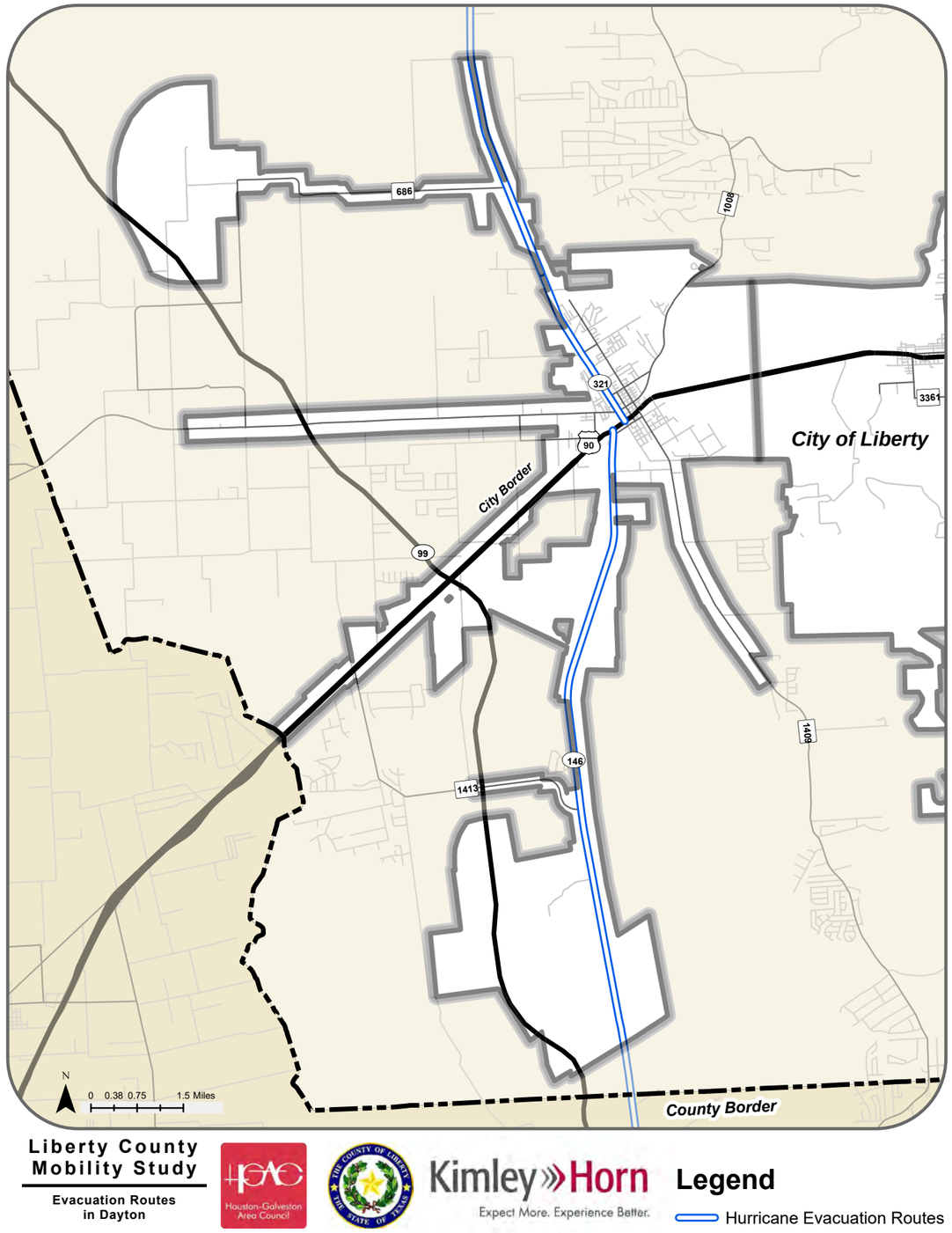
- UPRR-owned:
  - The Beaumont Subdivision runs east-west between Houston and Beaumont and passes through the north side of the city
  - The Lafayette Subdivision runs east-west between Houston and Beaumont along US 90 and passes through both downtown Dayton and Liberty
  - The Baytown Subdivision runs north-south, generally following SH 146 south of Dayton, and merges with the Lafayette Subdivision west of town; this train crosses US 90 at grade and, like the train through town, is a source of delay and annoyance for locals. The Gulf Inland Logistics Park is also adjacent to this line
- BNSF-owned north-south track that extends north from the east side of the city

Exhibit 6.1.3e illustrates the railroad facilities – lines and crossings – existing in Dayton.

EVACUATION ROUTES

Hurricane evacuation routes designated by TxDOT within the City of Dayton are illustrated in ***Exhibit 6.1.3f.***

Exhibit 6.1.3f – Evacuation Routes in Dayton



6.1.4 SAFETY

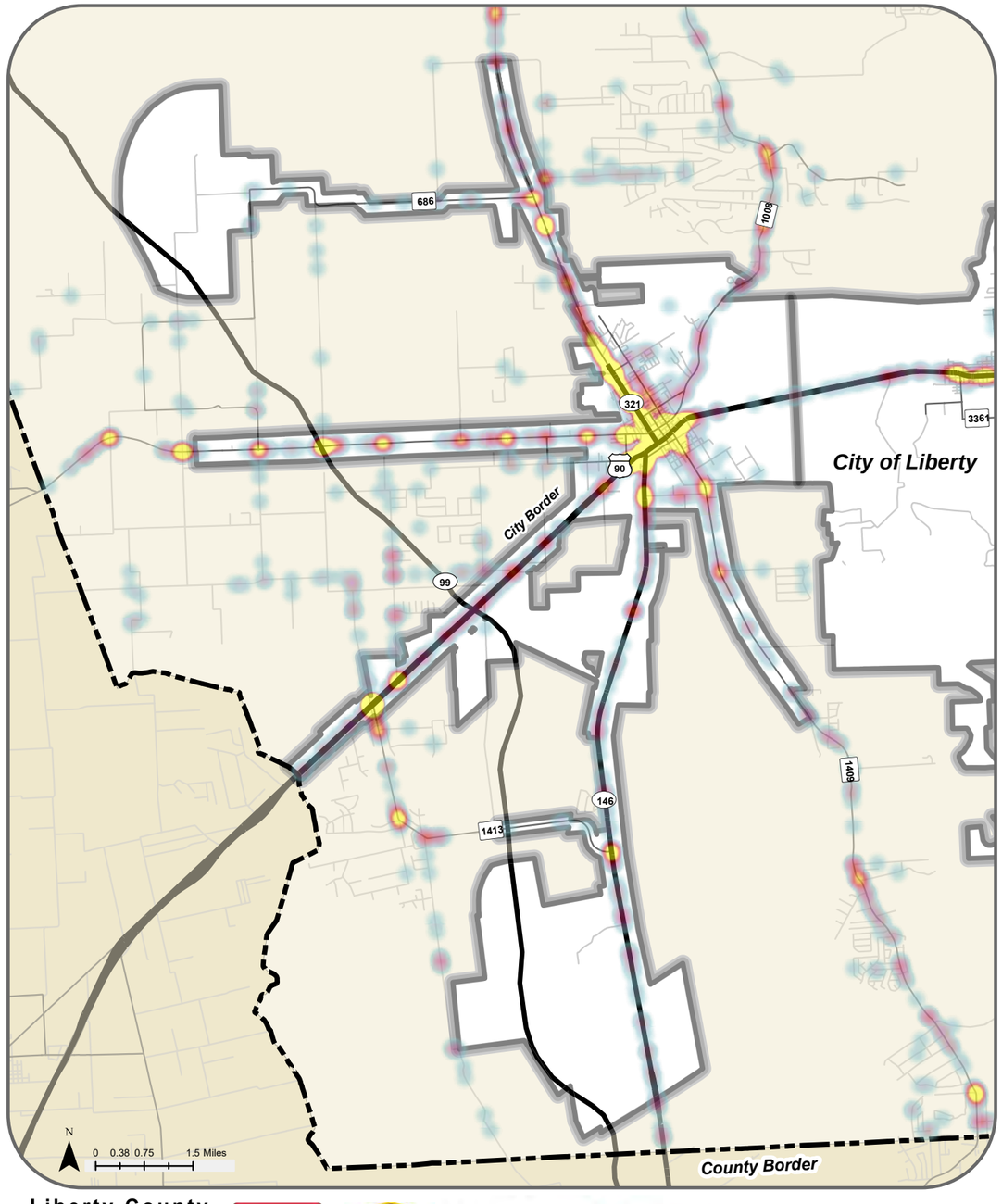
Crash data was collected in Dayton during years 2016 through 2020. Most crashes during that time happened in downtown Dayton and at junctions of major corridors. The top 3 highest concentrations of crashes are located at the following intersections:

1. US 90 at FM 1413 (101 crashes)
2. US 90 at SH 146 (91 crashes)
3. US 90/SH 146 at SH 321 (83 crashes)

Exhibit 6.1.4a illustrates the density of all crashes in and around the city.

Source: TxDOT CRIS

Exhibit 6.1.4a – Crash Density in Dayton



While crashes occur on all roadways, higher crash density occurs along higher capacity/speed roadways and at intersections of higher capacity/speed roadways. ***Table K*** shows the classifications of each roadway, what percentage (by length of roadway) of Dayton's roadway network they account for, what percentage of overall crashes take place on that classification of roadway, and percent of total fatalities occur on that classification of roadway.

Table K – Crash Percentage by Roadway

Roadway Classification	Length of Roadway (miles)	Percent of Total Roadway Network	Number of crashes	Percent of Total Crashes	Number of Fatalities	Percent of Total Fatalities
Interstate	-	-	-	-	-	-
Freeway/Expressway	-	-	-	-	-	-
Principal Arterial	431	56%	974	67%	8	35%
Minor Arterial	157	20%	252	17%	5	22%
Major Collector	126	16%	388	27%	8	35%
Minor Collector	1	-	7	<1%	-	-
Local	57	7%	113	113	1	9%
Total	**771**	**100%**	**1734**	**100%**	**23**	**100%**

6.1.5 IDENTIFIED NEEDS

In a meeting held with Liberty County and City of Dayton staff, the following needs were identified:

- More railroad and waterway crossings are needed to improve cross-town mobility
- A grade-separated railroad crossing at Klemp Road is needed; Klemp Road could be extended north to connect with SH 321
- Church Street needs to be studied and possibly widened

During both public meetings and through the online feedback tool, members of the public identified the following needs in Dayton:

- Intersections and interchanges with the Grand Parkway (SH 99) should be signalized (concern for existing stop sign-controlled intersections)
- US 90 is congested throughout downtown
- A traffic study should be done before closing Klemp Road
- Too frequent school bus stops along SH 321 cause congestion during school peak hours
- It would be beneficial to connect US 90 to FM 1008

Full details of public and Steering Committee comments are included in ***Appendix B.***

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6.2 ANALYSIS AND RECOMMENDATIONS

6.2.1 SCENARIO COMPARISON

SHORT-TERM INTERSECTION ANALYSIS

Each study intersection was analyzed to better understand current operations before recommendations could be developed. Synchro™, a traffic analysis software, was used to create a model to analyze the operation of study intersections as they currently operate, in the "2021 Existing" scenario, during the weekday hours of highest use, or the PM peak hour (5:00-7:00 PM). A summary of the analysis results is illustrated in ***Exhibit 6.2.1a*** and the complete analysis results can be found in ***Appendix D***.

In the 2021 Existing scenario, half of the study intersections in the City of Dayton exceed capacity, and anecdotes indicate that conditions may be even worse than the analysis results indicate. Many stakeholders have expressed frustration about congestion along US 90 and SH 321 due to the train that passes through town regularly. Drivers seek alternate routes around the center of town to avoid the congestion, but lack of capacity on those local roads leads to further congestion. During peak hours, and especially when the train is passing through, the City of Dayton comes to a standstill.

The results of the 2021 Existing analysis scenario helped determine potential improvements to the network that could be applied in the short-term. Short-term improvements are assumed to be constructed or implemented within five years of this study.

Another Synchro™ model was created to analyze the operation of study intersections with the addition of short-term improvements to the existing roadway network, also known as the "2021 Improved" scenario. Adjusted 2021 volumes were used. A summary of the analysis results is illustrated in ***Exhibit 6.2.1a*** and the complete analysis results can be found in ***Appendix D***.

Due to the implementation of short-term improvements, the Synchro analysis determined that there would be a 38% decrease in delay at the study intersections between the 2021 Existing and Improved scenarios.

Exhibit 6.2.1a – Short-Term Analysis Results and Improvements for City of Dayton

1 Signalize; coordinate signals along US 90; install exclusive right-turn and left-turn lanes (southbound)

2 Install one through lane (eastbound and westbound); Permitted+Protected Left-Turn (westbound); Permissive+Overlap right-turn (northbound)

3 Install high visibility marked crosswalks; install pedestrian signals; install through-right turn lane in addition to existing exclusive right-turn lane (eastbound); Flashing Yellow Arrow Left-Turn for all approaches

4 Signalize; install high visibility marked crosswalks; install left-turn lanes (westbound and northbound)

5 Install lighting and signage; realign to intersect at right-angle

6 None

Legend

Level-Of-Service

- A
- B
- C
- D
- E
- F

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LONG-TERM INTERSECTION ANALYSIS

Another Synchro™ model was created to analyze the operation of study intersections in the 2045 Existing analysis scenario. A summary of the analysis results is illustrated in ***Exhibit 6.2.1b*** and the complete analysis results can be found in ***Appendix D***.

More than two of the study intersections in the 2045 Existing scenario have a failing LOS, meaning they will need additional capacity improvements to those recommended in the short-term. An increase in "failing" intersections is expected in 2045 due to background growth and development.

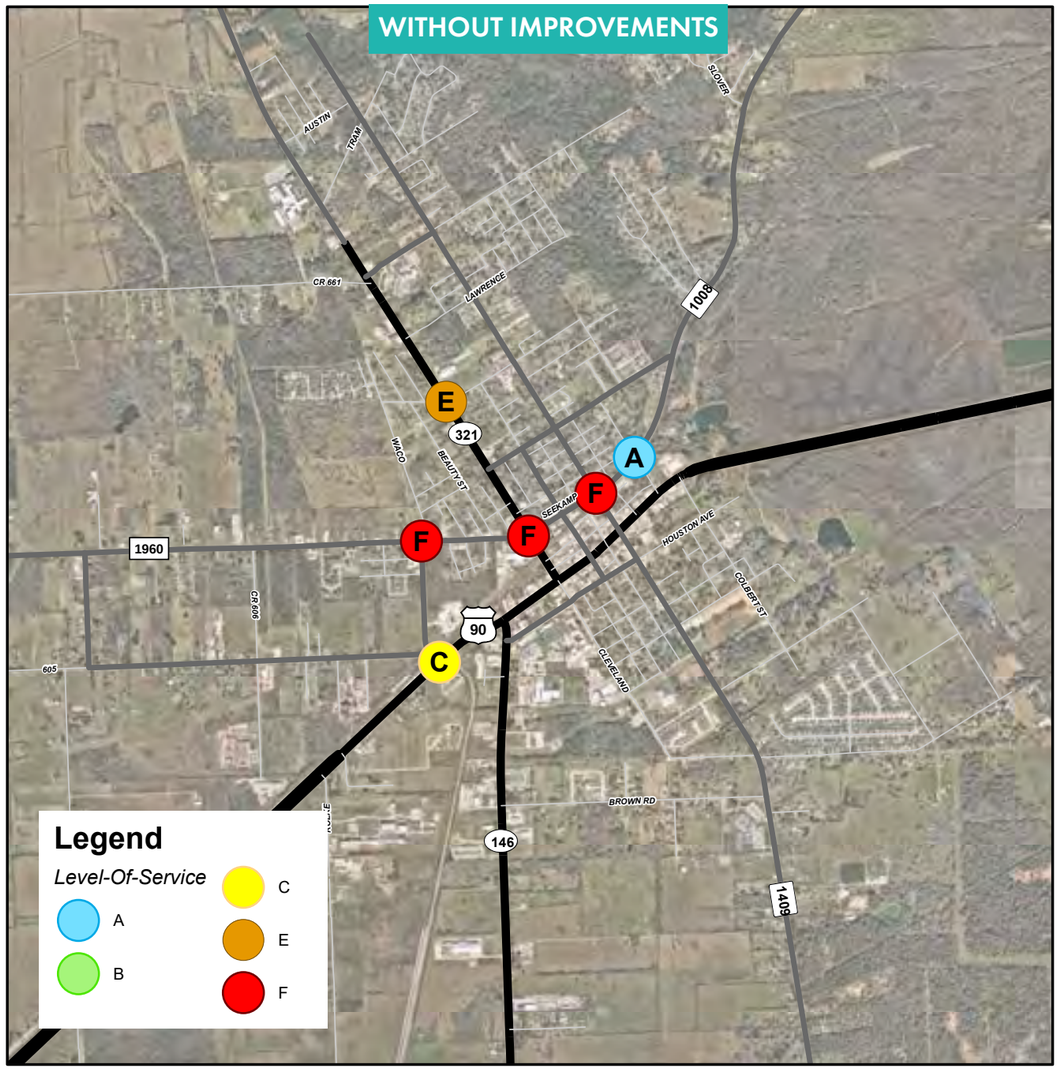
The results of the 2045 Existing analysis scenario helped determine potential improvements to the network that could be applied in the long-term. Long-term improvements are assumed to be constructed or implemented between five and twenty-five years after this study's completion, between years 2026 and 2046.

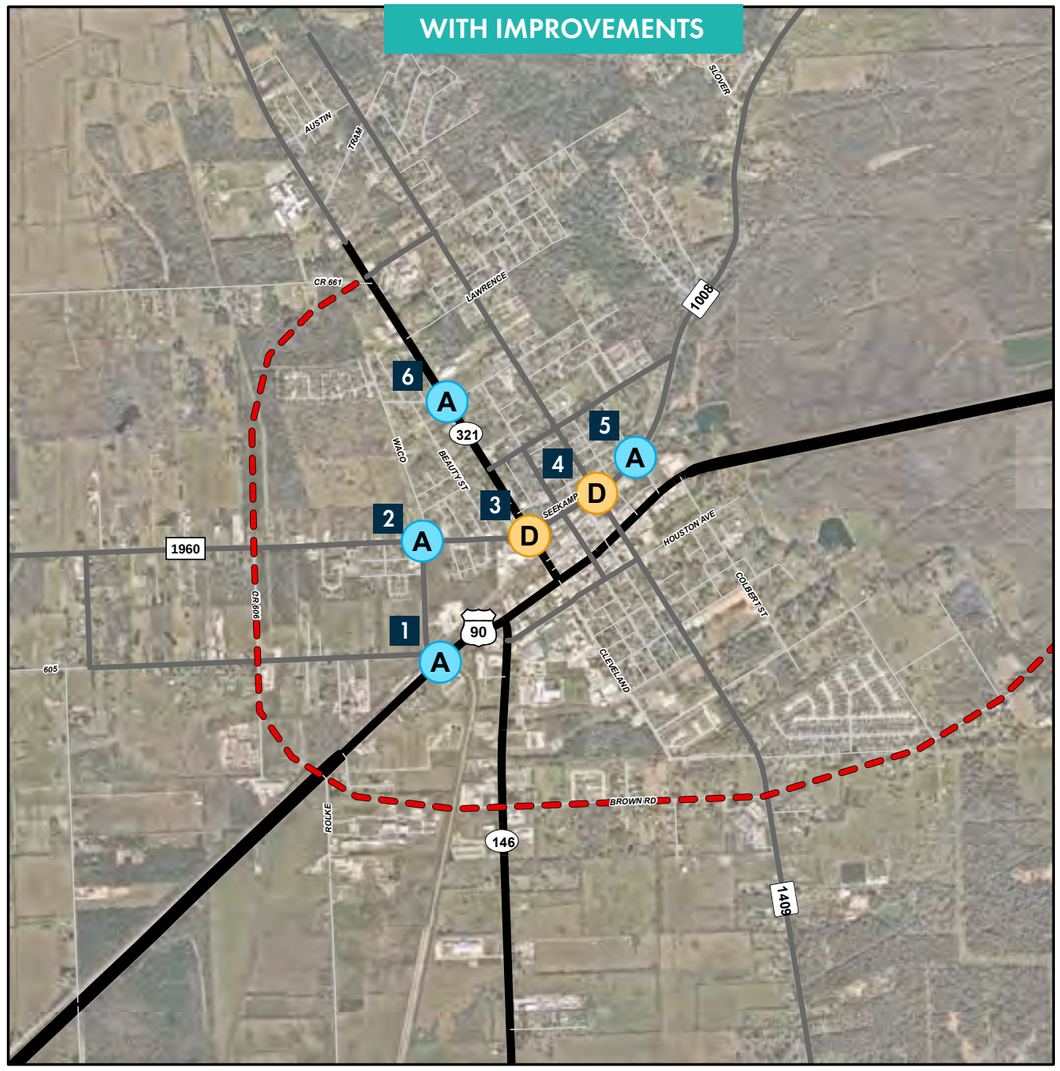
Another Synchro™ model was created to analyze the operation of study intersections with the addition of short-term and long-term improvements to the existing roadway network, also known as the 2045 Improved scenario. Projected 2045 volumes were used. A summary of the analysis results is illustrated in ***Exhibit 6.2.1b*** and the complete analysis results can be found in ***Appendix D***.

Due to the implementation of long-term improvements that notably include the construction of a bypass around the city, the Synchro analysis determined that there would be an 87% decrease in delay at the study intersections between the 2045 Existing and Improved scenarios.

All the improvements recommended at study intersections are discussed in ***Section 6.2.2***.

Exhibit 6.2.1b – Long-Term Analysis Results and Improvements for City of Dayton





1 Proposed US 90 bypass is expected to relieve congestion at this intersection; upgrade Waco Street to Major Collector: 2-4 lanes, curb and gutter, sidewalks; install exclusive right-turn lane with 500' storage (westbound)

2 Proposed US 90 bypass is expected to relieve congestion at this intersection; realign northbound and southbound legs of Waco Street; install exclusive right-turn lane with 200' storage (eastbound); install exclusive right-turn lane (northbound)

3 Proposed US 90 bypass is expected to relieve congestion at this intersection; install exclusive right-turn lane with 200' storage (westbound); Permissive+Overlap right-turn (eastbound and westbound)

4 Proposed US 90 bypass is expected to relieve congestion at this intersection; install exclusive left-turn lanes (all approaches); install through lane (eastbound and westbound); install exclusive right-turn lane (northbound); add storage to right-turn lane (eastbound); Permitted+Protected Left-Turn (all approaches); Permissive+Overlap right-turn (northbound)

5 Proposed US 90 bypass is expected to relieve congestion at this intersection

6 Proposed US 90 bypass is expected to relieve congestion at this intersection; upgrade Linney Street to Major Collector: curb and gutter, sidewalks; Install exclusive right-turn lane (westbound)

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LONG-TERM CORRIDOR ANALYSIS

Each study corridor was analyzed to better understand current operations before recommendations could be developed. Volume-to-capacity ratio (V/C) was the metric used to analyze and evaluate operations under both "existing" and "improved" conditions. Refer to ***Section 3.1.4*** for an expanded explanation of how V/C was determined for each corridor.

Table L - Long-Term Corridor Analysis

Corridor Name (ID)	2021 ADT/ Lane	2021 "Existing" V/C	2045 ADT/ Lane	2045 "Existing" V/C
CR 602/604 (G-1)	161	0.01	259	0.02
CR 602/604 (G-2)	554	0.04	891	0.06
FM 1413 (H-1)	2,355	0.19	3,788	0.3
CR 486 (I-1)	408	0.03	656	0.04
Waco Street (L-1)	1,510	0.1	2,429	0.17
CR 606/Klemp Road (L-2)	413	0.03	664	0.05
US 90/SH 146 (S-11)	3,633	0.25	5,843	0.41
SH 146 (S-12)	3,708	0.26	5,964	0.41

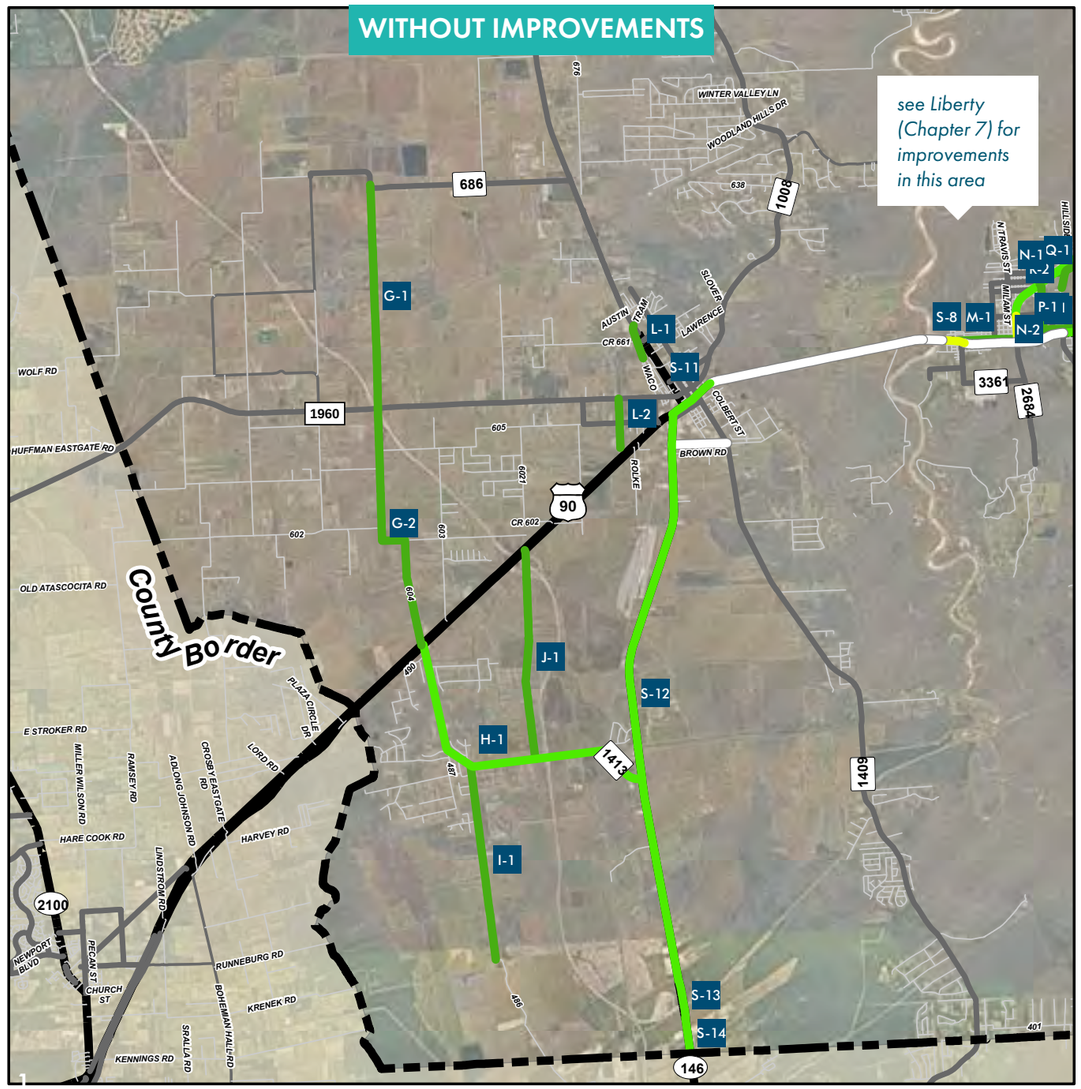
Where additional through lanes are recommended in the long-term (2045), capacity will increase. If the proposed Dayton Bypass around the west and southern portions of the city is constructed, further reductions in volumes and V/C are expected along these study corridors as drivers choose to avoid traffic in downtown Dayton. Improved capacity of Klemp Road is listed as "To be Determined" (TBD) because it will be a segment of the bypass and may take on additional traffic.

Table M - Long-Term Corridor Analysis Capacity Comparison

Corridor Name (ID)	2045 "Existing"		2045 "Improved"		% Change in Capacity
	ADT/Lane	V/C	ADT/Lane	V/C	
CR 602/604 (G-1)	259	0.02	259	0.02	-
CR 602/604 (G-2)	891	0.06	891	0.06	-
FM 1413 (H-1)	3,788	0.3	3,788	0.3	-
CR 486 (I-1)	656	0.04	656	0.04	-
Waco Street (L-1)	2,429	0.17	2,429	0.17	-
CR 606/Klemp Road (L-2)	664	0.05	TBD	TBD	TBD
5,8430.41US 90/SH 146 (S-11)	5,843	0.41	3,895	0.27	33%
SH 146 (S-12)	5,964	0.41	3,976	0.28	33%

See V/C illustrated in the City of Dayton in ***Exhibit 6.2.1c.***

Exhibit 6.2.1c – Long-Term Corridor Analysis Results and Improvements for City of Dayton



G-1	None	L-2	Incorporate into Proposed Dayton Bypass	S-13	Widen to minimum 6-lane divided cross-section
G-2	None	S-10	Widen to minimum 7-lane cross-section with 14-foot center two-way left-turn lane	S-14	Widen to minimum 7-lane cross-section with 14-foot center two-way left-turn lane
H-1	None	S-11	Widen to minimum 7-lane cross-section with 14-foot center two-way left-turn lane		
I-1	None	S-12	Widen to minimum 6-lane divided cross-section		

Legend

Volume-to-Capacity Ratio

- N/A
- 0.00-0.25
- 0.25-0.50
- 0.50-0.75
- 0.75-1.00
- >1.00

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6.2.2 RECOMMENDATION MATRIX

Recommended improvements across all study locations in Dayton – intersections and corridors – have been summarized in a Recommendation Matrix and Summary Sheets for easy review. Both documents can be found in ***Appendix E***.

Information provided in the Recommendation Matrix includes the total construction cost and expected monetary benefits of each recommended improvement, the score pertaining to each of the project's goals, and a brief description of each of the recommended improvements at the study location. See S***ection 8.2*** for a full explanation of how costs and benefits were determined and how recommendations were evaluated per the project goals.

Additionally, ***Table N*** outlines the number of occurrences of each recommended improvement in the City of Dayton.

Table N – Recommendations in Dayton

Recommended Improvement	Occurrences
Install pedestrian elements	17
Install shared use path	16
Install left-turn lane	1
Install right-turn lane	5
Install through lane / widen road	16
Install / improve pavement markings	3
Realign intersection	5
Install / improve pavement	1
Construct roadway extension	1
Construct grade separation	3
Signalize	2
Optimize/coordinate signal	1
Change left-turn phasing	2
Add right-turn overlap	3
Install Flashing Yellow Arrow signal	1
Install intersection lighting	1
Proposed US 90 Bypass	7

All information which led to the development of recommended improvements for each study intersection and corridor, including its location within the study area, crash data, and capacity analysis results is organized in Summary Sheets. This provides a more visual snapshot of the study location as it is now and as it could be with the implementation of the recommendations. The Summary Sheets for study locations in the City of Dayton are below and Summary Sheets for all study locations are included in ***Appendix E***.

Liberty County Mobility Study, Intersection Summary Sheets

US 90 & Waco Street

Intersection ID: Dayton - 1

Existing Aerial View

Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Signalize - Coordinate signals along US 90	- Proposed US 90 bypass is expected to relieve congestion at this intersection - Upgrade Waco Street to Major Collector: 2-4 lanes, curb and gutter, sidewalks
Lane Configuration	- Install exclusive right-turn and left-turn lanes - southbound	- Install exclusive right-turn lane with 500' storage - westbound
Turn Types		

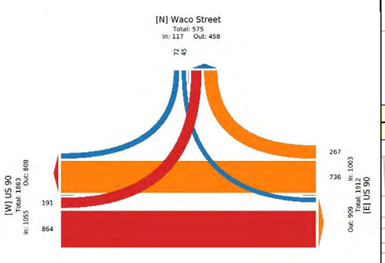
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	123.63	F	15.5	B
	2045	4128.3	F	7.6	A
PM Peak	2021	4.37	A	6.5	A
	2045	20.04	C	5.6	A

Crash Data (2016-2020)

Total	Fatal	Serious Injury
63	0	4

2021 Movement Counts



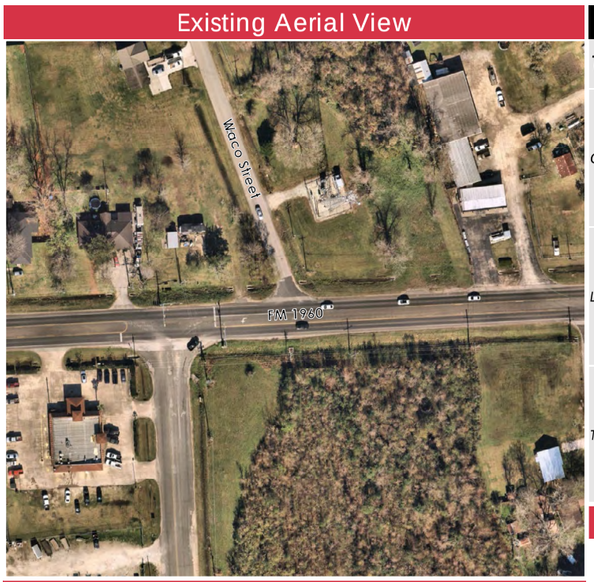
Location Key Map

Liberty County Mobility Study, Intersection Summary Sheets

Waco Street & FM 1960

Intersection ID: Dayton - 2

Existing Aerial View



Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection		- Proposed US 90 bypass is expected to relieve congestion at this intersection - Realign northbound and southbound legs of Waco Street
Lane Configuration	- Install one through lane - eastbound and westbound	- Install exclusive right-turn lane with 200' storage - eastbound - Install exclusive right-turn lane - northbound
Turn Types	- Permitted+Protected (Left-Turn) - westbound - Permissive+Overlap (right-turn) - northbound	

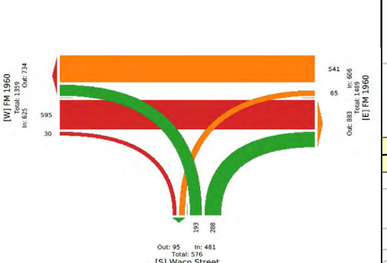
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	19.17	C	21.4	C
	2045	61.59	F	4.6	A
PM Peak	2021	62.44	F	32.6	C
	2045	186.04	F	8.8	A

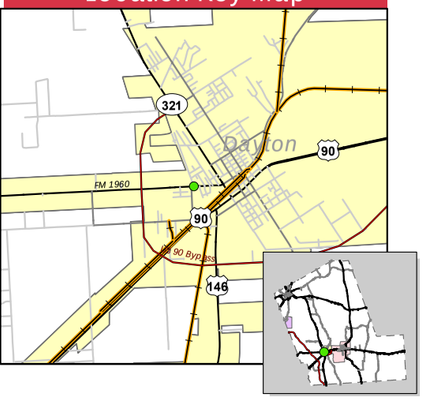
Crash Data (2016-2020)

Total	Fatal	Serious Injury
26	0	0

2021 Movement Counts



Location Key Map



Liberty County Mobility Study, Intersection Summary Sheets

Cleveland Street & FM 1960/Clayton Street

Intersection ID: Dayton - 3

Existing Aerial View

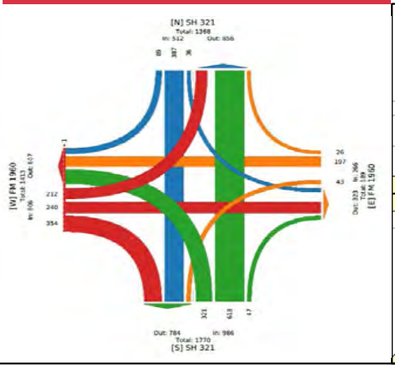
Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Install high visibility marked crosswalks - Install pedestrian signals	- Proposed US 90 bypass is expected to relieve congestion at this intersection
Lane Configuration	- Install through-right turn lane (in addition to existing exclusive right-turn lane) - eastbound	- Install exclusive right-turn lane with 200' storage - westbound
Turn Types	- Flashing Yellow Arrow (Left-Turn) - all approaches	- Permissive+Overlap (right-turn) - eastbound and westbound

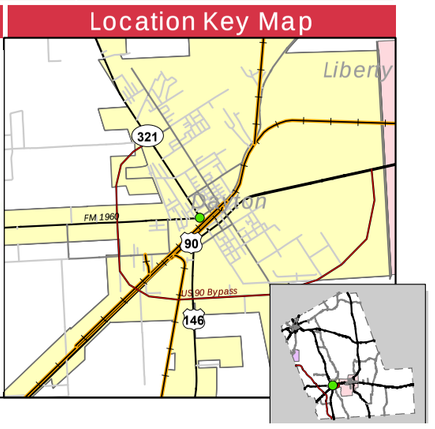
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	129.8	F	42.3	D
	2045	287.7	F	48.1	D
PM Peak	2021	83.2	F	44.8	D
	2045	229	F	39.7	D

2021 Movement Counts



Location Key Map



Crash Data (2016-2020)

Total	Fatal	Serious Injury
87	1	4

Liberty County Mobility Study, Intersection Summary Sheets

Winfree Street & Clayton Street

Intersection ID: Dayton - 4

Existing Aerial View

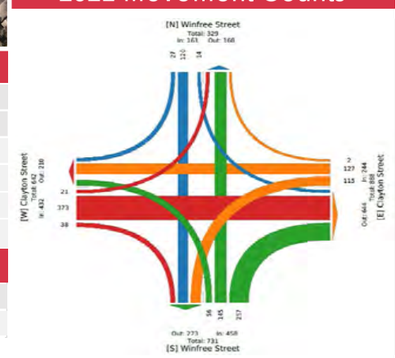
Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Signalize - Install high visibility marked crosswalks	- Proposed US 90 bypass is expected to relieve congestion at this intersection
Lane Configuration	- Install left-turn lanes - westbound and northbound	- Install exclusive left-turn lanes - all approaches - Install through lane - eastbound and westbound - Install exclusive right-turn lane - northbound - Add storage to right-turn lane - eastbound
Turn Types		- Permitted+Protected (Left-Turn) - all approaches - Permissive+Overlap (right-turn) - northbound

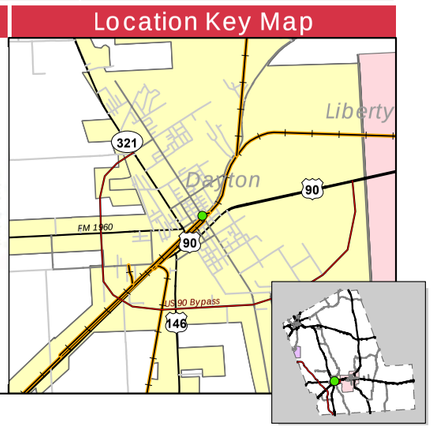
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	117.94	F	10.4	B
	2045	482.24	F	32.2	C
PM Peak	2021	214.72	F	24.6	C
	2045	663.34	F	27.1	C

2021 Movement Counts



Location Key Map



Crash Data (2016-2020)

Total	Fatal	Serious Injury
23	0	1

Liberty County Mobility Study, Intersection Summary Sheets

Clayton Street & Lowe Street

Intersection ID: Dayton - 5

Existing Aerial View

Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Install lighting and signage - Realign to intersect at right-angle	- Proposed US 90 bypass is expected to relieve congestion at this intersection
Lane Configuration		
Turn Types		

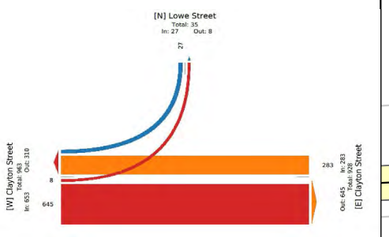
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	0	A	0	A
	2045	0.1	A	0.1	A
PM Peak	2021	0.4	A	0.4	A
	2045	0.5	A	0.5	A

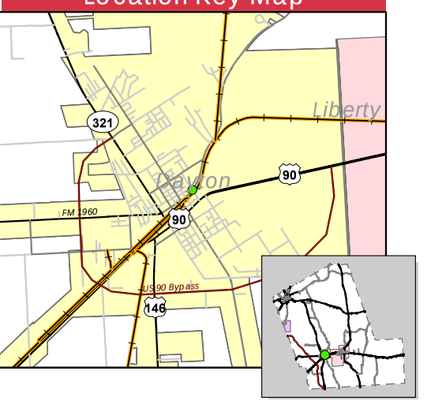
Crash Data (2016-2020)

Total	Fatal	Serious Injury
0	0	0

2021 Movement Counts



Location Key Map



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Liberty County Mobility Study, Intersection Summary Sheets

Cleveland Street & Linney Street

Intersection ID: Dayton - 6

Existing Aerial View

Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	None	- Proposed US 90 bypass is expected to relieve congestion at this intersection - Upgrade Linney Street to Major Collector: curb and gutter, sidewalks
Lane Configuration		- Install exclusive right-turn lane - westbound
Turn Types		

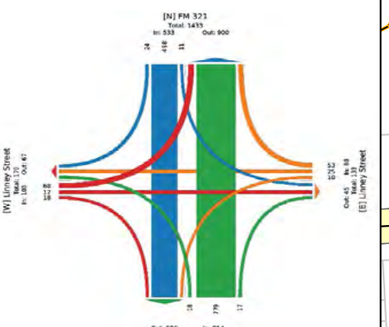
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	8.6	A	8.6	A
	2045	29.3	C	8	A
PM Peak	2021	9	A	8.8	A
	2045	66.6	E	8.7	A

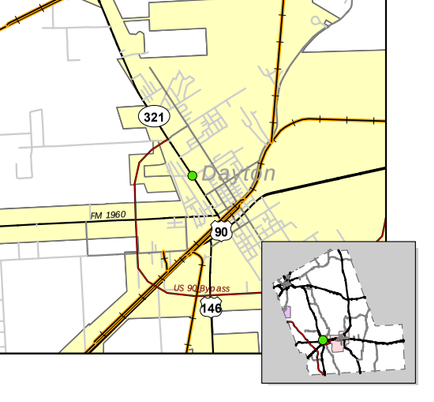
Crash Data (2016-2020)

Total	Fatal	Serious Injury
51	1	6

2021 Movement Counts



Location Key Map



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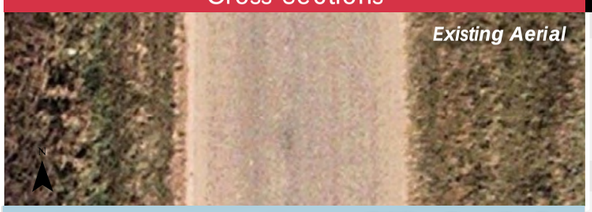
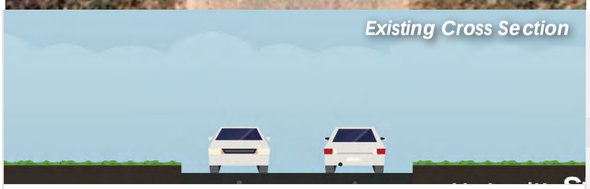
Liberty County Mobility Study, Corridor Summary Sheets

CR 602/604/610/615

from FM 686 to FM 1960
Corridor-Segment ID: G-1

Cross-Sections





Proposed Cross-Section

Recommended Improvements

General

Proposed Classification: Principal Arterial (4-6 lanes, Divided)
- Re-examine alignment and cross-section in updated countywide Thoroughfare Plan
- Further study required for the interchange of this corridor with Grand Parkway and FM 1960

Short-Term

Long-Term

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	377	0.03
2045	606	0.04

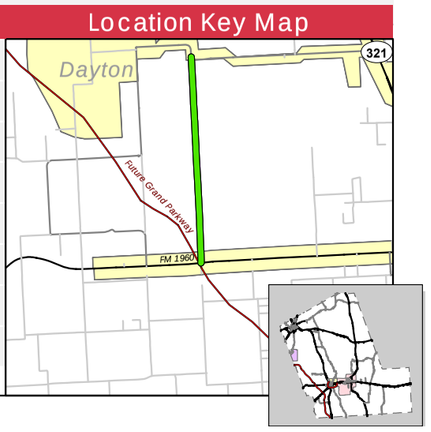
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
6	0	0	0	0

Segment Characteristics

Segment Length (mi)	3.64
Posted Speed (mph)	30
ROW Width (ft)	50
Roadway Width (ft)	22
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map



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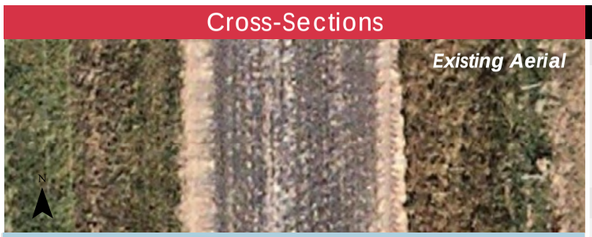
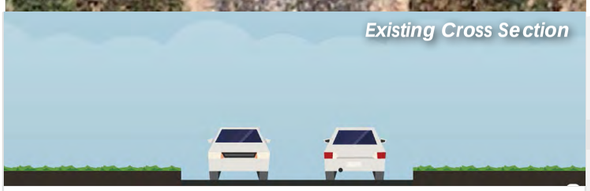
Liberty County Mobility Study, Corridor Summary Sheets

CR 602/604/610/615

from FM 1960 to US 90
Corridor-Segment ID: G-2

Cross-Sections





Proposed Cross-Section

Recommended Improvements

General

Proposed Classification: Principal Arterial (4-6 lanes, Divided)

Short-Term

Long-Term

- Provide grade-separated crossing over US 90 to connect with FM 1413 (Corridor H-1)
- Realign intersection with CR 602 in updated countywide Thoroughfare Plan

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	2354	0.16
2045	3786	0.25

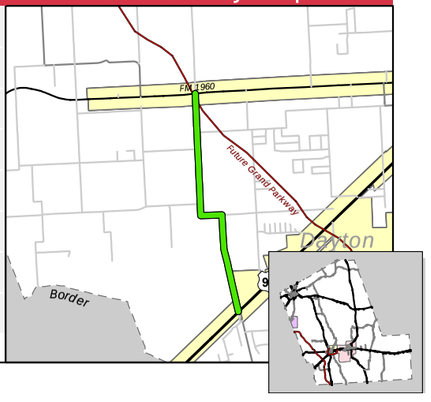
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
18	1	1	0	1

Segment Characteristics

Segment Length (mi)	4.57
Posted Speed (mph)	30
ROW Width (ft)	N/A
Roadway Width (ft)	24
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map



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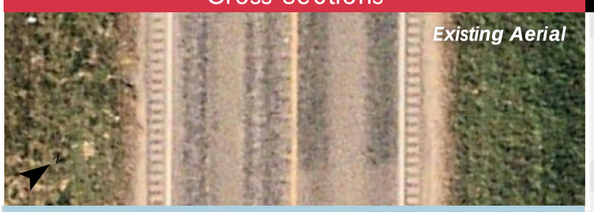
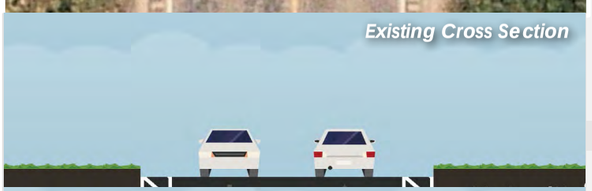
Liberty County Mobility Study, Corridor Summary Sheets

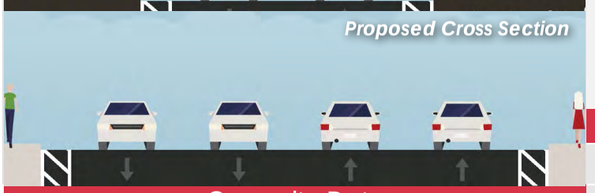
FM 1413

from US 90 to SH 146
Corridor-Segment ID: H-1

Cross-Sections







Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	6853	0.38
2045	11023	0.61

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
67	2	2	0	0

Recommended Improvements

General

Proposed Classification: Principal Arterial (4-6 lanes, Undivided)

Short-Term

- Install pedestrian elements (marked crosswalks, countdown signals where applicable, curb ramps, etc) at intersections

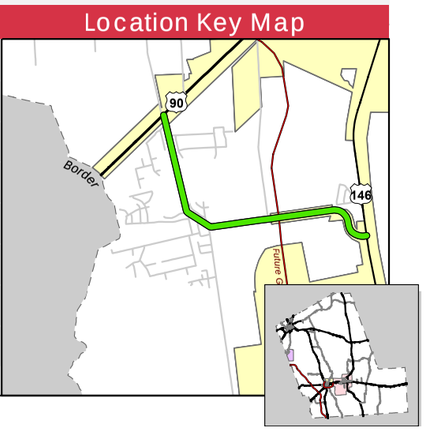
Long-Term

- Install 10-foot shared use path along at least one side of the corridor
- Realign intersection with CR 486 in updated countywide thoroughfare plan
- Realign intersection with SH 146 in updated countywide thoroughfare plan
- Construct grade-separated railroad crossing

Segment Characteristics

Segment Length (mi)	5.47
Posted Speed (mph)	50
ROW Width (ft)	60-70
Roadway Width (ft)	30
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map

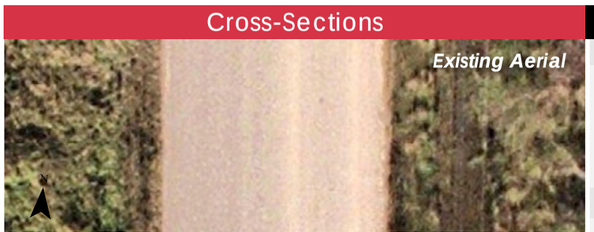


Liberty County Mobility Study, Corridor Summary Sheets

CR 486

from FM 1413 to 17,419 feet south of FM 1413
Corridor-Segment ID: I-1

Cross-Sections



Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	1688	0.11
2045	2715	0.18

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
15	0	0	0	0

Recommended Improvements

General

Proposed Classification: Principal Arterial (4-6 lanes, Undivided)

Short-Term

- Install pedestrian elements (marked crosswalks, countdown signals where applicable, curb ramps, etc) at intersections

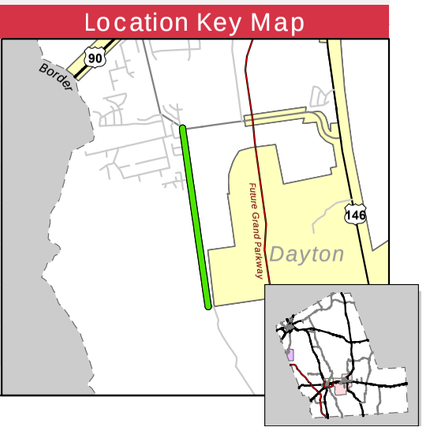
Long-Term

- Install 10-foot shared use path along at least one side of the corridor
- Realign intersection with FM 1413 in updated countywide thoroughfare plan

Segment Characteristics

Segment Length (mi)	3.3
Posted Speed (mph)	35
ROW Width (ft)	60
Roadway Width (ft)	22
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map

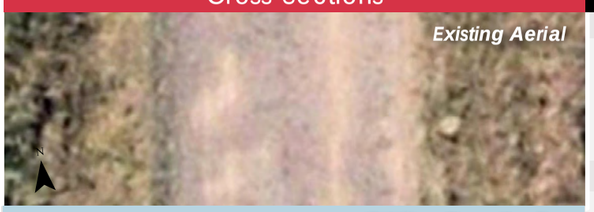


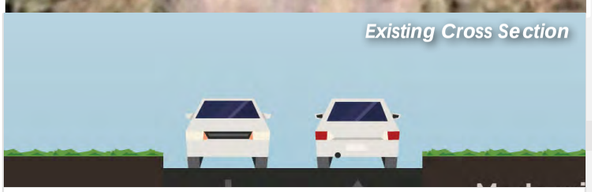
Liberty County Mobility Study, Corridor Summary Sheets

CR 491

from US 90 to FM 1413
Corridor-Segment ID: J-1

Cross-Sections





Proposed Cross-Section

Recommended Improvements

General

Proposed Classification: N/A
- Re-examine connections to SH 99, US 90, and FM 1413 in updated countywide Thoroughfare Plan

Short-Term

- Upgrade pavement for short-term residential use

Long-Term

Capacity Data

Study Year	*Average Daily Traffic*	*Volume-to-Capacity*
2021	130	N/A
2045	209	N/A

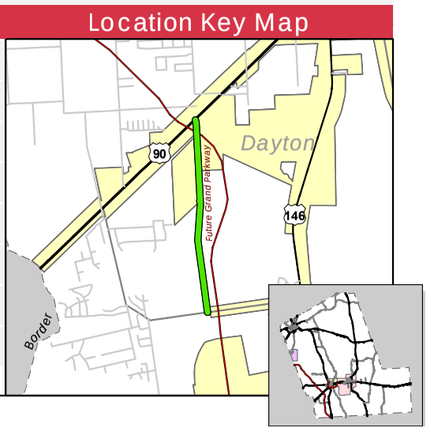
Crash Data (2016-2020)

Total	*Fatal*	*Serious Injury*	*Pedestrian*	*Bicycle*
3	0	0	0	0

Segment Characteristics

Segment Length (mi)	3.55
Posted Speed (mph)	30
ROW Width (ft)	50-170
Roadway Width (ft)	18
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map

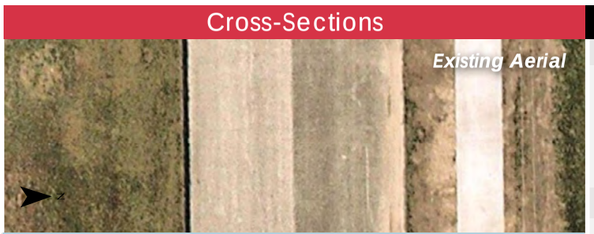


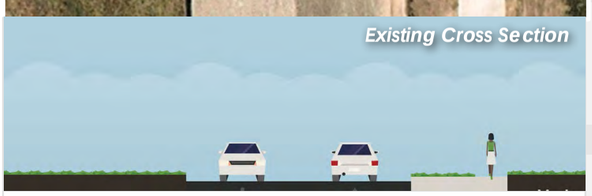
Liberty County Mobility Study, Corridor Summary Sheets

Lovers Lane

from SH 146 to Lovers Lane
Corridor-Segment ID: K-1

Cross-Sections





Proposed Cross-Section

Recommended Improvements

General

Proposed Classification: Collector

Short-Term

- Upgrade pavement markings

Long-Term

- Extend existing roadway westward from current terminus to connect with SH 146

Capacity Data

Study Year	*Average Daily Traffic*	*Volume-to-Capacity*
2021	N/A	N/A
2045	N/A	N/A

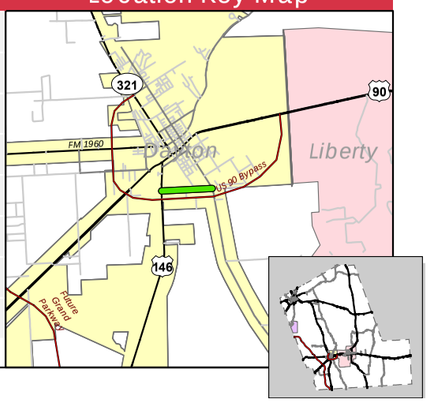
Crash Data (2016-2020)

Total	*Fatal*	*Serious Injury*	*Pedestrian*	*Bicycle*
1	0	1	0	0

Segment Characteristics

Segment Length (mi)	0.61
Posted Speed (mph)	N/A
ROW Width (ft)	N/A
Roadway Width (ft)	N/A
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	N/A
Sidewalk Count	N/A

Location Key Map

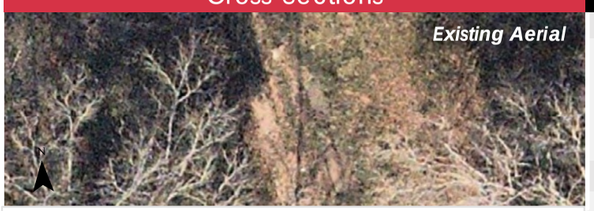


Liberty County Mobility Study, Corridor Summary Sheets

Waco Street

from Tram Road to Waco Street
Corridor-Segment ID: L-1

Cross-Sections



Existing Cross-Section

Proposed Cross-Section

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	N/A	N/A
2045	N/A	N/A

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
8	0	0	0	0

Recommended Improvements

General

Proposed Classification: N/A
None; do not construct
- The Dayton bypass is proposed to be extended along Klemp Road, which will merge into Norcross Lane. The extension of Waco Street would create an intersection with the bypass that would be too near the adjacent intersections per TxDOT standards

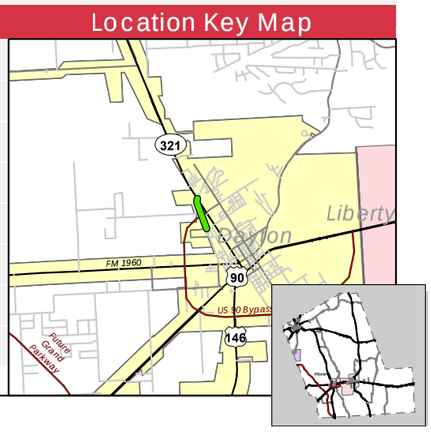
Short-Term

Long-Term

Segment Characteristics

Segment Length (mi)	0.58
Posted Speed (mph)	N/A
ROW Width (ft)	N/A
Roadway Width (ft)	N/A
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	N/A
Sidewalk Count	N/A

Location Key Map

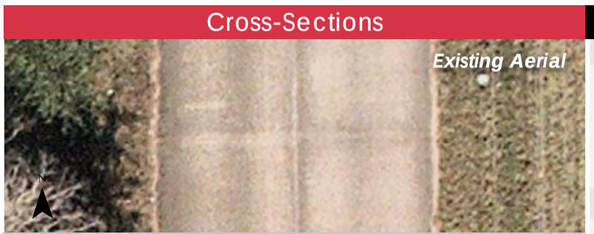


Liberty County Mobility Study, Corridor Summary Sheets

CR 606/Klemp Road

from FM 1960 to End Point
*Corridor-Segment ID: L-1**

Cross-Sections



Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	824	0.06
2045	1325	0.1

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
9	0	0	0	0

Recommended Improvements

General

Proposed Classification: Minor Arterial

Short-Term

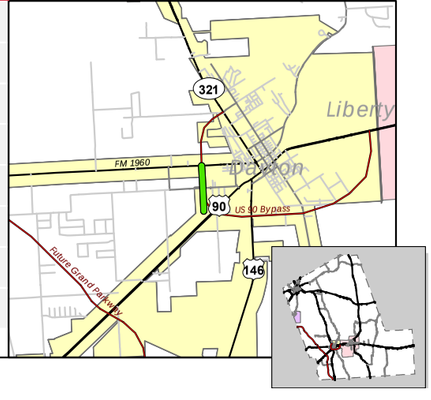
Long-Term

- Utilize as segment of US 90 bypass
- Construct grade-separated interchange with US 90

Segment Characteristics

Segment Length (mi)	0.83
Posted Speed (mph)	30
ROW Width (ft)	60
Roadway Width (ft)	28
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map

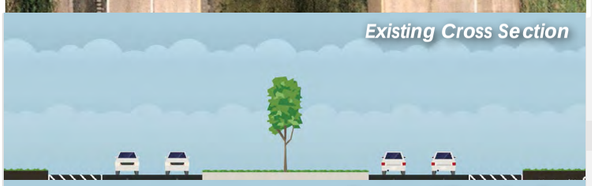


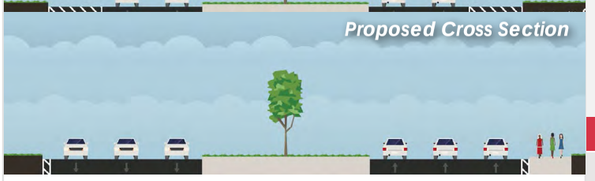
Liberty County Mobility Study, Corridor Summary Sheets

SH 146/US 90

from West End of Bridge (Trinity River) to Colbert Street
Corridor-Segment ID: S-10

Cross-Sections





Recommended Improvements

General

Proposed Classification: Principal Arterial (6 lanes, Divided)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor
- Widen to 6-lane divided cross-section

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	48968	1.36
2045	78762	2.19

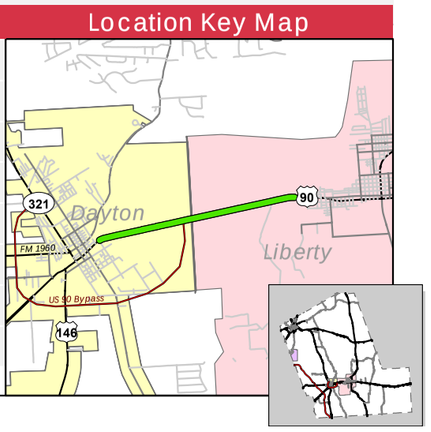
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
43	1	5	0	0

Segment Characteristics

Segment Length (mi)	3.65
Posted Speed (mph)	65
ROW Width (ft)	160
Roadway Width (ft)	120
Number of Lanes	4
Center Type	Divided
Center Width (ft)	40
Sidewalk Count	None

Location Key Map

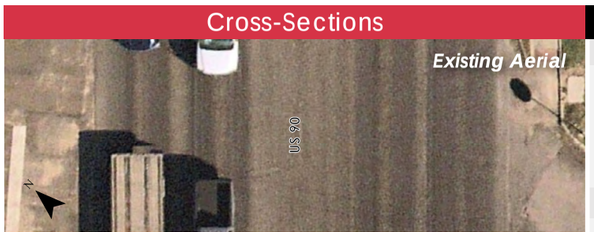


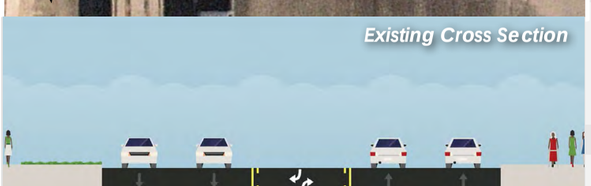
Liberty County Mobility Study, Corridor Summary Sheets

SH 146/US 90

from Colbert Street to SH 146
Corridor-Segment ID: S-11

Cross-Sections





Recommended Improvements

General

Proposed Classification: Principal Arterial (6 lanes + TWLTL)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor
- Widen to 7-lane cross-section with 14-foot center two-way left-turn lane

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	24798	0.69
2045	39886	1.11

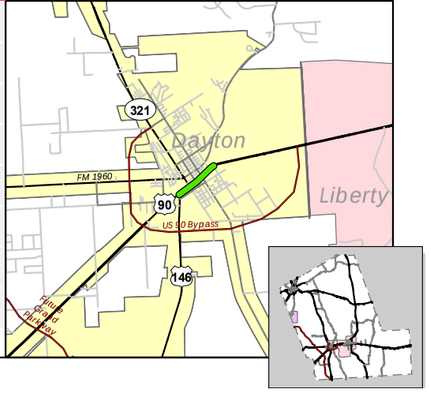
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
332	1	7	0	1

Segment Characteristics

Segment Length (mi)	0.82
Posted Speed (mph)	65
ROW Width (ft)	80
Roadway Width (ft)	64
Number of Lanes	5
Center Type	TWLTL
Center Width (ft)	16
Sidewalk Count	Both Sides

Location Key Map

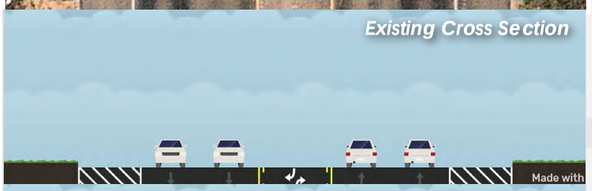


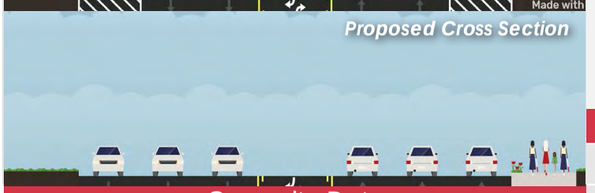
Liberty County Mobility Study, Corridor Summary Sheets

SH 146

from US 90/SH 146 to North End of Bridge (Trinity River Offshoot)
Corridor-Segment ID: S-12

Cross-Sections





Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	32143	0.89
2045	51700	1.44

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
244	3	12	0	1

Recommended Improvements

General

Proposed Classification: Principal Arterial (6 lanes + TWLTL)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

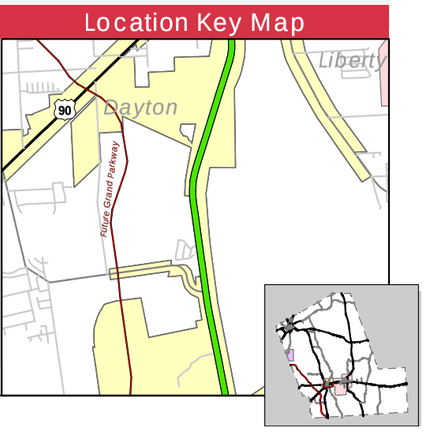
Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor
- Widen to 7-lane cross-section with 14-foot center two-way left-turn lane

Segment Characteristics

Segment Length (mi)	9.74
Posted Speed (mph)	65
ROW Width (ft)	140
Roadway Width (ft)	85
Number of Lanes	5
Center Type	TWLTL
Center Width (ft)	14
Sidewalk Count	None

Location Key Map

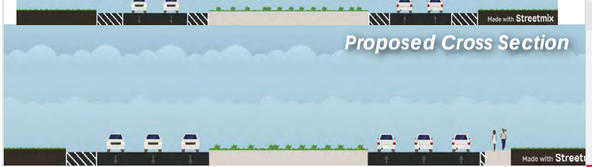


Liberty County Mobility Study, Corridor Summary Sheets

SH 146

from North End of Bridge to South End of Bridge (Trinity River Offshoot)
Corridor-Segment ID: S-13

Cross-Sections



Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	32143	0.89
2045	51700	1.44

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
8	0	1	0	1

Recommended Improvements

General

Proposed Classification: Principal Arterial (6 lanes, Divided)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

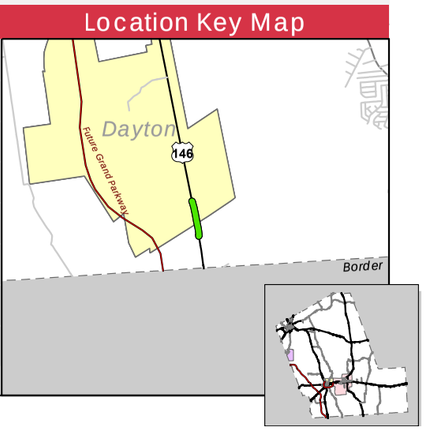
Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor
- Widen to 6-lane divided cross-section

Segment Characteristics

Segment Length (mi)	0.66
Posted Speed (mph)	65
ROW Width (ft)	200
Roadway Width (ft)	145
Number of Lanes	4
Center Type	Divided
Center Width (ft)	58
Sidewalk Count	None

Location Key Map



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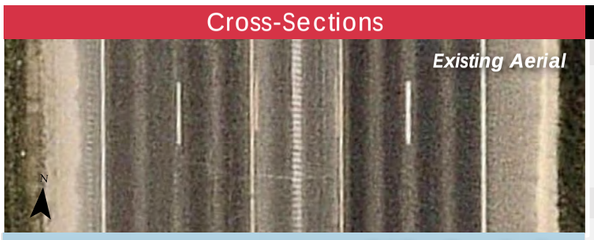
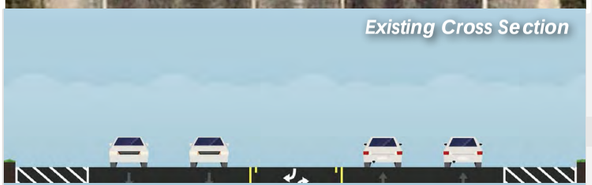
Liberty County Mobility Study, Corridor Summary Sheets

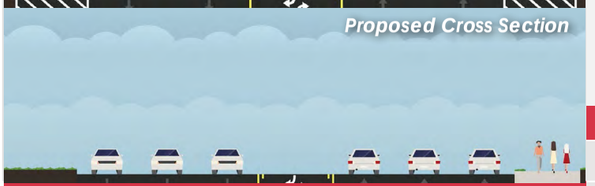
SH 146

from South End of Bridge (Trinity River Offshoot) to Southern County Limits
Corridor-Segment ID: S-14

Cross-Sections







Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	32143	0.89
2045	51700	1.44

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
5	0	1	0	0

Recommended Improvements

General

Proposed Classification: Principal Arterial (6 lanes + TWLTL)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

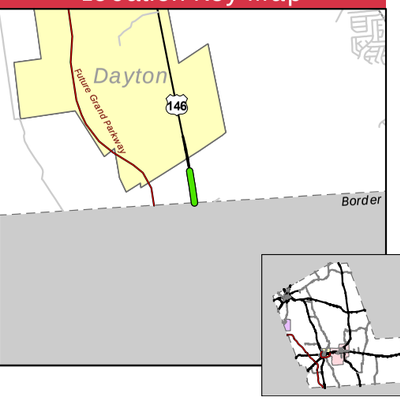
Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor
- Widen to 7-lane cross-section with 14-foot center two-way left-turn lane

Segment Characteristics

Segment Length (mi)	0.59
Posted Speed (mph)	65
ROW Width (ft)	140
Roadway Width (ft)	83
Number of Lanes	5
Center Type	TWLTL
Center Width (ft)	14
Sidewalk Count	None

Location Key Map



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6.2.3 IMPLEMENTATION PLAN

The City of Dayton should program recommended improvements per its own priorities and should add them into its Capital Improvement Plan as appropriate. Implementation of recommended improvements may require coordination between municipal entities within Liberty County. Specifically, City of Dayton may partner with Liberty County, TxDOT, and the City of Liberty. ***Table N*** below provides an outline of how many projects Dayton may need to partner on, what the construction cost of those projects would be, and what potential monetary benefits would result from implementing those projects.

Table O – City of Dayton Partnering Opportunities

	Number of Improvement Projects	Total Potential Benefits	Total Construction Cost
Dayton + Liberty County	24	$ 245,383,708	$ 30,699,325
Dayton + TxDOT + Liberty County	21	$ 238,481,808	$ 7,277,789
Dayton + Liberty + TxDOT + Liberty County	40	$ 90,876,592	$ 657,558,736

The local entities should partner together to create coordinated funding applications and apply to include projects within H-GAC's Regional Transportation Plan (RTP). Together, TxDOT and the local entities should coordinate with H-GAC to apply for Transportation Improvement Program (TIP) funding. Further discussion about the H-GAC TIP process can be found in ***Section 8.3.3***.

7

City of Liberty

- 7.1 Existing Conditions
- 7.2 Analysis and Recommendations

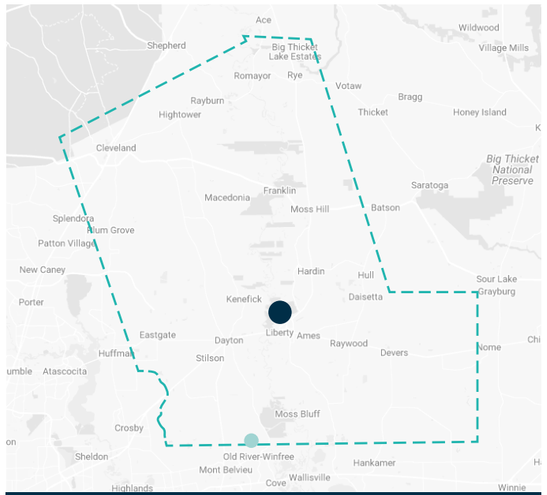
City of Liberty

7.1 EXISTING CONDITIONS

7.1.1 DEMOGRAPHICS

POPULATION

Based on data from the US Census Bureau, the population in the City of Liberty was 8,279 as of the 2020 Census, 9.0% of the total population in Liberty County. Liberty is the second most populated city in the county after Dayton and is the county seat.



CITY OF LIBERTY TOTAL POPULATION: **8,279**

POPULATION DENSITY

CITY OF LIBERTY	LIBERTY COUNTY
195	**79**
PERSONS PER SQ. MILE	*PERSONS PER SQ. MILE*

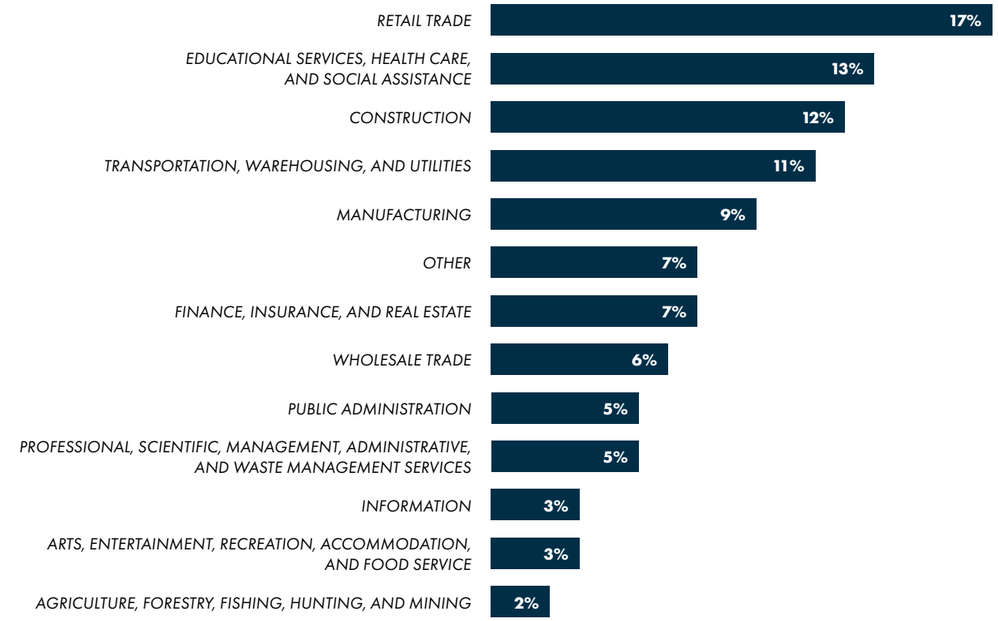
Liberty is more than twice as densely populated as the county overall. The population density of the city is 195 persons per square mile, whereas the county's is 79 persons per square mile.

Liberty County is facing significant growth due to expanding residential, commercial and industrial development. According to US Census estimates, the Liberty's population increased by 3.2% between April 2020 and July 2021.

EMPLOYMENT

Employment opportunities in Liberty County are available in a variety of industries. Relative to the county, the City of Liberty has a greater portion of employees in Retail Trade, Wholesale Trade, and Finance, Insurance, and Real Estate. The construction industry is expected to grow over the next twenty years due to increased development along and near the Grand Parkway (SH 99).

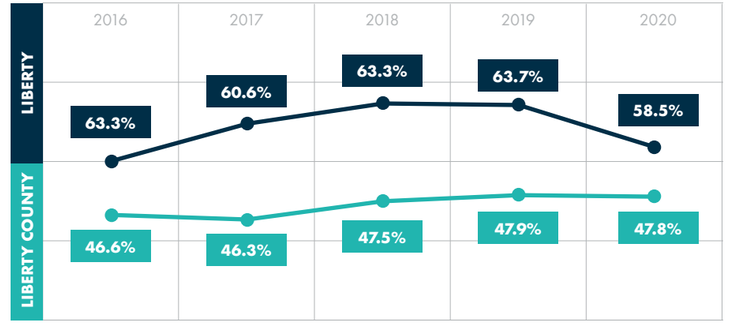
INDUSTRIES IN THE CITY OF LIBERTY



Source: U.S. Census Bureau

EMPLOYMENT RATE (%)

The employment rate in the City of Liberty has been greater than that in Liberty County by about 5% on average since 2016. After years of steady growth in employment, Liberty experienced a short decline during the COVID-19 pandemic in 2020. With the anticipated development and growth in the area, employment rate is expected to increase.

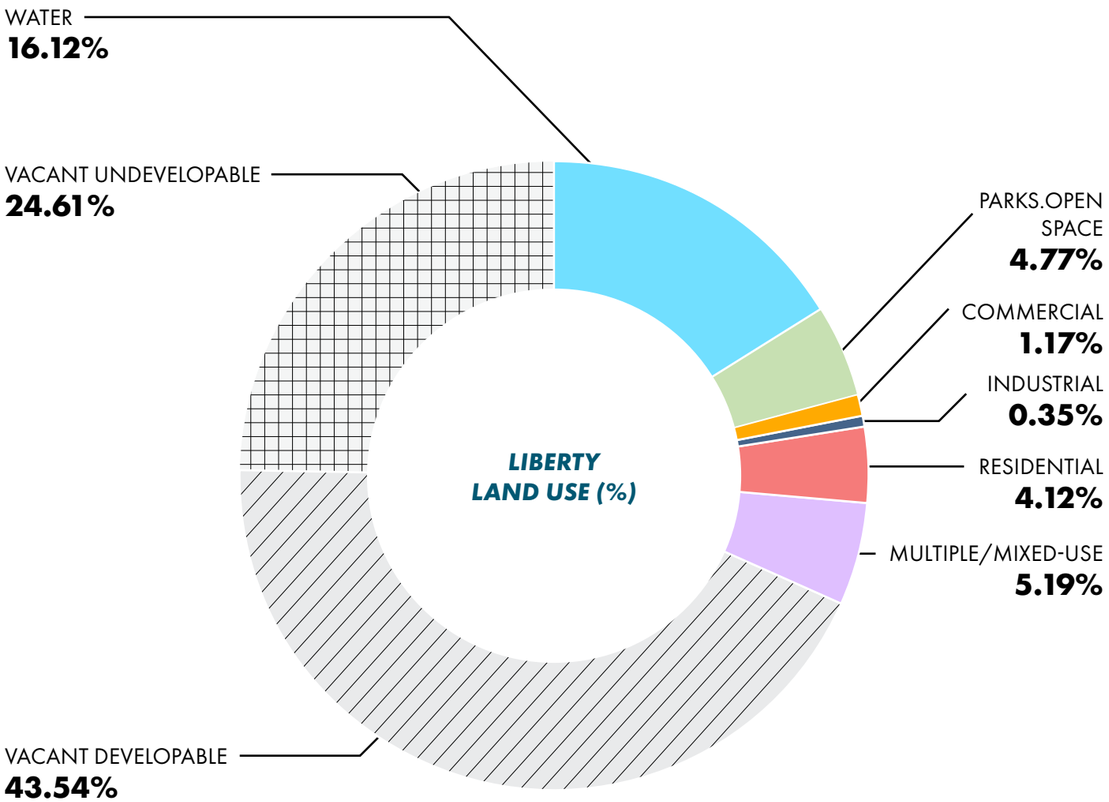


Source: U.S. Census Bureau

7.1.2 LAND USE

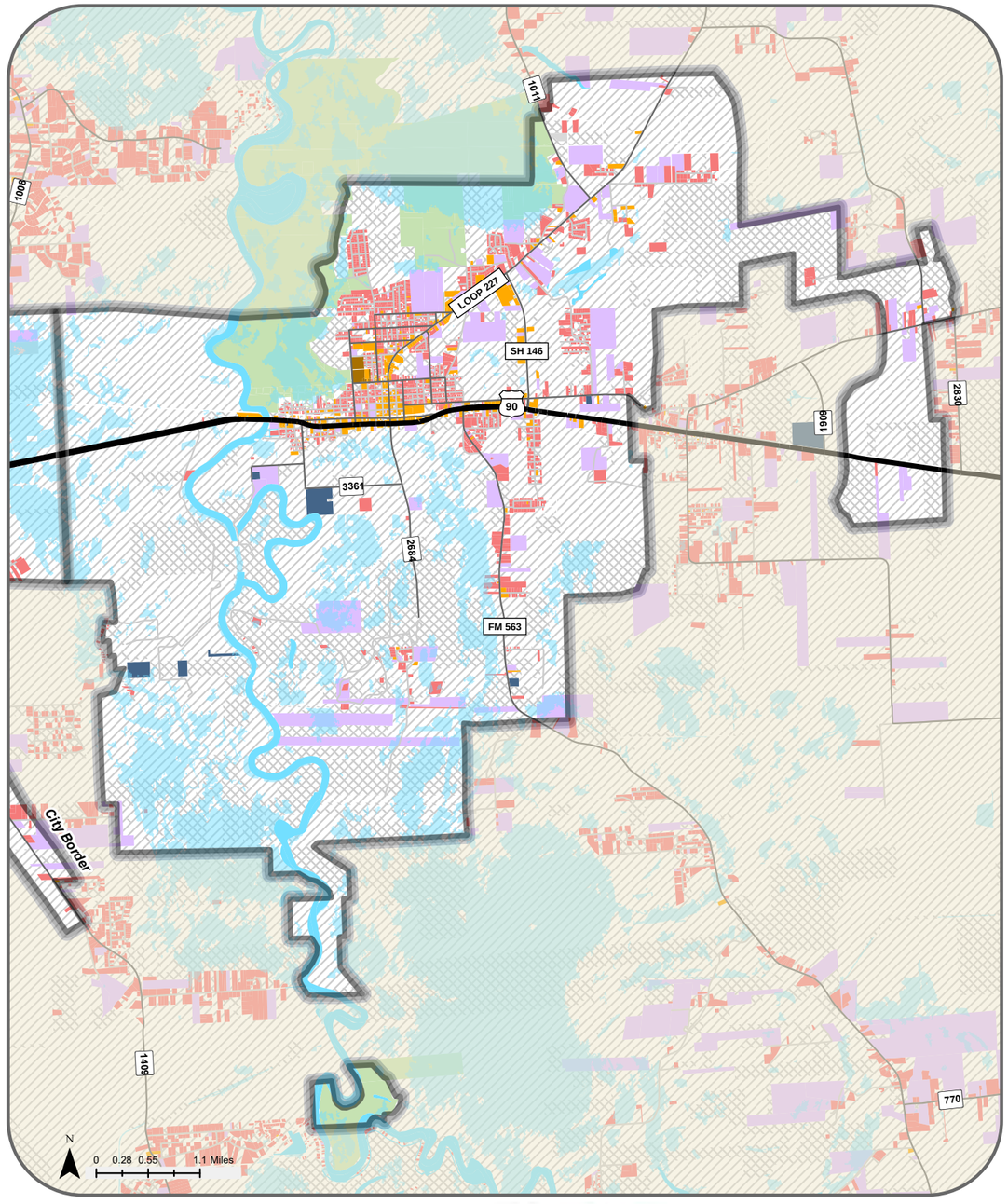
Liberty is located on US 90, east of Dayton and the Trinity River. Of the three largest cities in Liberty County, Liberty has the greatest portion of open water and wetland within its city limits. Currently, residential and commercial development is concentrated within the downtown area, along SH 146 going northeast and along Wallisville Road going south. There are also smaller separated pockets of development on the east side of the city, along and near the SH 146 bypass.

Exhibit 7.1.2a illustrates the distribution of land use throughout the City of Liberty.



Source: H-GAC R-LUIS

Exhibit 7.1.2a – Land Uses in the City of Liberty

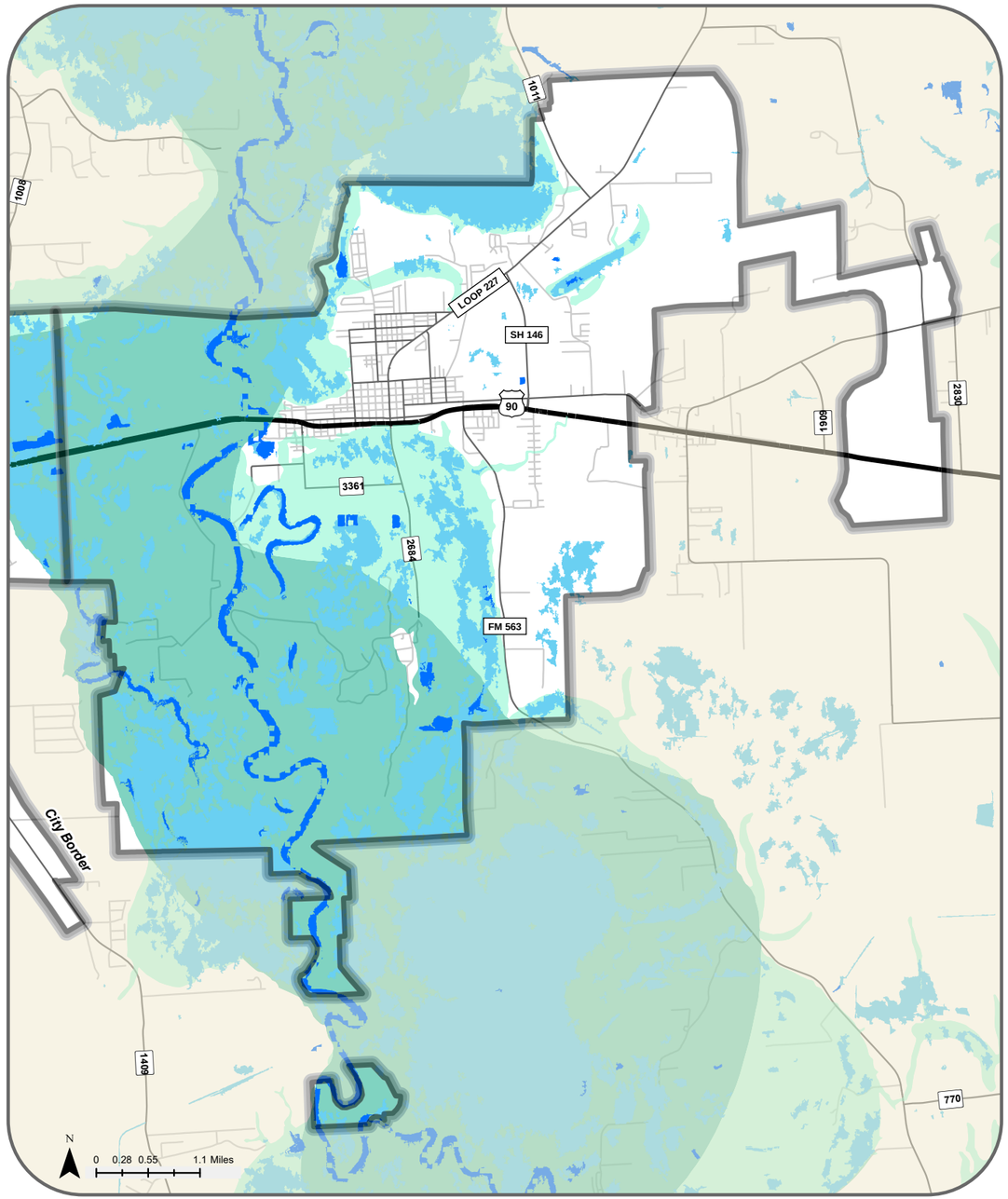


ENVIRONMENTAL FEATURES

Open water and wetlands account for 4,860 acres of the land in Liberty. Additionally, 7,420 acres of the city are undevelopable, largely due to the Trinity River floodplain that dominates the west and north quadrants of the city. Most of these wetlands have been utilized as parks and are acknowledged by residents as land that is unlikely to develop. See these waterways in ***Exhibit 7.1.2b***.

While these waterways pose a threat of flooding, they can also serve as potential recreational space and natural paths for hike and bike trails. Currently, there are1,436 acres of park space in the City of Liberty. See the location of parks and open spaces in ***Exhibit 7.1.2a***.

Exhibit 7.1.2b – Environmental Features in the City of Liberty



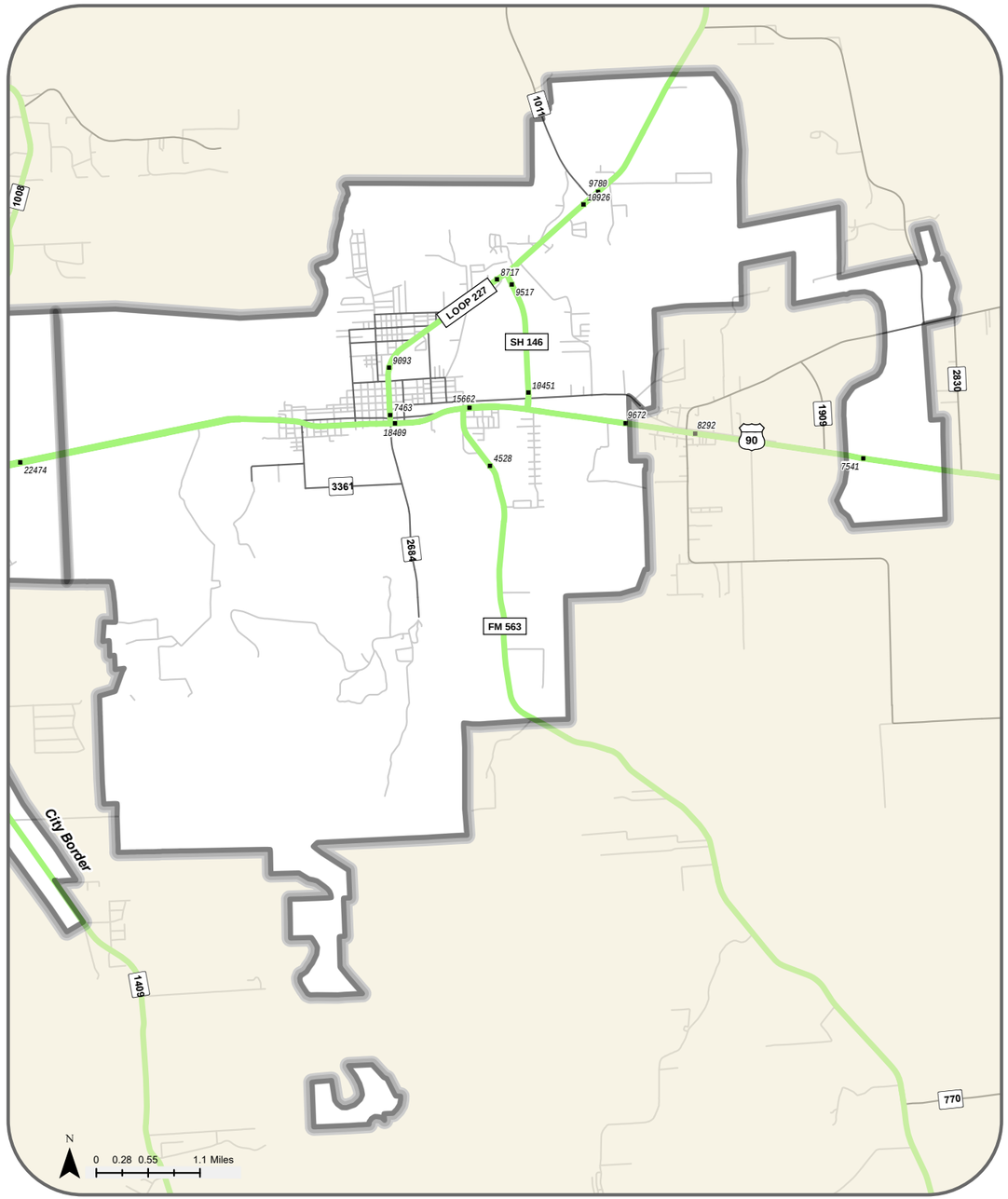
7.1.3 TRANSPORTATION

ROADWAYS

Important corridors in the City of Liberty are illustrated in Exhibit 7.1.3a. These include the following

- **State Highway 146 (SH 146)** runs north-south through the center of the county, connecting the cities of Dayton and Liberty with Baytown to the south. In the City of Liberty, SH 146 branches off on the east side of downtown to provide a bypass for passers-through and heavy commercial vehicles.
- **US Highway 90 (US 90)** runs east-west through the southern third of the county, connecting Dayton and Liberty with Beaumont and Louisiana to the east and Houston to the west.
- **State Loop 227 (SL 227)** runs generally north-south through downtown Liberty, connecting SH 146 to US 90. There are many businesses and municipal buildings along this corridor, including the Liberty County Courthouse.

Exhibit 7.1.3a– Important Roadways in Liberty



ACTIVE MODES

The existing active transportation network in the City of Liberty is limited. Data collected from H-GAC's Open Data portal indicates that there are approximately 3.2 miles of sidewalks and no designated on-street bikeway facilities within the city limits of Liberty.

Denser areas with more concentrated land uses have the potential to generate more biking and walking trips. Major destinations include natural areas, parks, and schools. There are seven independent school districts (ISD) within or partially within Liberty County, including Liberty ISD. Student transportation may increase demand for Safe Routes to School (SRTS) opportunities, especially for newly built schools.

A high-level review of existing plans reveals that there is varying interest in building and implementing active infrastructure among cities and the county.

- The **Liberty County Community Plan** prioritizes areas near schools for robust sidewalk networks, downtown areas with the county's three largest cities are prioritized for bike lane facilities, and undevelopable natural areas along creeks are prioritized for hike and bike trails to preserve floodplains.

Popular fitness and activity tracking apps are widely available on smartphones, smart watches, and bike computers. One such platform, Strava, allows its user data to be mapped by public agencies to highlight areas where there is bicycling and walking demand and better understand where infrastructure improvements may be desired. Although a useful database of information, one caveat with Strava data is that the data collected is user reported and not fully representative of a community's full demographics, especially for people who do not use Strava or other GPS tracking apps to share their data; Strava users tend to skew white, male, and median age.

Pedestrian Infrastructure

Apart from the blocks around City Hall and the County Courthouse, sidewalks are not standard nor uniformly available within Liberty. School campuses may have limited sidewalks between buildings and outdoor play areas and fitness facilities. Both the Liberty County Community Plan and Dayton Tomorrow 2035 Comprehensive Plan specifically call out the need to improve pedestrian safety and provide sidewalk connections for students walking and biking to schools.

Where there are sidewalks present, a variety of attributes creates an unwelcoming pedestrian environment, including short and discontinuous segments, a lack of ADA accessible curb cuts or curb ramps, narrow non-ADA compliant sidewalk widths, deteriorating concrete and other materials, unmarked crosswalks, a lack of trees and shade, and a lack of separation from parking and auto travel lanes.

The annual Strava data for pedestrians indicates the highest frequency of walking occurs within or immediately adjacent the city limits of Liberty. Most pedestrian activity is confined to the area around Liberty Dayton Regional Medical Center, downtown Liberty east of Main Street, and Liberty Municipal Confederate Park (see ***Exhibit 7.1.3b***).

Bicycle Infrastructure

Although there are no designated on-street bicycle facilities anywhere within Liberty, there are several shared biking and walking trails within natural areas nearby: the Butler Tract Trail, the Brierwood Tract-Gaylor Lake Loop, the Paige Trail, and the McGuire Tract-Greens Bayou Loop in or near the Trinity River National Wildlife Refuge.

According to bicycle recreationalists and advocates, the lack of route options other than major auto thoroughfares presents one of the biggest challenges. One suggestion is to use bike and shared use paths as a floodplain management strategy to prohibit additional development in environmentally sensitive, natural areas. There is a lack of funding and governmental interest for bike routes and paths, especially regarding the expense of planning, implementing, and maintaining bike lanes, according to bicycle advocates. A pressing concern is the repaving of older roadways with larger aggregate materials that create rough and uneven surfaces that are not suited for bike travel; repaved roadways which once had smoother gutter and shoulder areas for biking are becoming inaccessible to bicycle riders and are not adequately swept or maintained.

The annual Strava data for bicyclists indicates a demand for cycling between the county's cities and communities along major routes such as US 90 and SH 146, with the highest demand along SH146 between Liberty, Hardin, and Big Thicket Estates. Within Liberty, the highest cycling demand is along Main Street and North Main Street (SL 227/SH 146) to Hardin. Other routes in high demand are Bowie Street, Jefferson Drive near the high school; Sam Houston Street, Beaumont Road, and Donatto Drive parallel or adjacent to stretches of US 90, and along West and East Street to Ames (see ***Exhibit 7.1.3b***).

In sum, opportunities and challenges for implementing active transportation improvements in Liberty were identified through quantitative and qualitative analysis of available data and stakeholder interviews.

OPPORTUNITIES

- A confluence of civic uses, restaurants, services, and tourist destinations and accommodations in the downtown area of Liberty offer opportunities for implementing sidewalk networks.
- School campuses lack sidewalk connections to surrounding residential neighborhoods, representing opportunities to serve existing and new schools with pedestrian infrastructure.
- Environmentally sensitive areas, such as floodplains near natural amenities, may provide opportunities for trail routes that could also potentially reduce or prevent development pressures.

CHALLENGES

- There is a lack of connected sidewalks and sidewalk networks; where sidewalks do exist, these segments are partial, discontinuous, lack ADA accessible curbs and widths, and have deteriorating pavement, concrete, and/or asphalt conditions.
- There are limited funding sources for improvements at the local and county levels.

RECOMMENDATIONS

- Refer to countywide active mode recommendations in ***Chapter 4***.

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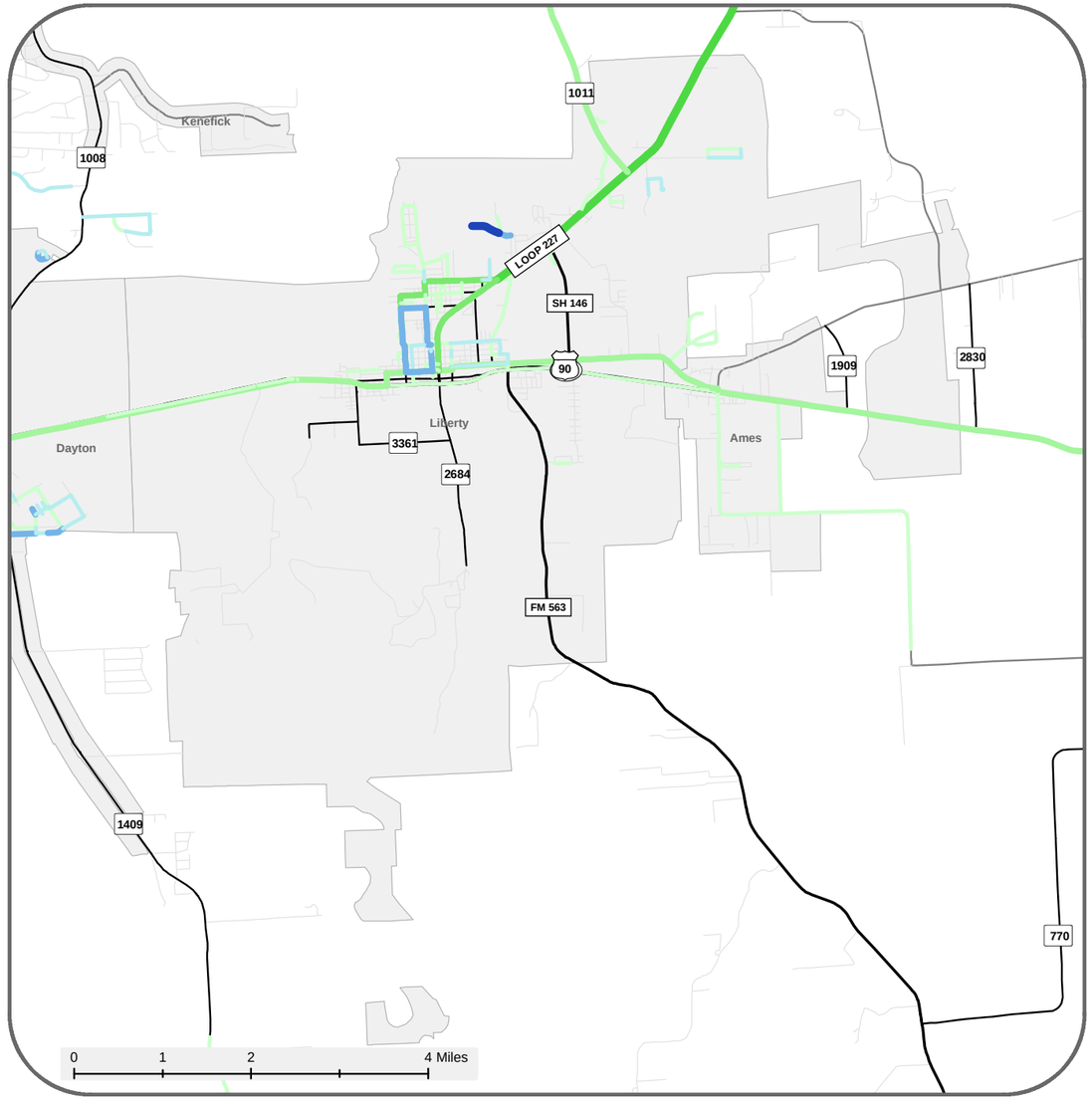
Exhibit 7.1.3b - Liberty Combined Bicycle and Pedestrian Strava Activity



Source: Strava, TxDOT Roadway Inventory

TRANSIT

The Brazos Transit District (BTD) serves Liberty with one fixed circular route that also circulates within Dayton and Ames. It provides transportation between the cities' core areas four times per day (see ***Exhibit 7.1.3c***). Service operates on weekdays from 9:00 a.m. to 4:00 p.m. and is not available on major federally recognized holidays. One-way fixed route rides cost $1.00 for the public and are $0.50 for seniors, people with disabilities, individuals covered by Medicare, and children aged 6-12 years of age. Rides are free for children under 6 years of age with a paying customer. This fixed route does not have established bus stops; riders flag down bus drivers along the route to board and communicate to the driver where they would like to disembark. Currently, no funding is dedicated to bus stops. The agency has considered that "flex zone" service may better serve patrons with on-demand services. Other transit providers in the H-GAC region, such as Fort Bend County Transit, have reported success with this type of service.

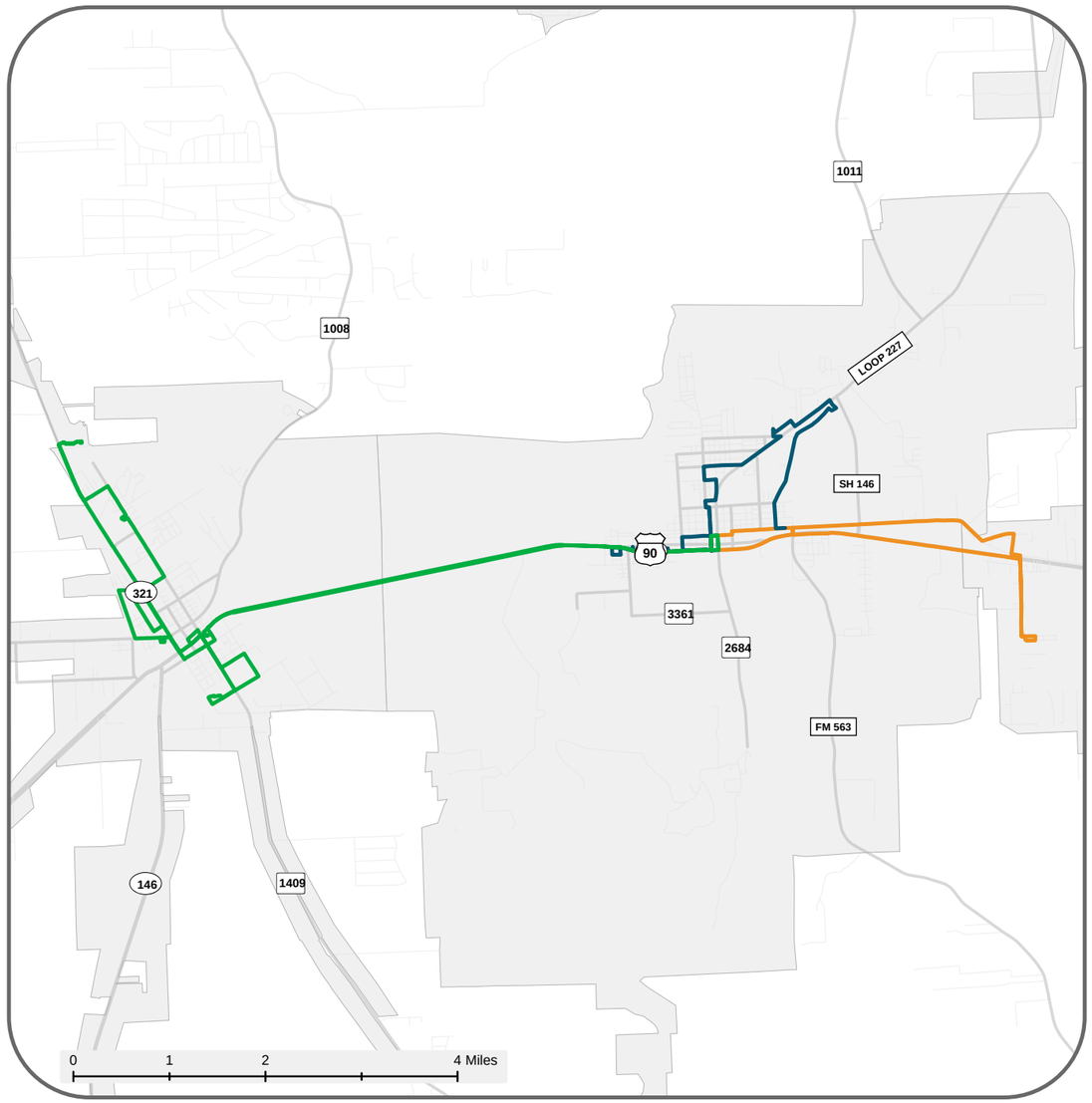
Demand Response and ADA Paratransit service is currently unavailable in Liberty.

Ridership data for the fixed route shows that there was a decline in ridership from 2018 to 2020, due to the COVID-19 pandemic, but that 2021 ridership numbers tracked consistently with 2019 and 2020 figures. The Liberty-Dayton fixed route experiences ridership ranging between 4,000 and 7,600 passengers.

The route has experienced minimal changes since service became operational, and stakeholder feedback suggested that there may be a need for a fixed stop at the courthouse in Liberty as well as service extensions from Dayton to Downtown Houston, a major employment destination. One suggestion may be the inclusion of park and ride facilities, which would require coordination with other service providers.

According to data provided by BTD, in Liberty the greatest frequency of boardings occurs near the Liberty courthouse offices, the commercial area north of North Main Street between Jefferson Drive and Cook Road, Walmart, and in Ames at West Main Street and Martin Luther King Road.

Exhibit 7.1.3c - Libertv-Davton Fixed Route



Source: H-GAC Open Data, TxDOT Roadway Inventory, Brazos Transit District

A high-level review of existing plans highlights the level of effort related to bicycling, pedestrian, and transit improvements in Liberty County.

- The **Liberty County Transit Plan** suggests service and operations improvements, including park-and-ride options, interagency collaboration, and improving on-demand services. Proposed park-and-ride routes include service between Liberty-Dayton and Baytown, Liberty-Dayton and Beaumont, and Liberty-Dayton to Cleveland. Public comments requested better integration between last mile connections to the transit system and bike racks on buses.
- The **High-Capacity Transit Task Force Priority Network**, which is the transit component of the current 2045 Regional Transportation Plan (RTP), recommends a future park and ride bus service between Dayton and downtown Houston and the Texas Medical Center that the Liberty-Dayton route would tie into, as well as regional bus routes linking Liberty and Dayton to Humble and Atascocita and to Mont Belvieu and Baytown.

In sum, opportunities and challenges for implementing transit improvements in Liberty were identified through quantitative and qualitative analysis of available data and stakeholder interviews with Brazos Transit District.

CHALLENGES

- Transit demand exceeds on-demand supply, highlighting capacity challenges; there are no formal bus stops with shelter, benches, signage, or other amenities; lack of a dedicated funding source, such as a sales or ad valorem tax, or impact fees, limits the ability for the Brazos Transit District to supply additional service.

OPPORTUNITIES

- Serve areas of frequent transit fixed route boardings and alightings "hotspots" with improved pedestrian infrastructure and dense mixed development.

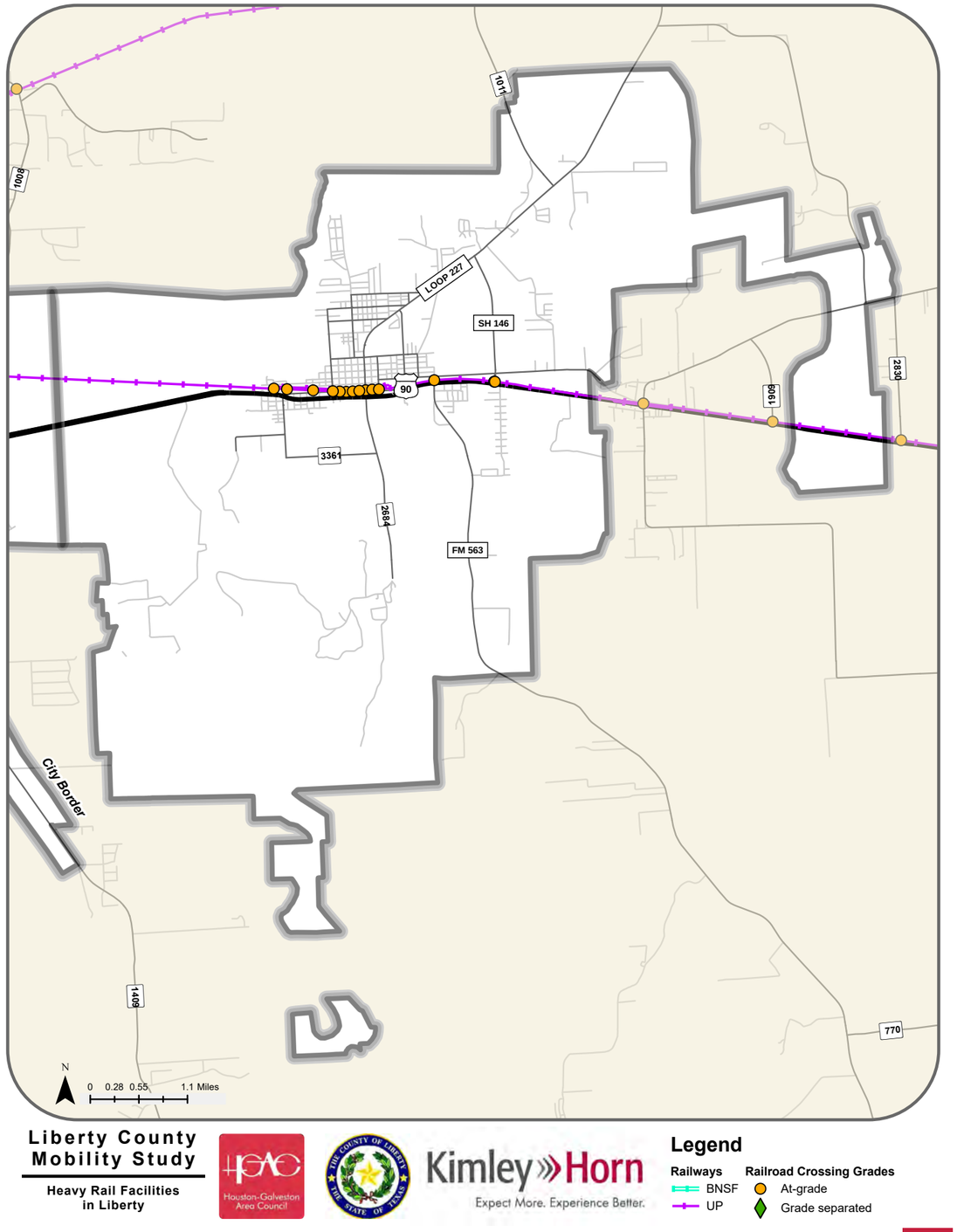
RECOMMENDATIONS

The City of Liberty should work with the Brazos Transit District and H-GAC to participate in future studies and consider future transit improvements as the county's population continues to grow. Specific elements could include:

- Flex Zone Operations
- A Park-and-Ride lot near the adjacent City of Dayton to serve commuter bus service into downtown Houston and the Texas Medical Center

H-GAC is planning to conduct a regional connector bus study, which will explore the feasibility of bus routes that connect the region's outlying communities to each other as well as the urban core. Such services could enhance Liberty's connectivity to the rest of the region.

Exhibit 7.1.3d – Railroad Facilities in Liberty



FREIGHT

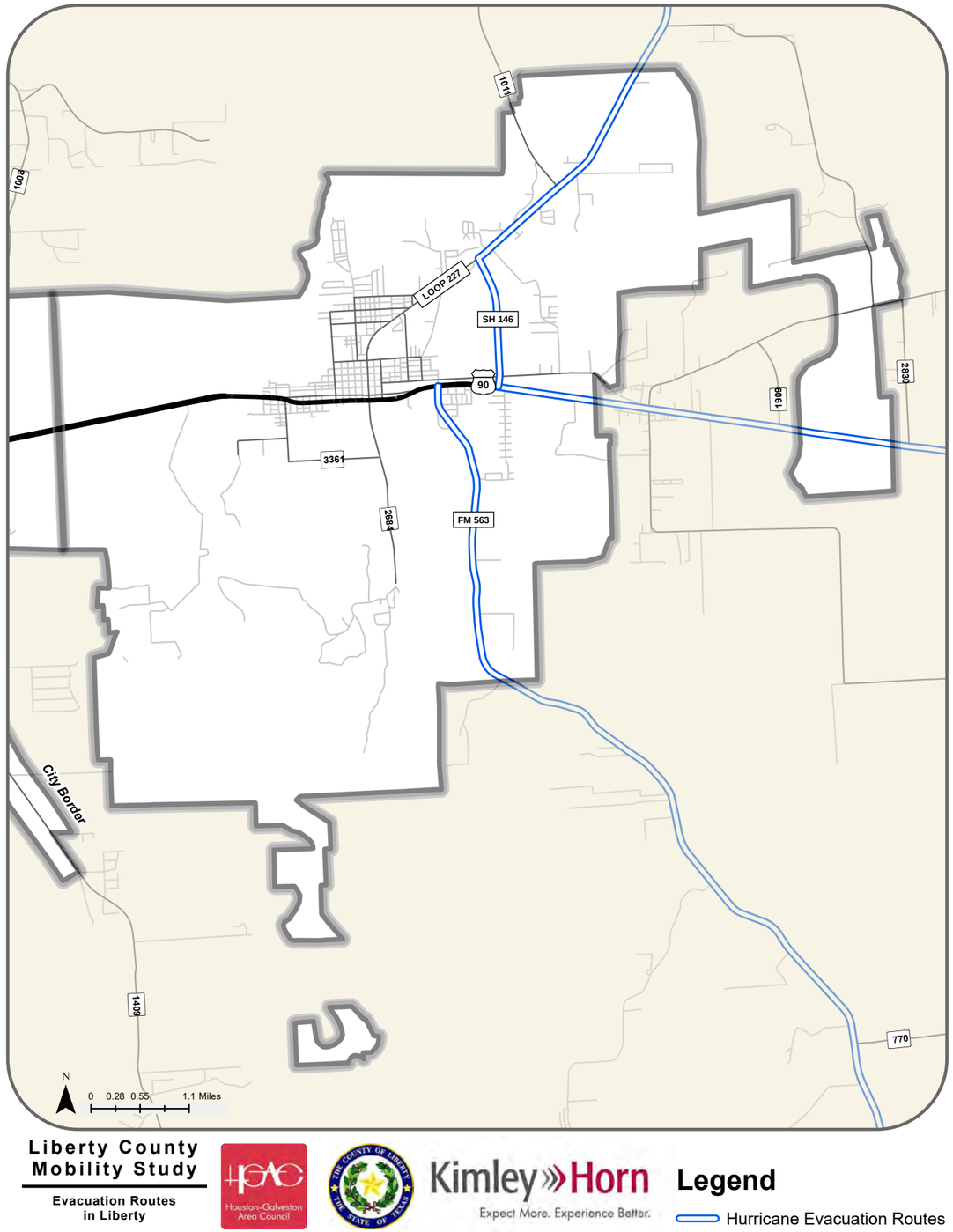
Only one rail line passes through the City of Liberty: the UPRR-owned Lafayette Subdivision that runs east-west through town and generally follows US 90.

Exhibit 7.1.3d illustrates the railroad facilities – lines and crossings – existing in Liberty.

EVACUATION ROUTES

Hurricane evacuation routes designated by TxDOT within the City of Liberty are illustrated in ***Exhibit 7.1.3e***.

Exhibit 7.1.3e – Evacuation Routes in Liberty



7.1.4 SAFETY

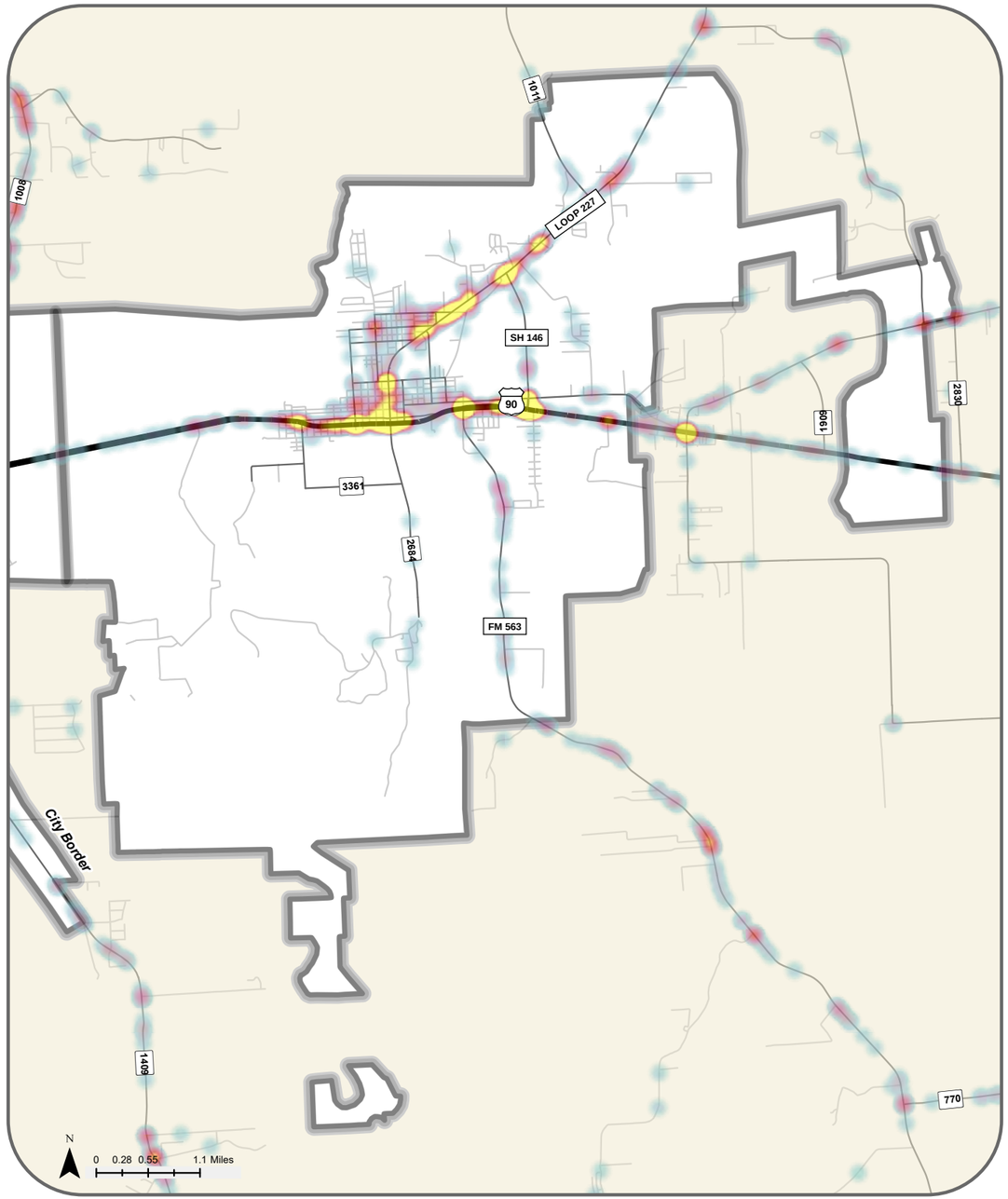
Crash data was collected in the City of Liberty during years 2016 through 2020. Most crashes during that time happened in downtown Liberty and at junctions of major corridors. The top 3 highest concentrations of crashes are located at the following intersections:

1. US 90 at SH 146 Bypass (59 crashes)
2. US 90 at Main Street/SL 227 (43 crashes)
3. US 90 at Wallisville Road (35 crashes)

Exhibit ***7.1.4a*** illustrates the density of all crashes in and around the city.

Source: TxDOT CRIS

Exhibit 7.1.4a – Crash Density in Liberty



While crashes occur on all roadways, higher crash density occurs along higher capacity/speed roadways and at intersections of higher capacity/speed roadways. ***Table P*** shows the classifications of each roadway, what percentage (by length of roadway) of Liberty's roadway network they account for, what percentage of overall crashes take place on that classification of roadway, and percent of total fatalities occur on that classification of roadway.

Table P– Crash Percentage by Roadway

Roadway Classification	Length of Roadway (miles)	Percent of Total Roadway Network	Number of crashes	Percent of Total Crashes	Number of Fatalities	Percent of Total Fatalities
Interstate	-	-	-	-	-	-
Freeway/Expressway	-	-	-	-	-	-
Principal Arterial	66	20%	323	22%	2	22%
Minor Arterial	152	46%	347	24%	6	67%
Major Collector	32	10%	86	6%	-	-
Minor Collector	6	2%	10	1%	1	11%
Local	72	22%	129	9%	-	-
Total	**328**	**100%**	**895**	**100%**	**9**	**100%**

7.1.5 IDENTIFIED NEEDS

In a meeting held with Liberty County and City of Liberty staff, the following needs were identified:

- There is a consensus that there isn't enough existing parking at the County courthouse, so taking away parking could be a major inconvenience to visitors and employees of the courthouse; may consider a garage around the corner or down the street. Concern about parking came in response to a recommendation made about improving the Courthouse Square. See ***section 7.2*** for a potential Courthouse area re-design. This recommendation assumes an off-site parking arrangement.
- Main Street should be mixed-use, primarily commercial; residential development will fan out from the corridor
- Revised zoning along Main Street is proposed
- Main Street will likely need a continuous two-way left-turn lane
- Students are mostly not allowed to walk or bike to and from school; pedestrian facilities may be useless
- New striping around the school as well as a three-way stop at the intersection of Bowie & Grand are needed for safety
- An east-west bypass north of Liberty may not be feasible because of the levy and floodplain
- When IH-10 is closed, US 90 experiences exacerbated congestion
- The intersection of the SH 146 bypass with US 90 experiences significant delay due to trucks making left turns
- New subdivisions are expected to bring significant growth to the local school district

During both public meetings and through the online feedback tool, members of the public identified the following needs in Liberty:

- Consider using FM 1011 to alleviate SH 146 traffic through downtown
- Upgrade and expand the hurricane evacuation route

Full details of public and Steering Committee comments are included in ***Appendix B***.

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7.2 ANALYSIS AND RECOMMENDATIONS

7.2.1 SCENARIO COMPARISON

SHORT-TERM INTERSECTION ANALYSIS

Each study intersection was analyzed to better understand current operations before recommendations could be developed. Synchro™, a traffic analysis software, was used to create a model to analyze the operation of study intersections as they currently operate, in the "2021 Existing" scenario, during the weekday hours of highest use, or the PM peak hour (5:00-7:00 PM). A summary of the analysis results is illustrated in ***Exhibit 7.2.1a*** and the complete analysis results can be found in ***Appendix D***.

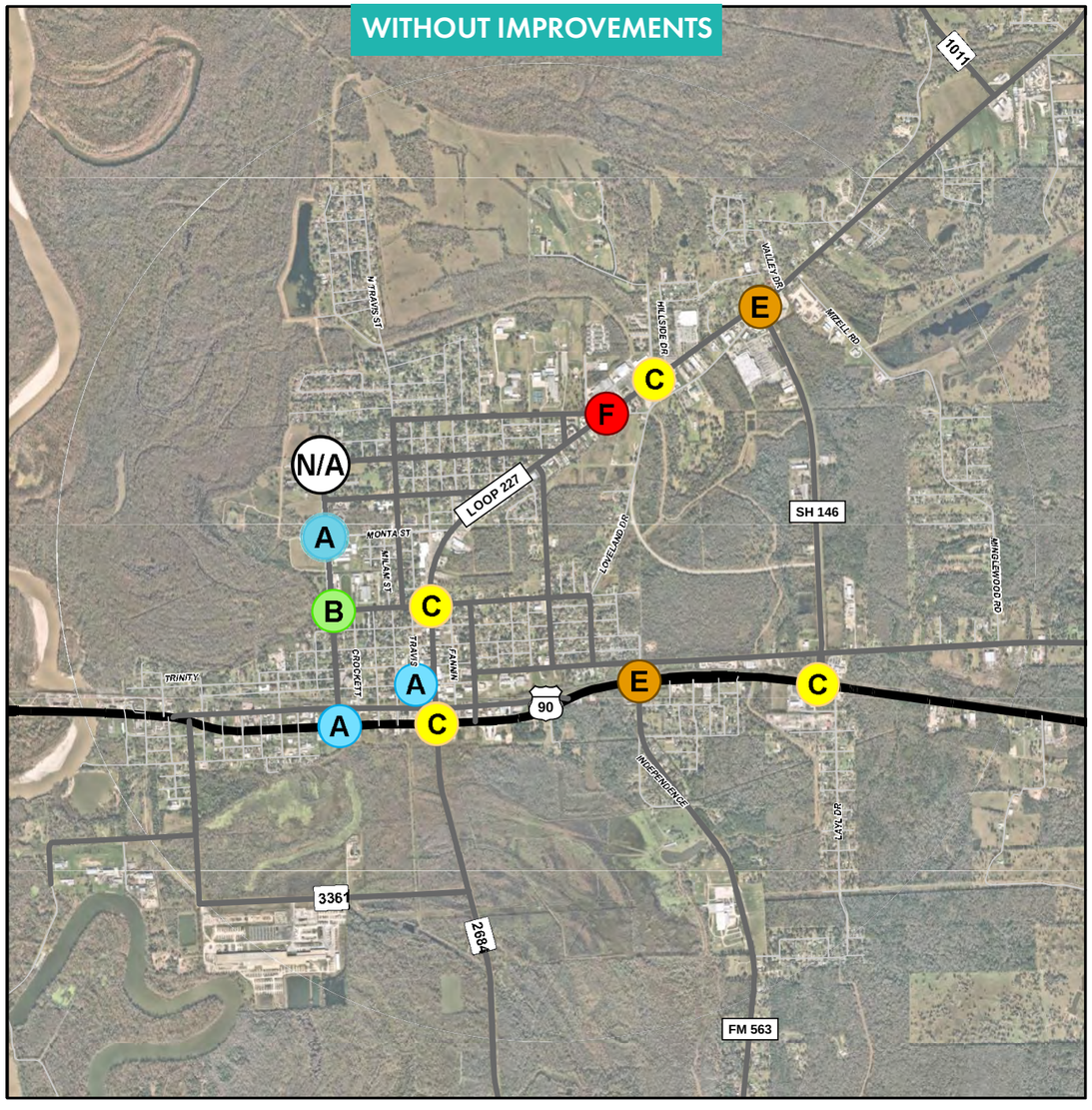
In the 2021 Existing scenario, only two of the eleven study intersections in the City of Liberty exceed capacity, meaning they will need capacity improvements in addition to potential safety improvements. The remaining study intersections, need no capacity improvements but may need safety improvements.

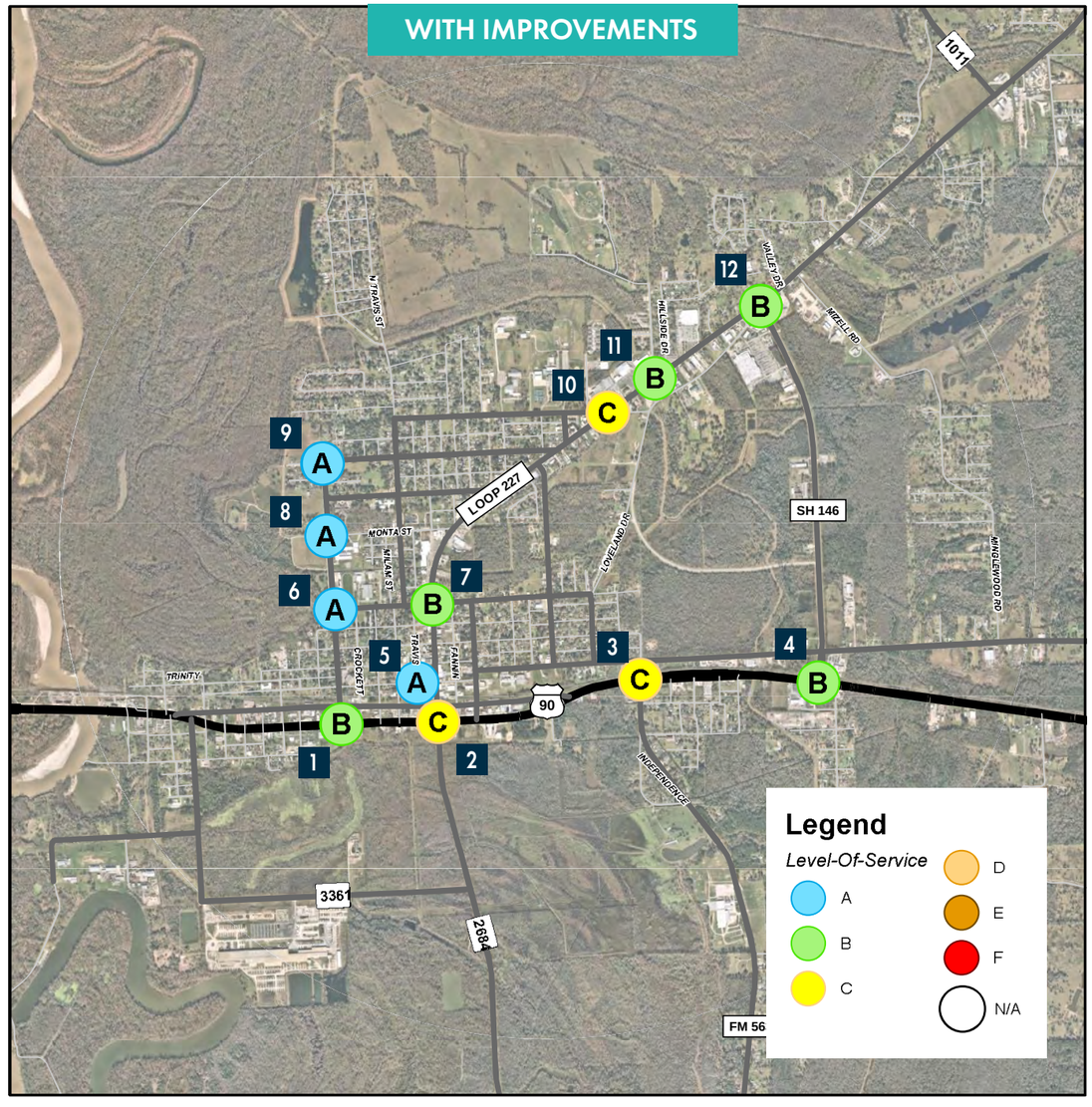
The results of the 2021 Existing analysis scenario helped determine potential improvements to the network that could be applied in the short-term. Short-term improvements are assumed to be constructed or implemented within five years of this study.

Another Synchro™ model was created to analyze the operation of study intersections with the addition of short-term improvements to the existing roadway network, also known as the "2021 Improved" scenario. Adjusted 2021 volumes were used. A summary of the analysis results is illustrated in ***Exhibit 7.2.1a*** and the complete analysis results can be found in ***Appendix D***.

Due to the implementation of short-term improvements, the Synchro analysis determined that there would be a 29% decrease in delay at the study intersections between the 2021 Existing and Improved scenarios.

Exhibit 7.2.1a – Short-Term Analysis Results and Improvements for City of Dayton





1 Optimize cycle length and phase splits; coordinate signals along US 90

2 Coordinate signals along US 90; install exclusive left-turn lane (southbound); Permitted+Protected Left-Turn (all approaches); Permissive+Overlap right-turn (southbound)

3 Optimize cycle length and phase splits; coordinate signals along US 90; Permitted+Protected Left-Turn (eastbound, westbound)

4 Coordinate signals along US 90; Permitted+Protected Left-Turn (eastbound)

5 None

6 Install stop signs at all 3 approaches; refresh striping and install high visibility marked crosswalks; install exclusive left-turn lane (westbound)

7 Optimize cycle length and phase splits; install high visibility marked crosswalks, curb ramps, and pedestrian signal; Flashing Yellow Arrow Left-Turn for all approaches

8 None

9 Install stop signs at all approaches; refresh and install striping

10 Optimize cycle length and phase splits; install high visibility marked crosswalks; install left-turn lanes (eastbound and westbound); install through lane (northbound); Flashing Yellow Arrow Left-Turn for all approaches

11 Optimize cycle length and phase splits; install exclusive right-turn lane (southbound)

12 Optimize cycle length and phase splits; Permitted+Protected Left-Turn (southbound)

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LONG-TERM INTERSECTION ANALYSIS

Another Synchro™ model was created to analyze the operation of study intersections in the 2045 Existing analysis scenario. A summary of the analysis results is illustrated in ***Exhibit 7.2.1b*** and the complete analysis results can be found in ***Appendix D***.

More than half of the study intersections in the 2045 Existing scenario have a failing LOS, meaning they will need additional capacity improvements to those recommended in the short-term. An increase in "failing" intersections is expected in 2045 due to background growth and development.

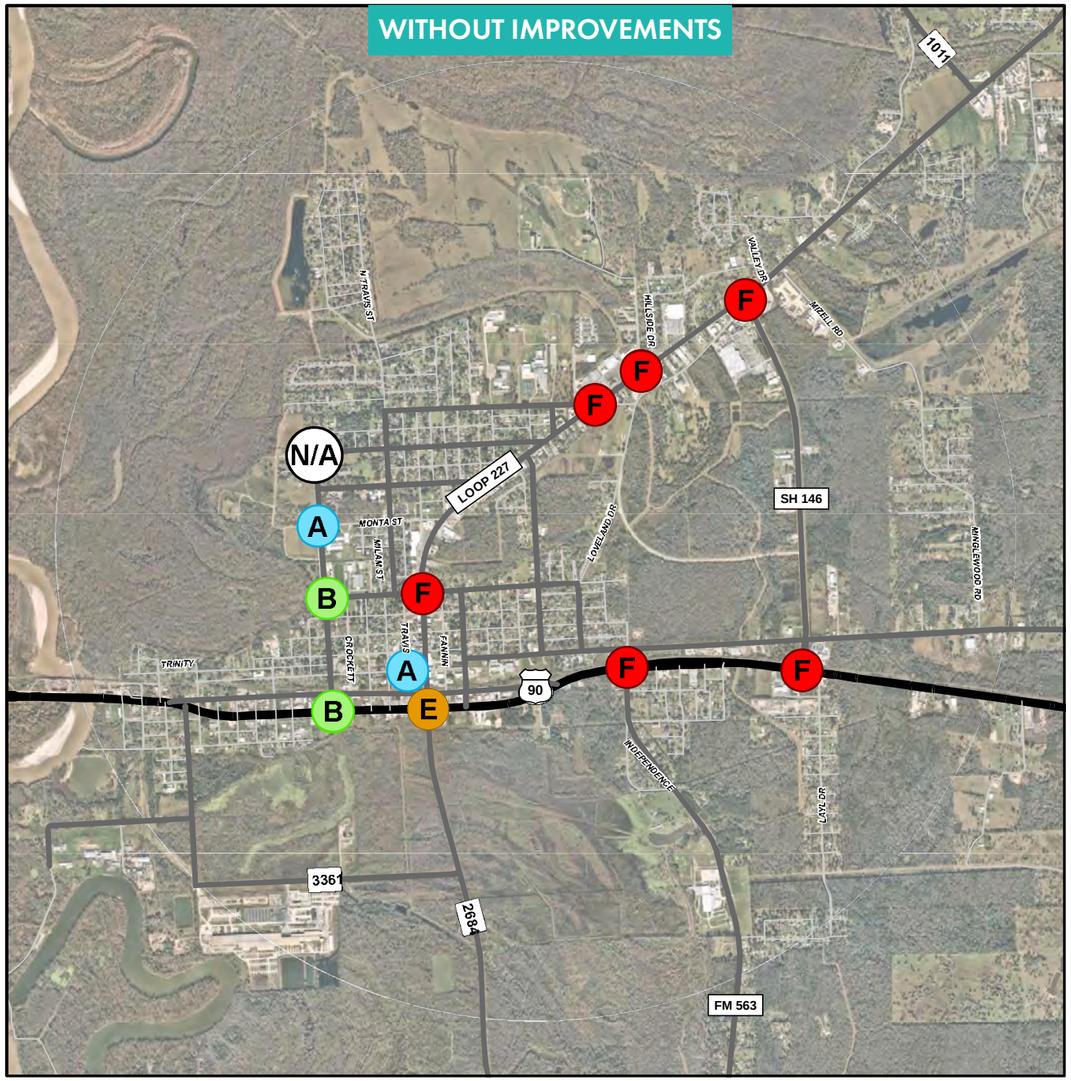
The results of the 2045 Existing analysis scenario helped determine potential improvements to the network that could be applied in the long-term. Long-term improvements are assumed to be constructed or implemented between five and twenty-five years after this study's completion, between years 2026 and 2046.

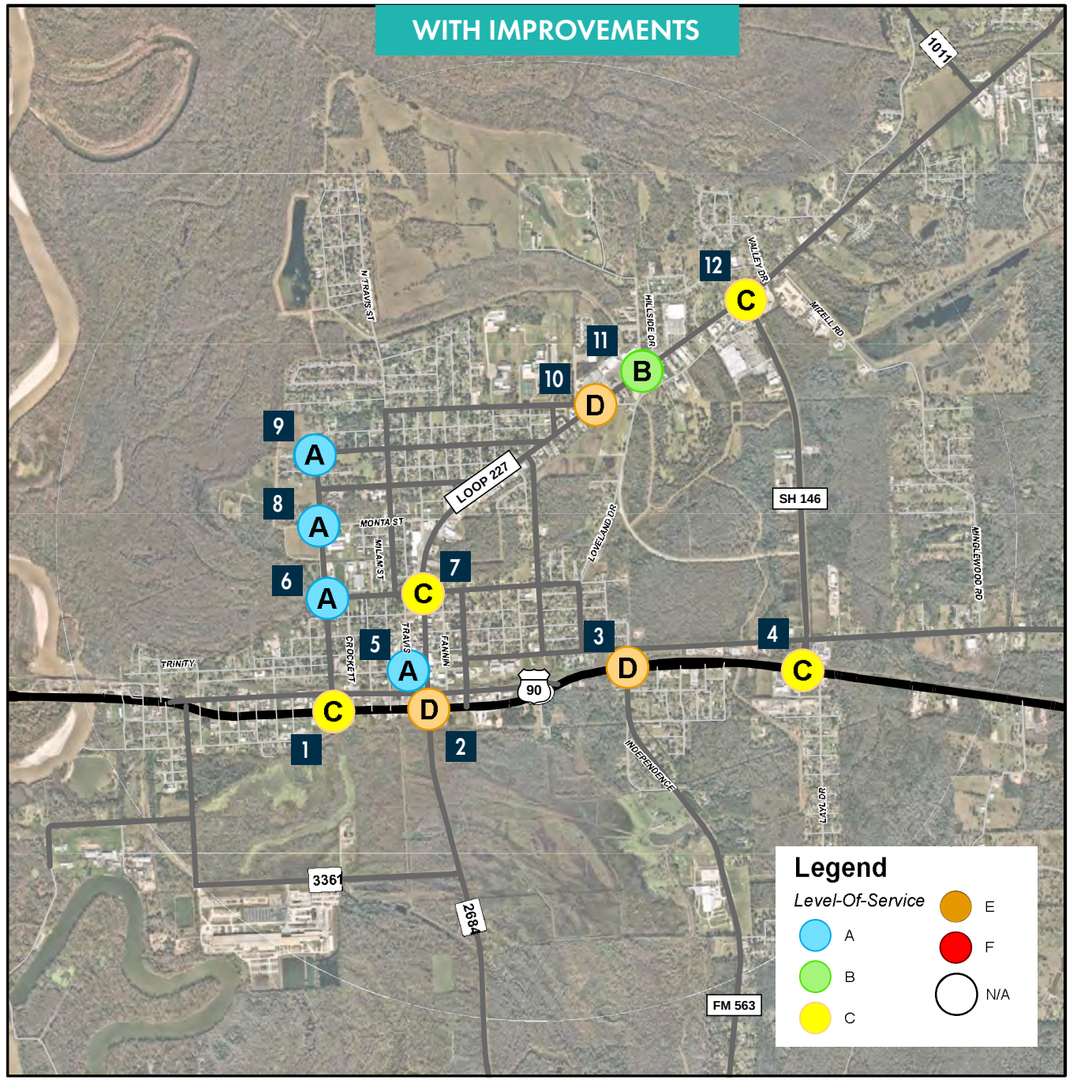
Another Synchro™ model was created to analyze the operation of study intersections with the addition of short-term and long-term improvements to the existing roadway network, also known as the 2045 Improved scenario. Projected 2045 volumes were used. A summary of the analysis results is illustrated in ***Exhibit 7.2.1b*** and the complete analysis results can be found in ***Appendix D***.

Due to the implementation of long-term improvements, the Synchro analysis determined that there would be a 54% decrease in delay at the study intersections between the 2045 Existing and Improved scenarios.

All the improvements recommended at study intersections are discussed in ***Section 7.2.2***.

Exhibit 7.2.1b – Long-Term Analysis Results and Improvements for City of Liberty





1. Install shared use path along one side of US 90; install curb ramps, crosswalks, and pedestrian signals; Permitted+Protected Left-Turn (eastbound, westbound)
2. Install shared use path along one side of US 90; install curb ramps, crosswalks, and pedestrian signals
3. Install shared use path along one side of US 90; install curb ramps, crosswalks, and pedestrian signals; install exclusive right-turn lanes (northbound and southbound); Install exclusive left-turn lane (southbound)
4. Optimize cycle length and phase splits; install shared use path along one side of US 90; install curb ramps, crosswalks, and pedestrian signals
5. Realign intersection per Courthouse streetscape
6. None; Install exclusive right-turn lane (northbound); Install exclusive left-turn lane (southbound)
7. Change exclusive right-turn lane to a through-right turn lane (southbound)
8. Providing safe walking routes to schools in the area may reduce traffic here in the morning; install exclusive right-turn lane (northbound); install exclusive left-turn lanes (southbound and westbound)
9. None
10. Install sidewalks along both sides of Main Street; install curb ramps, crosswalks, and pedestrian signals; install exclusive through lanes (westbound and southbound)
11. Realign driveway with Cook Road to make a 4-legged intersection; install sidewalks both sides of Main Street; install exclusive through lanes (northbound and southbound)
12. Realign driveway (southbound approach) to make a 4-legged intersection; install sidewalks both sides of Main Street and SH 146; install exclusive through lanes (northbound)

LONG-TERM CORRIDOR ANALYSIS

Each study corridor was analyzed to better understand current operations before recommendations could be developed. Volume-to-capacity ratio (V/C) was the metric used to analyze and evaluate operations under both "existing" and "improved" conditions. Refer to ***Section 3.1.4*** for an expanded explanation of how V/C was determined for each corridor.

In the City of Liberty, because volume increases across all corridors between 2021 and 2045, V/C also increases and approaches capacity, as illustrated by V/C on ***Exhibit 7.2.1c***.

Table Q - Long-Term Corridor Analysis

Corridor Name (ID)	2021 ADT/ Lane	2021 "Existing" V/C	2045 ADT/ Lane	2045 "Existing" V/C
Martin Luther King Jr Drive (M-1)	659	0.04	1,060	0.07
Main Street/State Loop 227 (N-1)	3,186	0.22	5,124	0.36
Main Street/State Loop 227 (N-2)	4,780	0.33	7,688	0.53
Texas Street (O-1)	503	0.03	809	0.06
Beaumont Avenue (P-1)	725	0.05	1,166	0.08
Jefferson Drive (Q-1)	1,203	0.08	1,935	0.13
Woodspring Road/Lakeland Drive (R-1)	886	0.06	1,425	0.1
SH 146 (S-1)	5,681	0.46	9,138	0.73
SH 146 (S-2)	1,757	0.12	2,826	0.2
SH 146 (S-3)	4,393	0.29	7,066	0.47
SH 146 (S-4)	2,196	0.07	3,532	0.12
SH 146/US 90 (S-5)	7,849	0.55	12,625	0.88
SH 146/US 90 (S-6)	3,925	0.27	6,313	0.44
SH 146/US 90 (S-8)	5,044	0.35	8,113	0.56

Where through lanes are recommended in the long-term (2045), capacity will increase. However, expected volumes along SH 146/US 90 would still be above capacity. Further mitigations – possibly constructing additional or improving existing corridors – may be necessary to reduce volumes.

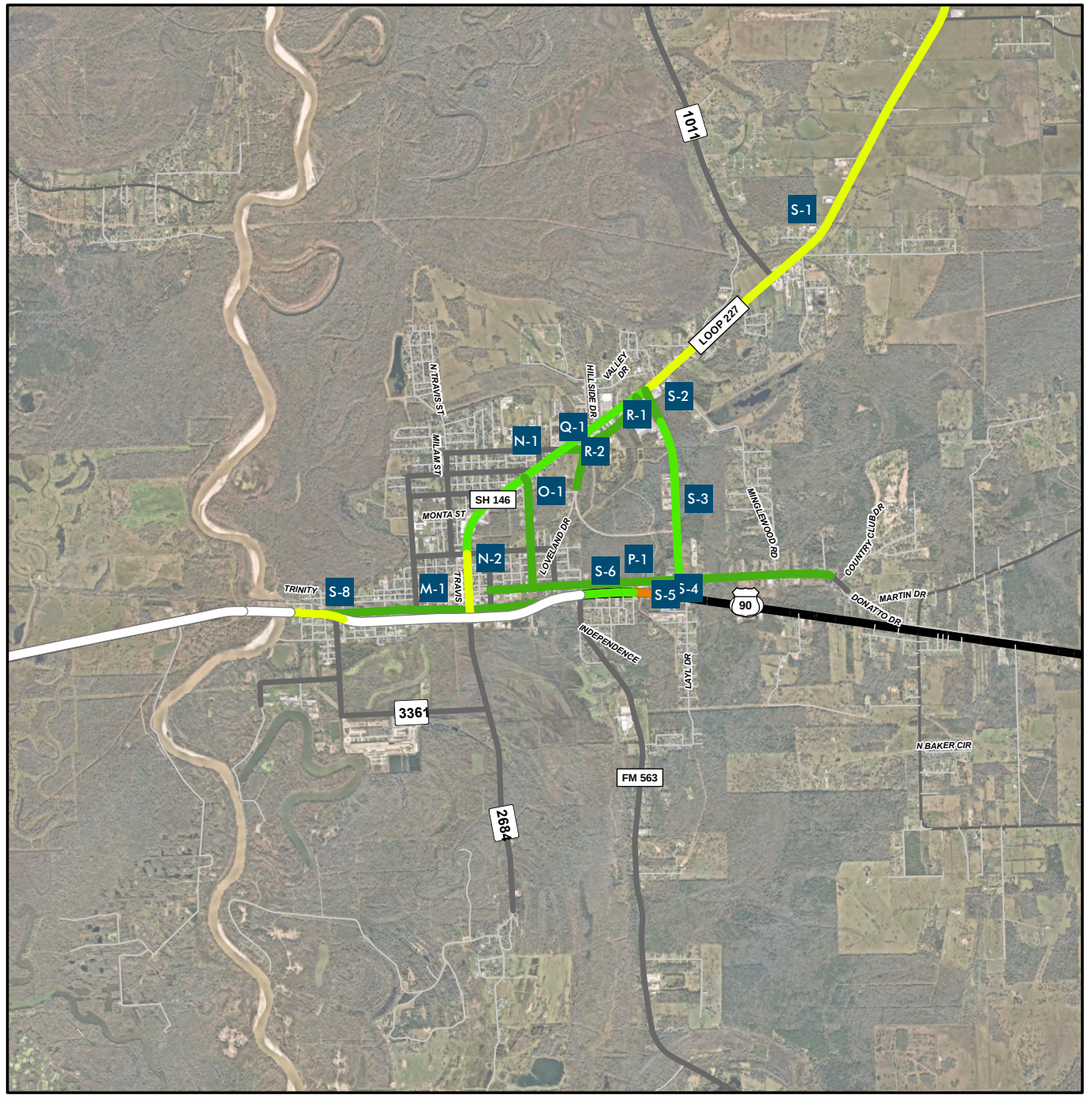
Further, stakeholders describe the Main Street (SL 227) corridor as dangerous and out of control due to excessive access points – driveways, cross-streets, etc. Drivers enter and exit the corridor in an uncontrolled fashion, making driving, walking, and biking unsafe. Increasing capacity along this corridor should be balanced with safety improvements and improvements to active modes facilities.

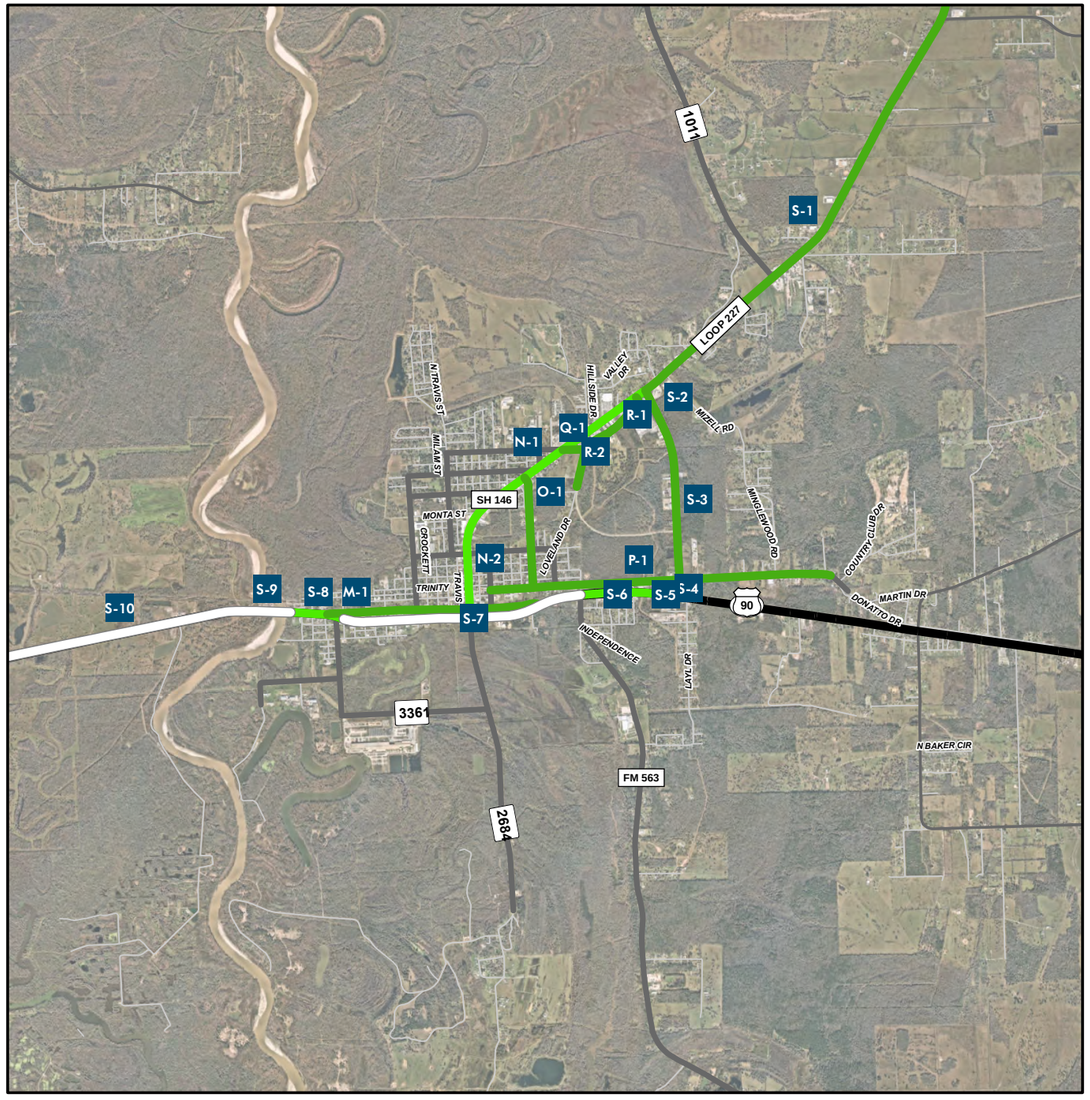
Table R - Long-Term Corridor Analysis Capacity Comparison

Corridor Name (ID)	2045 "Existing"		2045 "Improved"		% Change in Capacity
	ADT/ Lane	V/C	ADT/ Lane	V/C	
Martin Luther King Jr Drive (M-1)	1,060	0.07	1,060	0.07	-
Main Street/State Loop 227 (N-1)	5,124	0.36	3844	0.27	25%
Main Street/State Loop 227 (N-2)	7,688	0.53	3844	0.27	50%
Texas Street (O-1)	809	0.06	809	0.06	-
Beaumont Avenue (P-1)	1,166	0.08	583	0.04	49%
Jefferson Drive (Q-1)	1,935	0.13	967	0.07	49%
Woodspring Road/Lakeland Drive (R-1)	1,425	0.1	1,425	0.1	-
SH 146 (S-1)	9,138	0.73	3046	0.21	71%
SH 146 (S-2)	2,826	0.2	2355	0.16	17%
SH 146 (S-3)	7,066	0.47	2355	0.16	65%
SH 146 (S-4)	3,532	0.12	2355	0.16	37%
SH 146/US 90 (S-5)	12,625	0.88	4208	0.29	67%
SH 146/US 90 (S-6)	6,313	0.44	6,313	0.44	-
SH 146/US 90 (S-8)	8,113	0.56	5408	0.38	33%

See V/C illustrated in the City of Liberty in ***Exhibit 7.2.1c.***

Exhibit 7.2.1c – Long-Term Corridor Analysis Results and Improvements for City of Liberty





M-1 Refine access management

N-1 Widen to minimum 5-lane cross-section with 14-foot center two-way left-turn lane; refine access management

N-2 Widen to minimum 4-lane divided cross-section with center raised median and turn bays where appropriate

O-1 None

P-1 Widen to 4-lane undivided cross-section

Q-1 Widen to 4-lane undivided cross-section

S-1 Widen to minimum 6-lane divided cross-section

S-2 Widen to minimum 7-lane cross-section with 14-foot center two-way left-turn lane

S-3 Widen to minimum 6-lane divided cross-section

S-4 Widen to minimum 6-lane divided cross-section

S-5 Widen to minimum 6-lane divided cross-section

S-8 Widen to minimum 7-lane cross-section with 14-foot center two-way left-turn lane

S-9 Widen to minimum 6-lane divided cross-section

S-10 Widen to minimum 7-lane cross-section with 14-foot center two-way left-turn lane

Legend

Volume-to-Capacity Ratio

- N/A
- 0.00-0.25
- 0.25-0.50
- 0.50-0.75
- 0.75-1.00
- >1.00

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7.2.2 RECOMMENDATION MATRIX

Recommended improvements across all study locations in Liberty – intersections and corridors – have been summarized in a Recommendation Matrix and Summary Sheets for easy review. Both documents can be found in ***Appendix E***.

Information provided in the Recommendation Matrix includes the total construction cost and expected monetary benefits of each recommended improvement, the score pertaining to each of the project's goals, and a brief description of each of the recommended improvements at the study location. See ***Section 8.2*** for a full explanation of how costs and benefits were determined and how recommendations were evaluated per the project goals.

Additionally, ***Table S*** outlines the number of occurrences of each recommended improvement in the City of Liberty.

Table S – Recommendations in Liberty

Recommended Improvement	Occurrences
Install pedestrian elements	28
Install shared use path	23
Install sidewalk	7
Install left-turn lane	5
Install right-turn lane	5
Install through lane / widen road	19
Install / improve pavement markings	9
Realign intersection	3
Install / improve pavement	3
Construct roadway extension	1
Refine access management	3
Optimize/coordinate signal	8
Change left-turn phasing	5
Add right-turn overlap	1
Install Flashing Yellow Arrow signal	2
Install stop signs	2

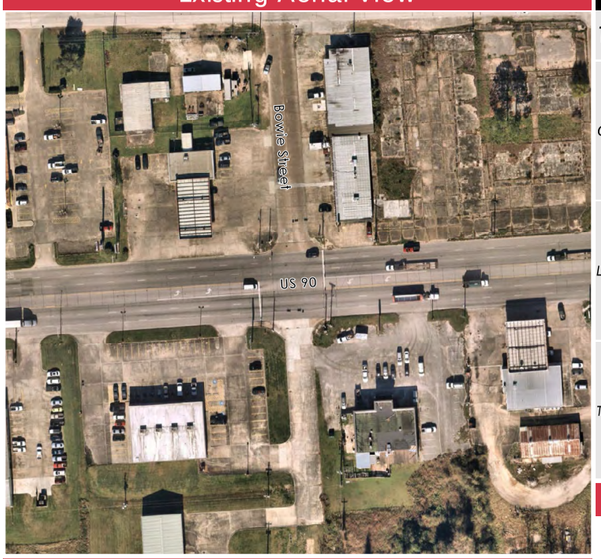
All information which led to the development of recommended improvements for each study intersection and corridor, including its location within the study area, crash data, and capacity analysis results is organized in Summary Sheets. This provides a more visual snapshot of the study location as it is now and as it could be with the implementation of the recommendations. The Summary Sheets for study locations in the City of Liberty are below and Summary Sheets for all study locations are included in ***Appendix E***.

Liberty County Mobility Study, Intersection Summary Sheets

Bowie Street & US 90

Intersection ID: Liberty - 1

Existing Aerial View



Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Optimize cycle length and phase splits - Coordinate signals along US 90	- Install shared use path along one side of US 90 - Install curb ramps, crosswalks, and pedestrian signals
Lane Configuration		
Turn Types		- Permitted+Protected (Left-Turn) - eastbound, westbound

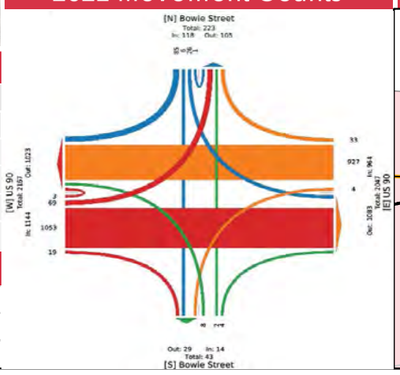
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	24.8	C	17.6	B
	2045	108.8	F	10.2	B
PM Peak	2021	11.4	A	12.1	B
	2045	23	B	13.3	C

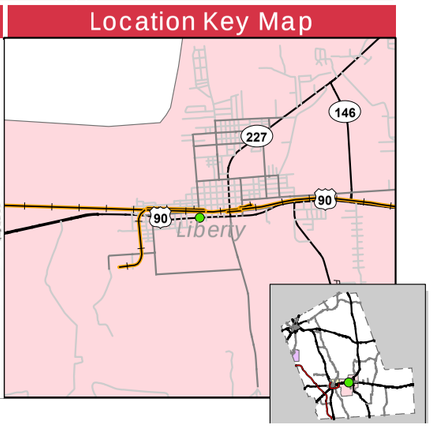
Crash Data (2016-2020)

Total	Fatal	Serious Injury
34	1	0

2021 Movement Counts



Location Key Map



Liberty County Mobility Study, Intersection Summary Sheets

Main Street (SL 227) & US 90

Intersection ID: Liberty - 2

Existing Aerial View

Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Coordinate signals along US 90	- Install shared use path along one side of US 90 - Install curb ramps, crosswalks, and pedestrian signals
Lane Configuration	- Install exclusive left-turn lane - southbound	
Turn Types	- Permitted+Protected (Left-Turn) - all approaches - Permissive+Overlap (right-turn) - southbound	

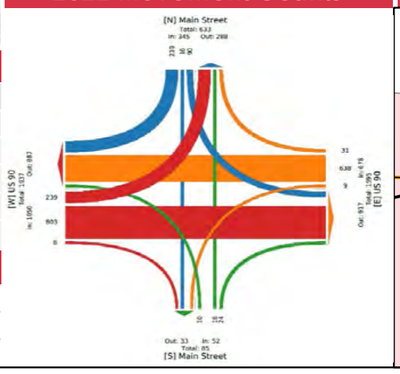
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	25.4	C	16.9	B
	2045	47.4	D	26.1	C
PM Peak	2021	31.5	C	20.6	C
	2045	79	E	38	D

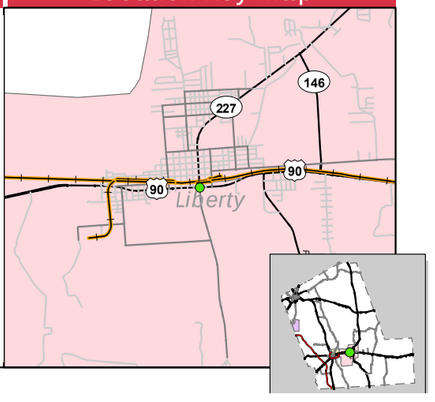
Crash Data (2016-2020)

Total	Fatal	Serious Injury
51	0	1

2021 Movement Counts



Location Key Map

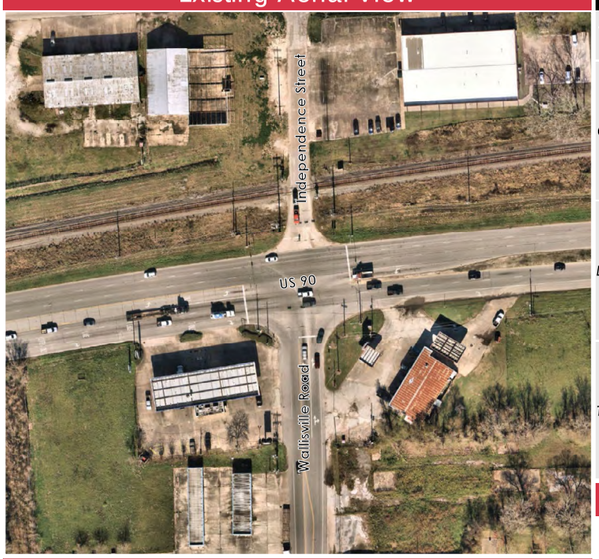


Liberty County Mobility Study, Intersection Summary Sheets

Independence Street & US 90

Intersection ID: Liberty - 3

Existing Aerial View



Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Optimize cycle length and phase splits - Coordinate signals along US 90	- Install shared use path along one side of US 90 - Install curb ramps, crosswalks, and pedestrian signals
Lane Configuration		- Install exclusive right-turn lanes - northbound and southbound - Install exclusive left-turn lane - southbound
Turn Types	- Permitted+Protected (Left-Turn) - eastbound, westbound	

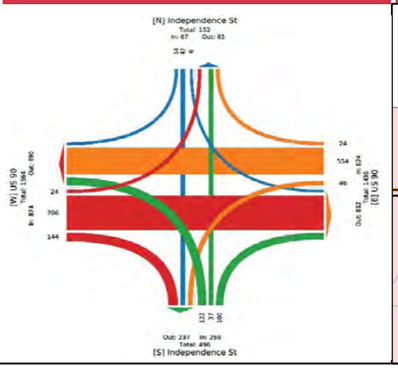
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	34.6	C	23.5	C
	2045	57.1	E	28.8	C
PM Peak	2021	60.8	E	34	C
	2045	174.5	F	40.8	D

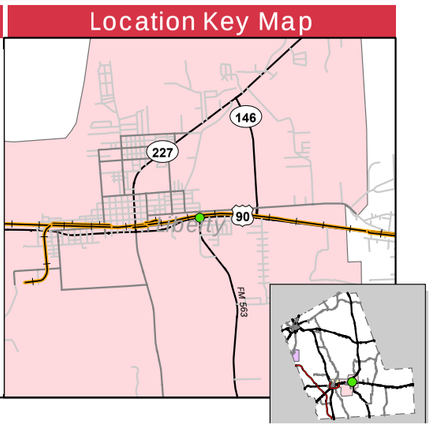
Crash Data (2016-2020)

Total	Fatal	Serious Injury
47	0	3

2021 Movement Counts



Location Key Map



Liberty County Mobility Study, Intersection Summary Sheets

US 90 & SH 146

Intersection ID: Liberty - 4

Existing Aerial View

Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Coordinate signals along US 90	- Optimize cycle length and phase splits - Install shared use path along one side of US 90; install curb ramps, crosswalks, and pedestrian signals
Lane Configuration		
Turn Types	- Permitted+Protected (Left-Turn) - eastbound	

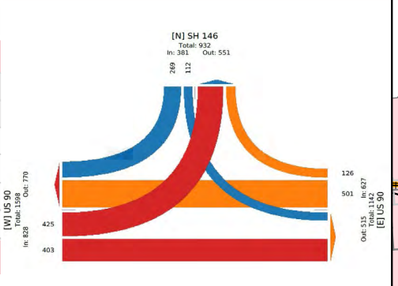
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	17.5	B	16.4	B
	2045	29.9	C	12.2	B
PM Peak	2021	26.2	C	11.7	B
	2045	115.4	F	26.6	C

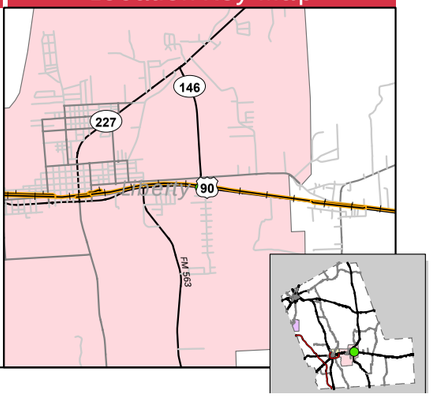
Crash Data (2016-2020)

Total	Fatal	Serious Injury
133	0	8

2021 Movement Counts



Location Key Map



Liberty County Mobility Study, Intersection Summary Sheets

Travis Street & Sam Houston Street

Intersection ID: Liberty - 5

Existing Aerial View

Recommended Improvements

Timeline	*Short-Term*	*Long-Term*
Overall Intersection	None	- Realign intersection per Courthouse streetscape design
Lane Configuration		
Turn Types		

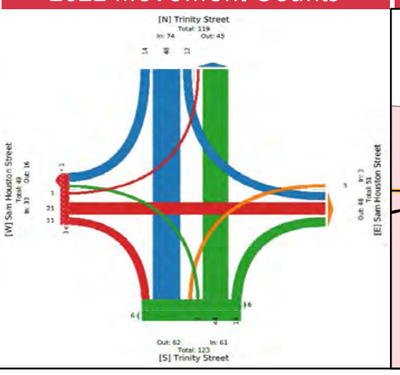
Traffic Model Results

Peak Hour	Study Year	*Existing Conditions*		*With Recommendations*	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	7.7	A	0.77	A
	2045	8.6	A	8.6	A
PM Peak	2021	7.8	A	1.59	A
	2045	8.8	A	8.8	A

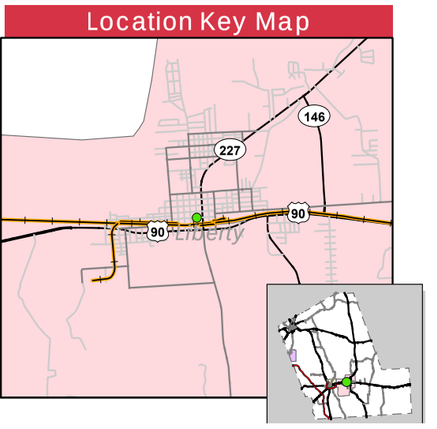
Crash Data (2016-2020)

Total	*Fatal*	*Serious Injury*
2	0	0

2021 Movement Counts



Location Key Map



Liberty County Mobility Study, Intersection Summary Sheets

Bowie Street & Grand Avenue

Intersection ID: Liberty - 6

Existing Aerial View

Recommended Improvements

Timeline	*Short-Term*	*Long-Term*
Overall Intersection	- Install stop signs at all 3 approaches - Refresh striping and install high visibility marked crosswalks	None
Lane Configuration	- Install exclusive left-turn lane - westbound	- Install exclusive right-turn lane - northbound - Install exclusive left-turn lane - southbound
Turn Types		

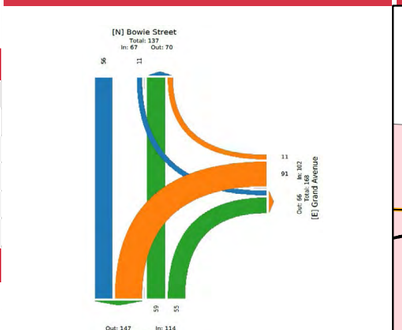
Traffic Model Results

Peak Hour	Study Year	*Existing Conditions*		*With Recommendations*	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	17.3	C	10.4	A
	2045	291.3	F	12.5	B
PM Peak	2021	10.1	B	8.4	A
	2045	14.1	B	12	A

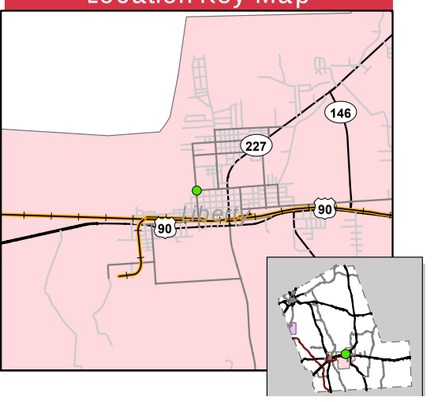
Crash Data (2016-2020)

Total	*Fatal*	*Serious Injury*
3	0	0

2021 Movement Counts



Location Key Map



Liberty County Mobility Study, Intersection Summary Sheets

Main Street (SL 227) & Grand Avenue

Intersection ID: Liberty - 7

Existing Aerial View

Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Optimize cycle length and phase splits - Install high visibility marked crosswalks, curb ramps, and pedestrian signal	
Lane Configuration		- Change exclusive right-turn lane to a through-right turn lane - southbound
Turn Types	- Flashing Yellow Arrow (Left-Turn) - all approaches	

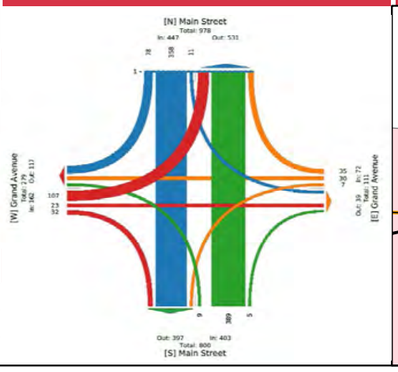
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	218.6	F	25.2	C
	2045	549.9	F	29.3	C
PM Peak	2021	24.9	C	16.2	B
	2045	78.2	F	29.2	C

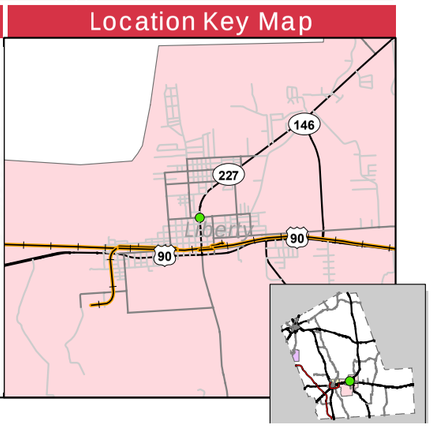
Crash Data (2016-2020)

Total	Fatal	Serious Injury
15	0	2

2021 Movement Counts



Location Key Map



Liberty County Mobility Study, Intersection Summary Sheets

Bowie Street & Monta Street

Intersection ID: Liberty - 8

Existing Aerial View

Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	None	- Providing safe walking routes to schools in the area may reduce traffic here in the morning
Lane Configuration		- Install exclusive right-turn lane - northbound - Install exclusive left-turn lanes - southbound and westbound
Turn Types		

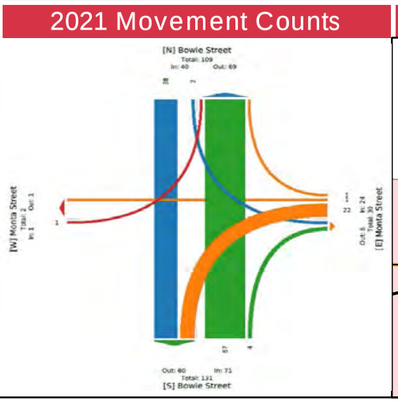
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	15.1	A	15.1	A
	2045	283	F	87.2	F
PM Peak	2021	1.9	A	1.9	A
	2045	2.1	A	2.1	A

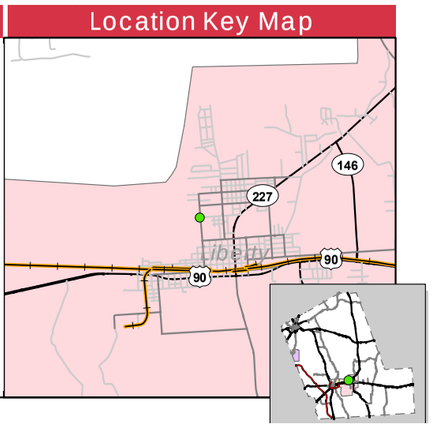
Crash Data (2016-2020)

Total	Fatal	Serious Injury
1	0	0

2021 Movement Counts



Location Key Map

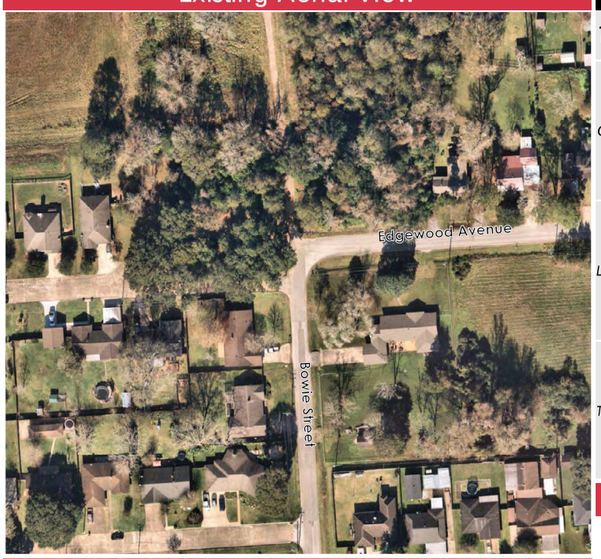


Liberty County Mobility Study, Intersection Summary Sheets

Bowie Street & Edgewood Street

Intersection ID: Liberty - 9

Existing Aerial View



Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Install stop signs at all approaches - Refresh and install striping	None
Lane Configuration		
Turn Types		

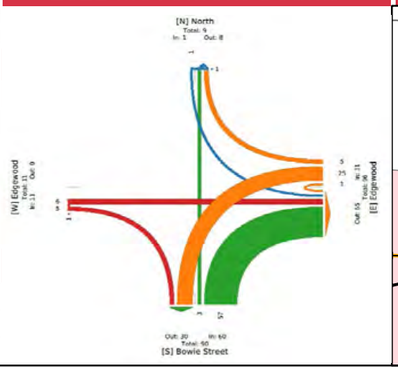
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	0	N/A	7.7	A
	2045	0	N/A	8.6	A
PM Peak	2021	0	N/A	7	A
	2045	0	N/A	7.3	A

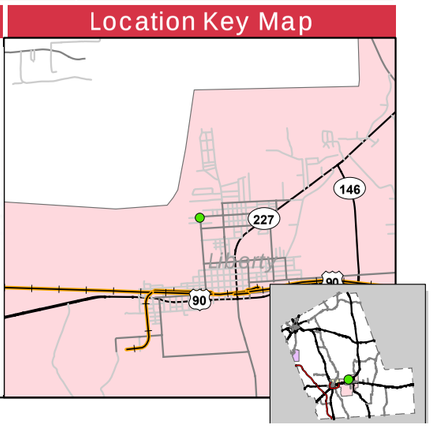
Crash Data (2016-2020)

Total	Fatal	Serious Injury
0	0	0

2021 Movement Counts



Location Key Map



Liberty County Mobility Study, Intersection Summary Sheets

Main Street (SL 227) & Jefferson Drive

Intersection ID: Liberty - 10

Existing Aerial View

Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Optimize cycle length and phase splits - Install high visibility marked crosswalks	- Install sidewalks along both sides of Main Street - Install curb ramps, crosswalks, and pedestrian signals
Lane Configuration	- Install left-turn lanes - eastbound and westbound - Install through lane - northbound	- Install exclusive through lanes - westbound and southbound approaches
Turn Types	- Flashing Yellow Arrow (Left-Turn) - all approaches	

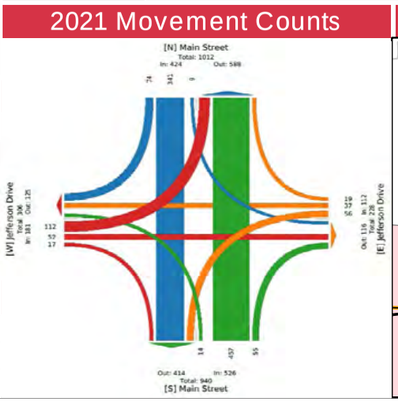
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	497.1	F	54.6	D
	2045	1014	F	52.4	D
PM Peak	2021	374.1	F	27.3	C
	2045	883.1	F	39.9	D

Crash Data (2016-2020)

Total	Fatal	Serious Injury
20	0	1

2021 Movement Counts



Location Key Map

Liberty County Mobility Study, Intersection Summary Sheets

Main Street (SL 227) & Cook Road

Intersection ID: Liberty - 11

Existing Aerial View

Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Optimize cycle length and phase splits	- Realign driveway with Cook Road to make a 4-legged intersection - Install sidewalks both sides of Main Street
Lane Configuration	- Install exclusive right-turn lane - southbound	- Install exclusive through lanes - northbound and southbound
Turn Types		

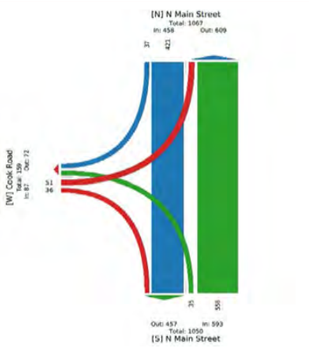
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	48	E	20.8	C
	2045	265.3	F	19.7	B
PM Peak	2021	18.4	C	12.3	B
	2045	251.9	F	13.3	B

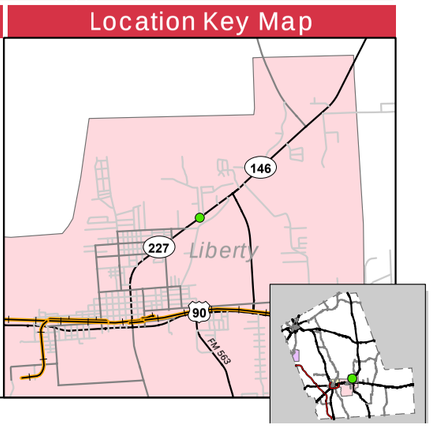
Crash Data (2016-2020)

Total	Fatal	Serious Injury
13	0	2

2021 Movement Counts



Location Key Map



Liberty County Mobility Study, Intersection Summary Sheets

Main Street (SL 227) & SH 146

Intersection ID: Liberty - 12

Existing Aerial View

Recommended Improvements

Timeline	Short-Term	Long-Term
Overall Intersection	- Optimize cycle length and phase splits	- Realign driveway (southbound approach) to make a 4-legged intersection - Install sidewalks both sides of Main Street and SH 146
Lane Configuration		- Install exclusive through lanes - northbound
Turn Types	- Permitted+Protected (Left-Turn) - southbound	

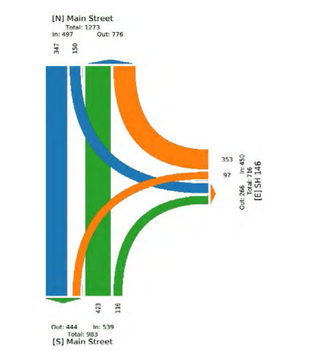
Traffic Model Results

Peak Hour	Study Year	Existing Conditions		With Recommendations	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
AM Peak	2021	37.4	E	16.3	B
	2045	175.05	F	21.3	C
PM Peak	2021	41.84	E	18	B
	2045	132.6	F	24.3	C

Crash Data (2016-2020)

Total	Fatal	Serious Injury
25	1	1

2021 Movement Counts



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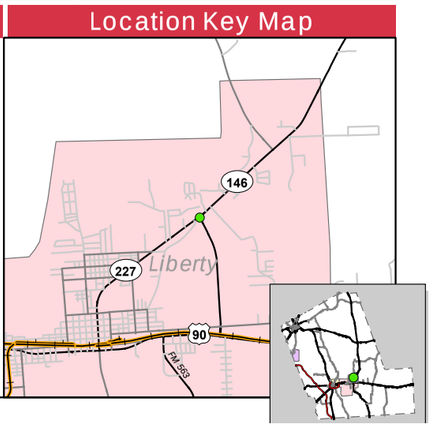
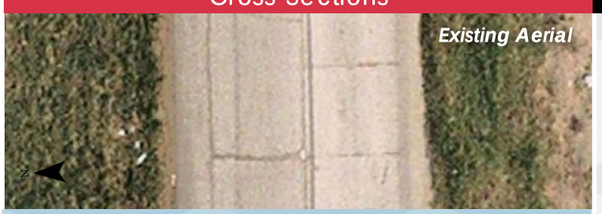


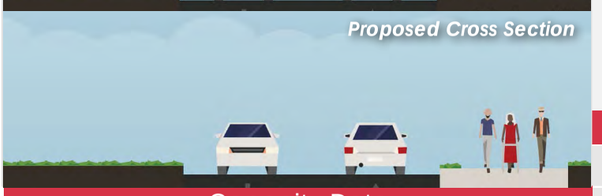
Liberty County Mobility Study, Corridor Summary Sheets

Martin Luther King Jr Drive

from US 90 to US 90
Corridor-Segment ID: M-1

Cross-Sections





Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	1760	0.14
2045	2831	0.22

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
41	0	1	1	1

Recommended Improvements

General

Proposed Classification: Minor Arterial

Short-Term

- Install pedestrian elements (marked crosswalks, countdown signals where applicable, curb ramps, etc) at intersections
- Upgrade pavement markings

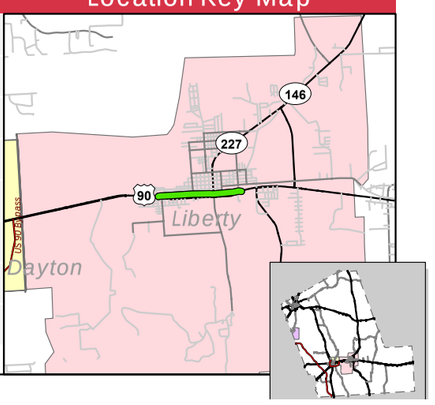
Long-Term

- Refine access management
- Install 6-foot sidewalk along at least one side of the corridor
- Install bikeway (shared use path or bike lanes) between US 90/SH 146 and Louisiana Street

Segment Characteristics

Segment Length (mi)	1.51
Posted Speed (mph)	30
ROW Width (ft)	50
Roadway Width (ft)	24
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map



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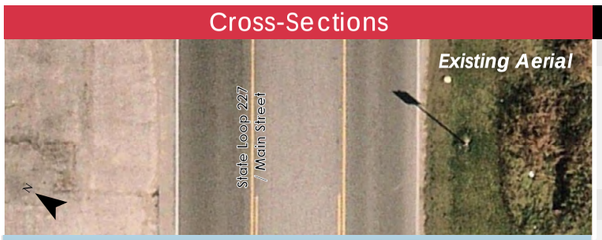
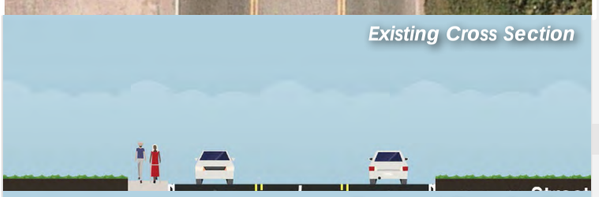
Liberty County Mobility Study, Corridor Summary Sheets

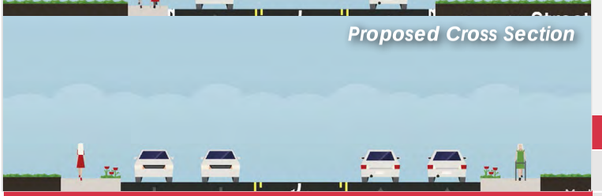
Main Street/State Loop 227

from SH 146 to Grand Avenue
Corridor-Segment ID: N-1

Cross-Sections







Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	12316	0.68
2045	19810	1.1

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
120	1	3	0	2

Recommended Improvements

General

Proposed Classification: Principal Arterial (4-6 lanes, Divided)

Short-Term

- Install pedestrian elements (marked crosswalks, countdown signals where applicable, curb ramps, etc) at intersections
- Upgrade pavement

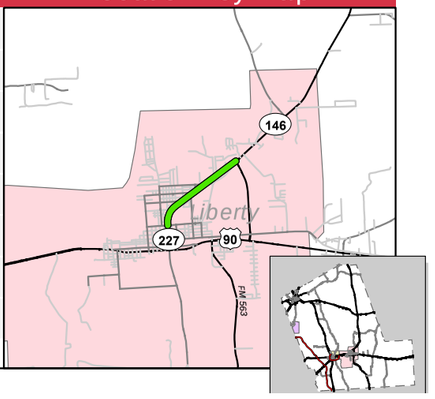
Long-Term

- Widen to minimum 5-lane cross-section with 14-foot center two-way left-turn lane
- Install 6-foot sidewalk along both sides of the corridor
'- Refine access management; further study required

Segment Characteristics

Segment Length (mi)	1.76
Posted Speed (mph)	45
ROW Width (ft)	60
Roadway Width (ft)	42
Number of Lanes	3
Center Type	TWLTL
Center Width (ft)	14
Sidewalk Count	None

Location Key Map



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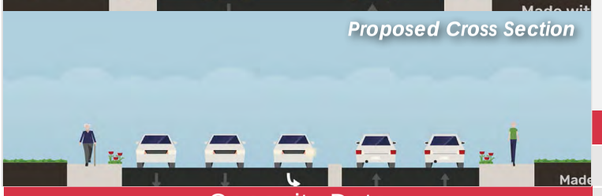
Liberty County Mobility Study, Corridor Summary Sheets

Main Street/State Loop 227

from Grand Avenue to US 90 / SH 146
Corridor-Segment ID: N-2

Cross-Sections



Recommended Improvements

General

Proposed Classification: Principal Arterial (4-6 lanes, Divided)

Short-Term

- Install pedestrian elements (marked crosswalks, countdown signals where applicable, curb ramps, etc) at intersections
- Upgrade pavement

Long-Term

- Widen to minimum 4-lane divided cross-section with center raised median and turn bays where appropriate
- Install 6-foot sidewalk along both sides of the corridor
'- Refine access management; further study required

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	12316	0.82
2045	19810	1.32

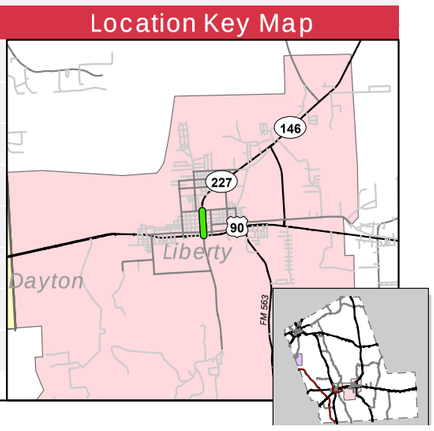
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
41	0	1	0	0

Segment Characteristics

Segment Length (mi)	0.45
Posted Speed (mph)	30
ROW Width (ft)	100
Roadway Width (ft)	36
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	Both Sides

Location Key Map



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Liberty County Mobility Study, Corridor Summary Sheets

Texas Street

from Main Street/State Loop 227 to Beaumont Avenue
Corridor-Segment ID: O-1

Cross-Sections

Recommended Improvements

General

Proposed Classification: Principal Arterial (4 lanes, Undivided)

Short-Term

- Install pedestrian elements (marked crosswalks, countdown signals where applicable, curb ramps, etc) at intersections
- Upgrade pavement
- Upgrade pavement markings

Long-Term

- Extend southward past existing terminus at Beaumont Avenue to connect to US 90 in updated countywide Thoroughfare Plan
- Install 10-foot shared use path or extend existing sidewalk along at least one side of the corridor

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	1553	0.1
2045	2498	0.17

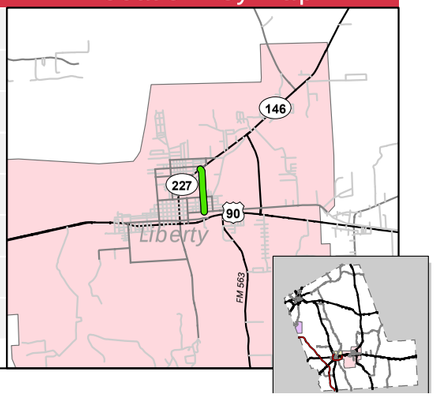
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
N/A	N/A	N/A	N/A	N/A

Segment Characteristics

Segment Length (mi)	0.78
Posted Speed (mph)	30
ROW Width (ft)	60
Roadway Width (ft)	24
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	One Side

Location Key Map



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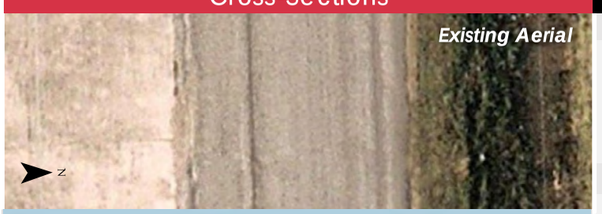
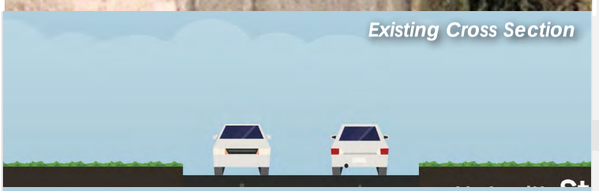
Liberty County Mobility Study, Corridor Summary Sheets

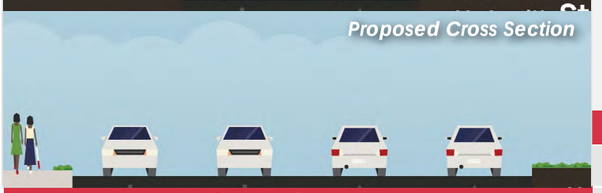
Beaumont Avenue

from San Jacinto Street to Eastern City Limits
Corridor-Segment ID: P-1

Cross-Sections







Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	5376	0.49
2045	8647	0.79

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
35	0	1	0	0

Recommended Improvements

General

Proposed Classification: Major Collector (4 lanes, Undivided)

Short-Term

- Install pedestrian elements (marked crosswalks, countdown signals where applicable, curb ramps, etc) at intersections
- Upgrade pavement markings

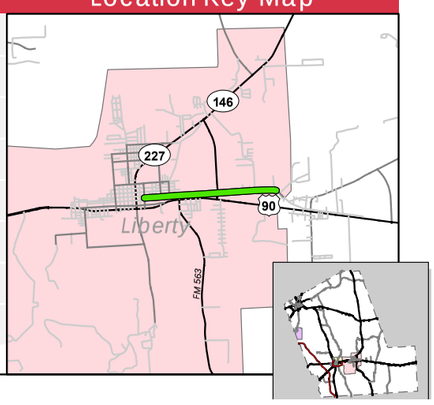
Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of Beaumont Avenue
- Widen to 4-lane undivided cross-section

Segment Characteristics

Segment Length (mi)	2.39
Posted Speed (mph)	30
ROW Width (ft)	60
Roadway Width (ft)	24
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map

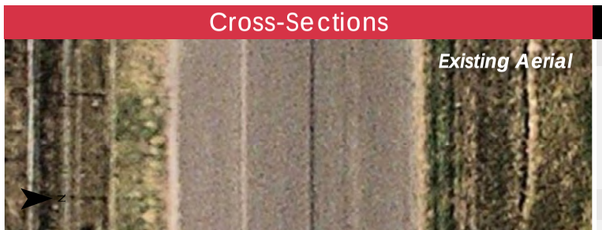


Liberty County Mobility Study, Corridor Summary Sheets

Jefferson Drive

from Main Street/State Loop 227 to Lakeland Drive
Corridor-Segment ID: Q-1

Cross-Sections



Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	4137	0.52
2045	6654	0.83

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
10	0	1	0	0

Recommended Improvements

General

Proposed Classification: Collector (4 lanes, Undivided)

Short-Term

- Install pedestrian elements (marked crosswalks, countdown signals where applicable, curb ramps, etc) at intersections
- Upgrade pavement markings

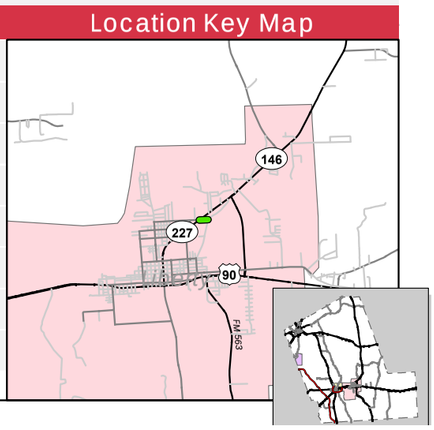
Long-Term

- Install 10-foot shared use path or 6-foot sidewalk along at least one side of the corridor
- Widen to 4-lane undivided cross-section

Segment Characteristics

Segment Length (mi)	0.16
Posted Speed (mph)	30
ROW Width (ft)	60
Roadway Width (ft)	24
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map

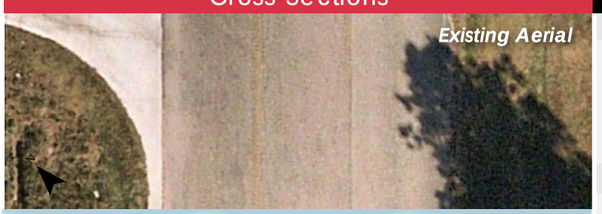


Liberty County Mobility Study, Corridor Summary Sheets

Woodspring Road/Lakeland Drive

from Main Street/State Loop 227 to Wal-Mart Driveway
Corridor-Segment ID: R-1

Cross-Sections



Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	N/A	N/A
2045	N/A	N/A

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
4	0	0	0	0

Recommended Improvements

General

Proposed Classification: Collector

Short-Term

- Install pedestrian elements (marked crosswalks, countdown signals where applicable, curb ramps, etc) at intersections
- Upgrade pavement markings

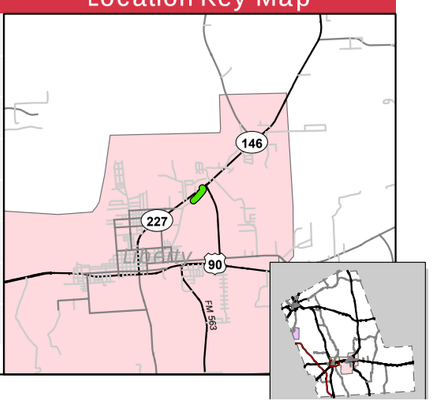
Long-Term

- Install 10-foot shared use path or 6-foot sidewalk along at least one side of the corridor

Segment Characteristics

Segment Length (mi)	0.3
Posted Speed (mph)	30
ROW Width (ft)	60
Roadway Width (ft)	36
Number of Lanes	3
Center Type	TWLTL
Center Width (ft)	14
Sidewalk Count	None

Location Key Map

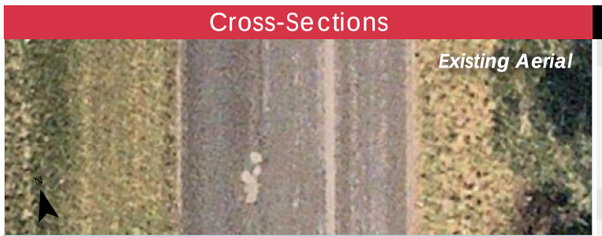


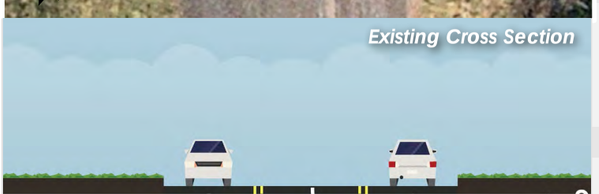
Liberty County Mobility Study, Corridor Summary Sheets

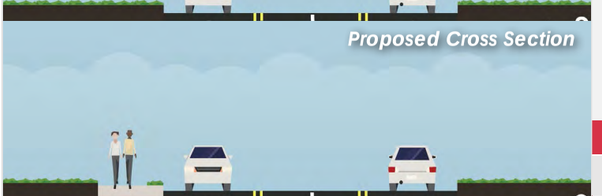
Woodspring Road/Lakeland Drive

from Wal-Mart Driveway to Woodspring Road
Corridor-Segment ID: R-2

Cross-Sections







Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	N/A	N/A
2045	N/A	N/A

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
1	0	0	0	0

Recommended Improvements

General

Proposed Classification: Collector

Short-Term

- Install pedestrian elements (marked crosswalks, countdown signals where applicable, curb ramps, etc) at intersections
- Upgrade pavement markings

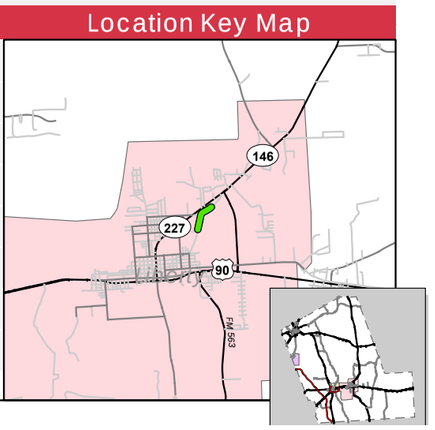
Long-Term

- Install 10-foot shared use path or 6-foot sidewalk along at least one side of the corridor

Segment Characteristics

Segment Length (mi)	0.51
Posted Speed (mph)	30
ROW Width (ft)	60
Roadway Width (ft)	24
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map

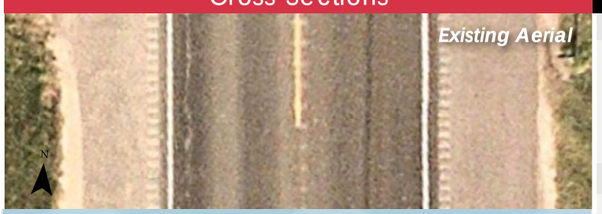


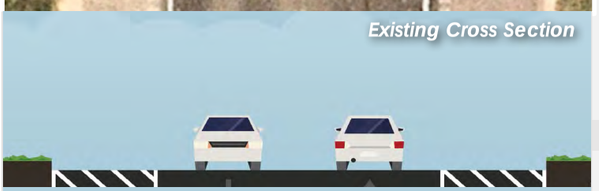
Liberty County Mobility Study, Corridor Summary Sheets

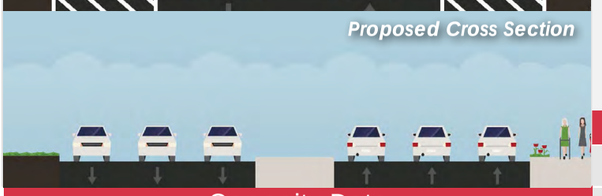
SH 146

from Northern County Limits to Main Street/State Loop 227
Corridor-Segment ID: S-1

Cross-Sections







Recommended Improvements

General

Proposed Classification: Principal Arterial (6 lanes, Divided)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor
- Widen to 6-lane divided cross-section

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	13915	0.77
2045	22381	1.24

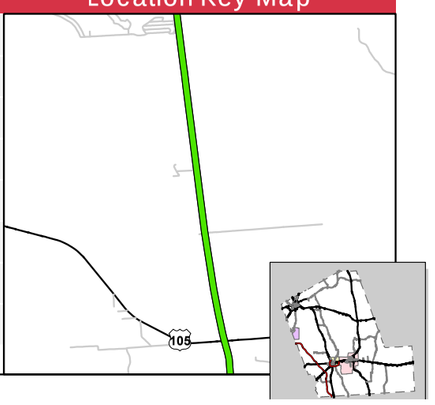
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
261	6	12	1	1

Segment Characteristics

Segment Length (mi)	29.51
Posted Speed (mph)	65
ROW Width (ft)	100
Roadway Width (ft)	45
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map



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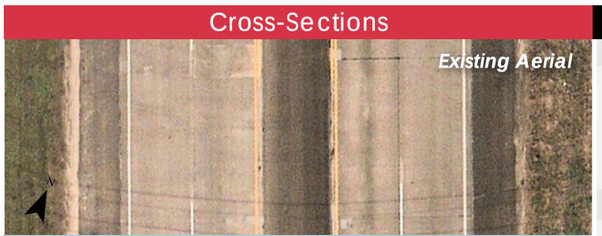
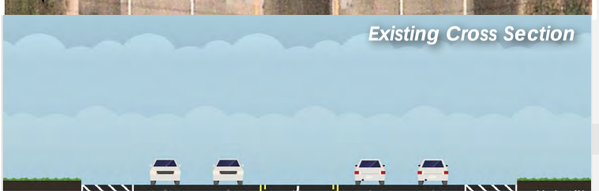
Liberty County Mobility Study, Corridor Summary Sheets

SH 146

from Main Street/State Loop 227 to Wal-Mart Driveway
Corridor-Segment ID: S-2

Cross-Sections





Recommended Improvements

General

Proposed Classification: Principal Arterial (6 lanes + TWLTL)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor
- Widen to 7-lane cross-section with 14-foot center two-way left-turn lane

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	20243	0.56
2045	32560	0.9

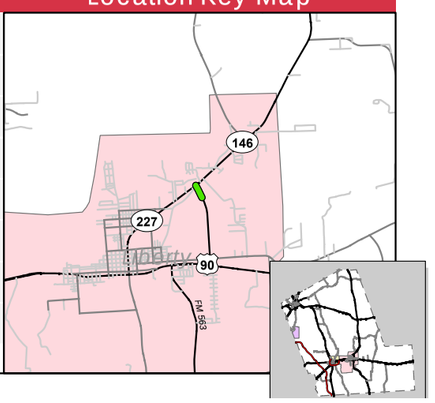
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
5	0	0	0	0

Segment Characteristics

Segment Length (mi)	0.25
Posted Speed (mph)	45
ROW Width (ft)	160
Roadway Width (ft)	88
Number of Lanes	5
Center Type	TWLTL
Center Width (ft)	15
Sidewalk Count	None

Location Key Map



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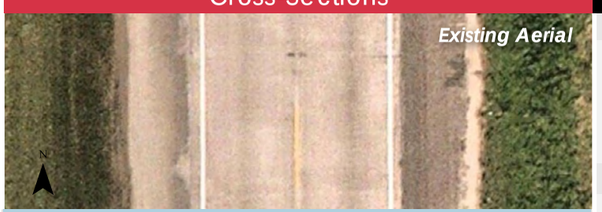
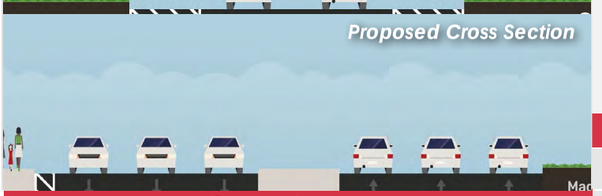
Liberty County Mobility Study, Corridor Summary Sheets

SH 146

from Wal-Mart Driveway to Beaumont Avenue
Corridor-Segment ID: S-3

Cross-Sections





Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	20243	1.12
2045	32560	1.81

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
10	2	0	0	1

Recommended Improvements

General

Proposed Classification: Principal Arterial (6 lanes, Undivided)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

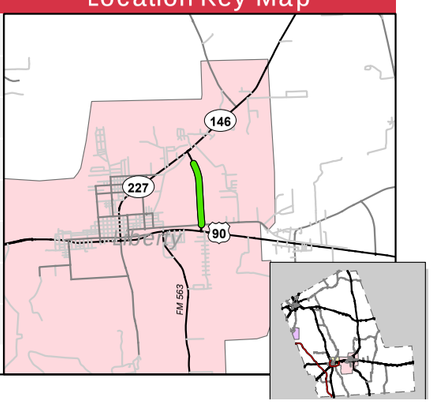
Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor
- Widen to 6-lane divided cross-section

Segment Characteristics

Segment Length (mi)	1.12
Posted Speed (mph)	45
ROW Width (ft)	140
Roadway Width (ft)	45
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map



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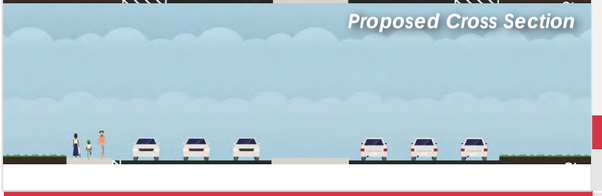
Liberty County Mobility Study, Corridor Summary Sheets

SH 146

from Beaumont Avenue to US 90
Corridor-Segment ID: S-4

Cross-Sections



Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	20243	0.56
2045	32560	0.9

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
48	0	0	0	0

Recommended Improvements

General

Proposed Classification: Principal Arterial (6 lanes, Divided)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

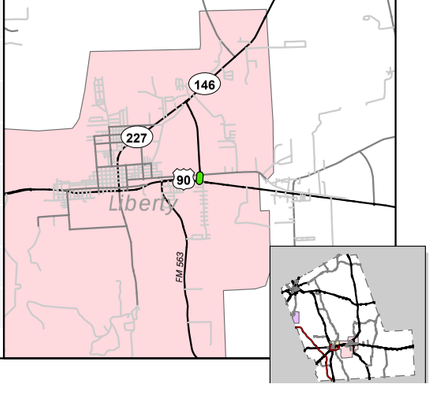
Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor
- Widen to 6-lane divided cross-section

Segment Characteristics

Segment Length (mi)	0.12
Posted Speed (mph)	55
ROW Width (ft)	140
Roadway Width (ft)	100
Number of Lanes	4
Center Type	Divided
Center Width (ft)	17
Sidewalk Count	None

Location Key Map



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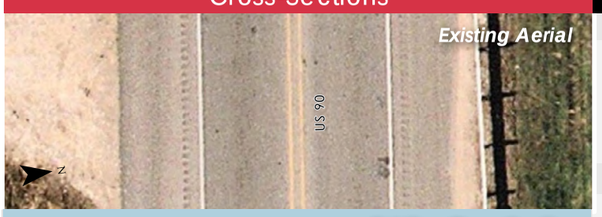
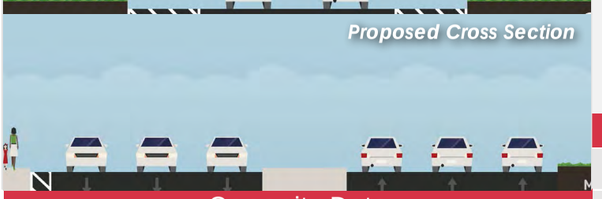
Liberty County Mobility Study, Corridor Summary Sheets

SH 146/US 90

from US 90/SH 146 to East Street
Corridor-Segment ID: S-5

Cross-Sections





Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	48968	2.72
2045	78762	4.38

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
40	0	0	0	0

Recommended Improvements

General

Proposed Classification: Principal Arterial (6 lanes, Divided)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

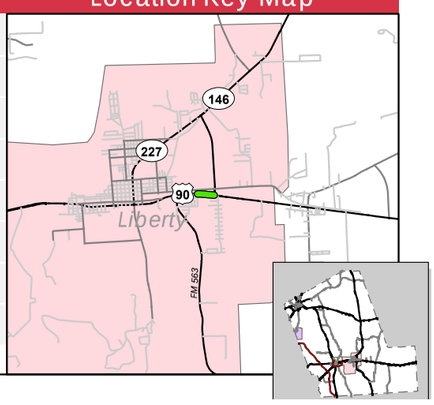
Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor
- Widen to 6-lane divided cross-section

Segment Characteristics

Segment Length (mi)	0.3
Posted Speed (mph)	50
ROW Width (ft)	200
Roadway Width (ft)	48
Number of Lanes	2
Center Type	Undivided
Center Width (ft)	0
Sidewalk Count	None

Location Key Map

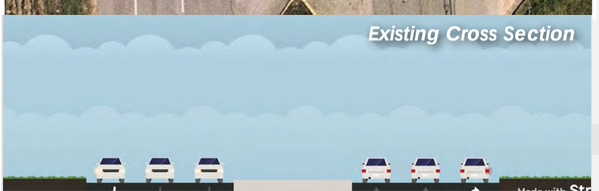


Liberty County Mobility Study, Corridor Summary Sheets

SH 146/US 90

from East Street to Wallisville Road/Independence Street
Corridor-Segment ID: S-6

Cross-Sections



Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	48968	1.36
2045	78762	2.19

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
50	0	0	0	0

Recommended Improvements

General

Proposed Classification: Principal Arterial (6 lanes, Divided)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

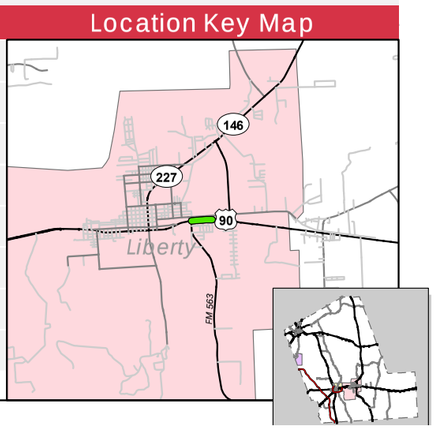
Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor

Segment Characteristics

Segment Length (mi)	0.38
Posted Speed (mph)	45
ROW Width (ft)	203
Roadway Width (ft)	100
Number of Lanes	4
Center Type	Divided
Center Width (ft)	24
Sidewalk Count	None

Location Key Map

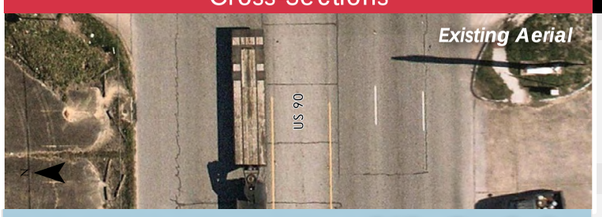


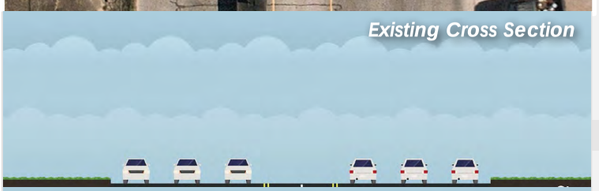
Liberty County Mobility Study, Corridor Summary Sheets

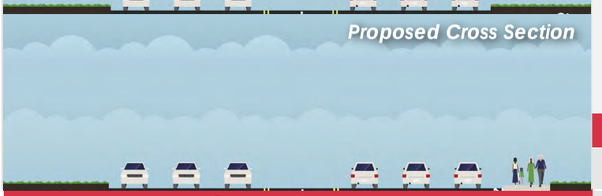
SH 146/US 90

from Wallisville Road/Independence Street to Alabama Street
Corridor-Segment ID: S-7

Cross-Sections







Recommended Improvements

General

Proposed Classification: Principal Arterial (No Cross-Section Change)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	48968	0.91
2045	78762	1.46

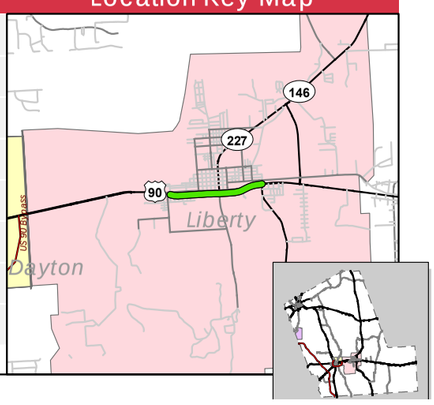
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
139	1	2	0	1

Segment Characteristics

Segment Length (mi)	1.69
Posted Speed (mph)	65
ROW Width (ft)	115
Roadway Width (ft)	85
Number of Lanes	7
Center Type	TWLTL
Center Width (ft)	16
Sidewalk Count	None

Location Key Map

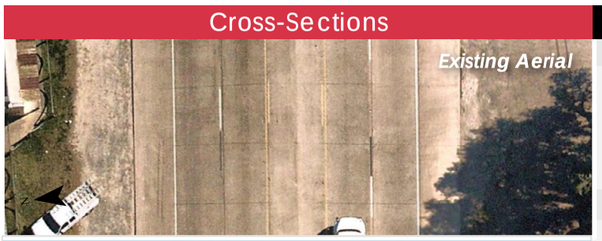


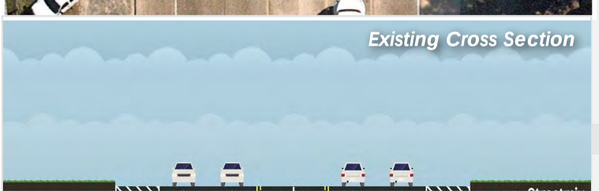
Liberty County Mobility Study, Corridor Summary Sheets

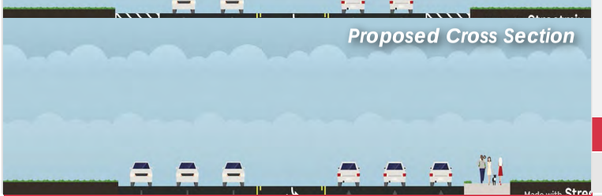
SH 146/US 90

from Alabama Street to East End of Bridge (Trinity River)
Corridor-Segment ID: S-8

Cross-Sections







Recommended Improvements

General

Proposed Classification: Principal Arterial (6 lanes + TWLTL)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor
- Widen to 7-lane cross-section with 14-foot center two-way left-turn lane

Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	48968	1.36
2045	78762	2.19

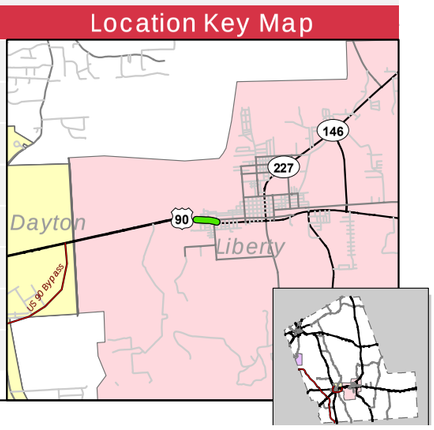
Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
23	0	1	0	0

Segment Characteristics

Segment Length (mi)	0.38
Posted Speed (mph)	65
ROW Width (ft)	150
Roadway Width (ft)	87
Number of Lanes	5
Center Type	TWLTL
Center Width (ft)	18
Sidewalk Count	None

Location Key Map



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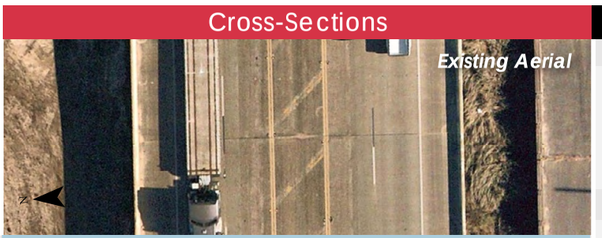
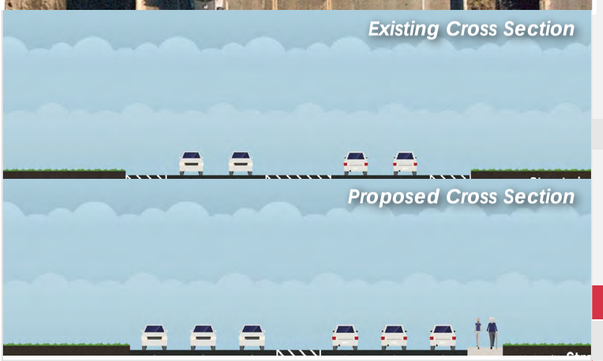
Liberty County Mobility Study, Corridor Summary Sheets

SH 146/US 90

from East End of Bridge to West End of Bridge (Trinity River)
Corridor-Segment ID: S-9

Cross-Sections





Capacity Data

Study Year	Average Daily Traffic	Volume-to-Capacity
2021	48968	1.36
2045	78762	2.19

Crash Data (2016-2020)

Total	Fatal	Serious Injury	Pedestrian	Bicycle
4	0	0	0	0

Recommended Improvements

General

Proposed Classification: Principal Arterial (6 lanes, Divided)

Short-Term

- Install periodic pedestrian crossings (marked crosswalks, crossing signs, etc)

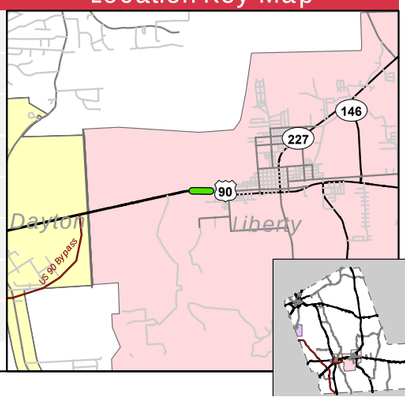
Long-Term

- Install 10-foot shared use path for pedestrian and bicyclist mobility along at least one side of the corridor
- Widen to 6-lane divided cross-section

Segment Characteristics

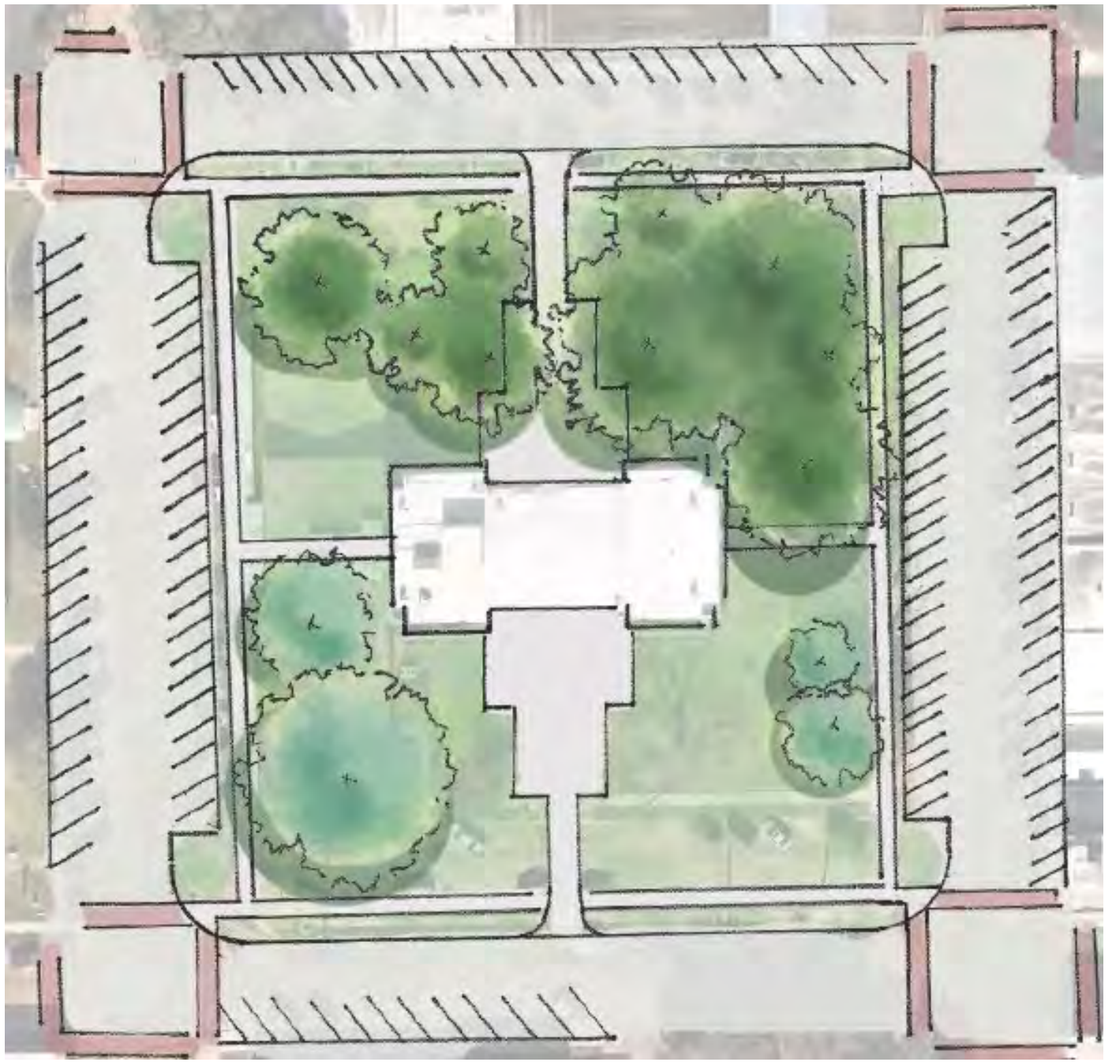
Segment Length (mi)	0.33
Posted Speed (mph)	65
ROW Width (ft)	175
Roadway Width (ft)	85
Number of Lanes	4
Center Type	Divided
Center Width (ft)	16
Sidewalk Count	None

Location Key Map



To alleviate safety issues and misaligned intersections surrounding the Liberty County Courthouse, it is recommended that the roadways be redesigned immediately surrounding the Courthouse.

The redesign address traffic issues and provide more green space to the Courthouse property. However, it would also remove some on-street parking in front of the Courthouse. As part of the recommendation, the City of Liberty should undergo a parking study and determine a location for an off-site parking garage. Crosswalks meeting Americans with Disabilities Act (ADA) requirements should be provided at all intersections surrounding the Courthouse to ensure ease of access for all users.



7.2.3 IMPLEMENTATION PLAN

The City of Dayton should program recommended improvements per its own priorities and should add them into its Capital Improvement Plan as appropriate. Implementation of recommended improvements may require coordination between municipal entities within Liberty County. Specifically, City of Liberty may partner with Liberty County, TxDOT, and the City of Dayton. ***Table T*** below provides an outline of how many projects Liberty may need to partner on, what the construction cost of those projects would be, and what potential monetary benefits would result from implementing those projects.

Table T – City of Liberty Partnering Opportunities

	Number of Improvement Projects	Total Potential Benefits	Total Construction Cost
Liberty + Liberty County	34	$ 3,749,586	$ 27,626,206
Liberty + TxDOT + Liberty County	50	$ 690,871,870	$ 38,983,857
Liberty + Dayton + TxDOT + Liberty County	40	$ 90,876,592	$ 657,558,736

The local entities should partner together to create coordinated funding applications and apply to include projects within H-GAC's Regional Transportation Plan (RTP). Together, TxDOT and the local entities should coordinate with H-GAC to apply for Transportation Improvement Program (TIP) funding. Further discussion about the H-GAC TIP process can be found in ***Section 8.3.3***.

8

Implementation

- 8.1 Improvements Summary
- 8.2 Evaluation of Improvements
- 8.3 Funding Options

Implementation

This chapter describes the process by which improvements were evaluated for future effectiveness based on the vision and goals that were established for the overall study. This chapter also compares the costs and benefits of each of the improvements and provides guidance on potential future funding.

8.1 IMPROVEMENTS SUMMARY

Based on the analysis of the study area, including existing conditions, population projections, and overall travel demand modeling, recommendations were made to improve overall safety and operations of the identified corridor and intersection locations throughout Liberty County. These recommendations were presented in the preceding four chapters for the Cities of Cleveland, Dayton and Liberty as well as for the County as a whole.

The recommendations were categorized as short-term or long-term depending on the location and type of recommendations. Short-term recommendations were designated as such because they are generally lower cost or more readily implemented. Long-term recommendations are those that may require right-of-way acquisition, require more planning or coordination, are major geometry changes, or are higher-cost solutions.

Each individual jurisdiction should program all potential projects per their own priorities and should add them into their Capital Improvement Plans appropriately.

The study recommends a total of 198 improvements broken down into the general categories of:

- **Active modes (73 recommendations)**
- **Geometrical changes (82 recommendations)**
- **Signals (43 recommendations)**

Overall, for Liberty County, the recommendations would cost a total of $965 million and provide ***$3.01 billion in benefits***.

	Intersections	Corridors	Areawide	Total
Safety Benefits	$98,903,862	$298,914,293	N/A	$3,006,855,563
Mobility Benefits	$1,102,950,711	N/A	$1,515,086,696	
Constructions Cost*	$42,323,833	$922,562,845	N/A	$964,886,678
			Overall Benefit/Cost	**3.12**

**Construction costs do not include Dayton Bypass. Conceptual alternatives for the bypass and cost estimates for each alternative are included in Appendix E.*

8.2 EVALUATION OF IMPROVEMENTS

The improvements recommended in this study were based on the Study Vision. In this chapter, performance measures derived from the Vision will be used to evaluate the effectiveness of the improvements. These improvements should be measured regularly in the future.

8.2.1 VISION AND GOALS

As stated in Chapter 1, the Vision for the Liberty County Mobility Study is as follows:

> *"The Vision of the Liberty County Mobility Study is to address County needs through multimodal transportation, development, and economic policy, while meeting H-GAC's goals of mobility, safety, and enabling economic opportunity."*

The Vision was further refined to align with H-GAC's goals as identified in the 2045 RTP. The fulfillment of each goal was evaluated using performance measures – measurable metrics such as travel time, connectivity, and volume-to-capacity ratio, etc.

Performance measures may apply to different scales in the study area; for instance, volume-to-capacity ratio applies to a corridor, whereas delay reduction applies to an intersection. At the same time, other performance measures, such as predicted crash reductions, apply to multiple scales and must account for their differences. Since crash reduction along a corridor is not directly comparable to crash reduction at an intersection, they must be reported separately. Also, areawide performance measures are not used to compare areas to each other but rather compare the one study area under existing conditions to itself under improved conditions. ***Table U*** breaks down the performance measures by goal and scale.

Table U – Performance Measures by Goal and Scale

Goal	Scale		
	Areawide	Corridor	Intersection
General Mobility	Travel Time Cost Savings; Connectivity	V/C	Delay Reduction
Freight Mobility	Routes and stops; Railroad crossings	Routes and stops; Railroad crossings	-
Safety	Predicted Crash Reduction	Predicted Crash Reduction	Predicted Crash Reduction
Economic	Construction Cost; ROW Acquisition	Construction Cost; ROW Acquisition	Cost; ROW Acquisition

8.2.2 IMPROVEMENT COSTS

Each recommendation has an associated unit cost. The unit used to quantify the recommendation may be Intersection (Int), Approach (App), Linear Feet (LF), Square Yards (SQYD), or Each (EA). These costs were estimated using current industry practice and the most recent TxDOT bid documents. ***Table V*** summarizes the cost estimates and other assumptions used in this analysis.

Table V – Cost Estimation

Improvements	Unit Cost	Unit	Notes and Assumptions
New Signal	$ 425,000	EA	
Signal Mod (Major)	$ 200,000	EA	Major modifications include changing all signal heads, replacing poles, rewiring conduit, etc.
Signal Mod (Minor)	$ 75,000	EA	Minor modifications include changing signal heads on one approach, changing left-turn phasing, etc.
Signal Mod (Hardware: lenses, back-plates with retroreflective borders, etc.)	$ 25,000	Int	Cost in terms of intersection, not individual backplate/lens
Reflectorized Signal Backplates	$ 3,000	Int	To replace all in an intersection
Flashing Yellow Arrow (2 approaches)	$ 4,000	App	$8,000 for 2 approaches
Flashing Yellow Arrow (4 approaches)	$ 3,000	App	$12,000 for 4 approaches
Signal Timing	$ 6,500	Int	
Vehicle Detection	$ 70,000	Int	Assume loop detection
Pedestrian countdown heads	$ 3,500	EA	Price per head, includes wiring
New PHB	$ 275,000	EA	
New RRFB	$ 40,000	EA	
Pedestrian Crossing Signs & Markings	$ 15,000	EA	Assume a standard midblock cross walk with signs (no RRFB)
Pedestrian Ramp	$ 5,000	EA	
Sidewalk	$ 35	LF	Assume 6' width
Shared Use Path	$ 65	LF	Assume 10' width
New Pavement Markings (whole intersection)	$ 5,000	App	Assume more than 2 approaches, up to 100-150' at every approach
Refresh Pavement Markings	$ 15	LF	Cost is based on LF of separate markings such as 4"W or 6"Y, etc.
Bike Lane	$ 15	LF	Striping only
Rumble Strips (Edge or Centerline)	$ 15	LF	Minimum threshold of $5000
Rumble Strips (Transverse)	$ 500	Lane	
Surface Treatment	$ 120	SQYD	
Left-turn Lane	$ 175,000	EA	(assume 300-foot turn lane)
Right-Turn Lane	$ 200,000	EA	(assume 300-foot turn lane)
TWLTL (on existing pavement)	$ 60	LF	
TWLTL (on new pavement)	$ 600	LF	Assume 14' existing medians
Road Diet (Reduce travel lanes + TWLTL)	$ 100	LF	Assume existing cross-section is 4-lane undivided and proposed section is 3-lane with bike lanes, no buffer
Raised Median	$ 500	LF	Cost is based off total LF of corridor and not the LF of actual median (median openings etc. would reduce cost); assume 14' median
Hooded Left-Turn in Median	$ 50,000	EA	
Positive Left-Turn Offset	$ 100,000	EA	
Driveway Closure	$ 20,000	EA	
Segment Lighting	$ 60	LF	Assume $9k/pole with 1 pole every 150 ft; lighting needed on both sides of the roadway if there is a median (double length)
Intersection Lighting	$ 30,000	Int	Based on 4 poles per intersection, cost is slightly less than segment
Remove/Trim Vegetation/Prep ROW	$ 5,000	EA	TxDOT avg price $1500 per STA, assumes 3.5 STA per site.
Updated Transit Stop (ADA Compliance)	$ 2,500	EA	
Small Signs	$ 1,000	EA	

8.2.3 IMPROVEMENT BENEFITS

To estimate benefits, reductions in crashes, intersection delay, and overall travel time were considered.

SAFETY BENEFITS

Each recommended improvement has an associated "Crash Modification Factor" or CMF, which helps us quantify the expected reduction in crashes associated with implementation. The CMF may be any value between 0 and 1.0; the smaller the value, the more effective the improvement is at reducing crashes. For example, if the CMF is 0.12, the improvement is expected to reduce crashes by 88% over its service life.

Some improvements may only apply to specific types of crashes, such as crashes that occur at night or crashes that involve a pedestrian or bicyclist. For example, installing a shared use path will not necessarily affect all crashes, but it will likely affect crashes involving pedestrians and bicyclists. Because bike-ped crashes make up a subset of the total crashes at a study location, we will only apply the CMF for a shared use path to that subset. For example, if there are 100 total crashes at a study location, 40 of them involve a pedestrian or bicyclist, and the CMF for a shared use path is 0.12, then we would expect 35 crashes involving a pedestrian or bicyclist to be "prevented" over the service life of the shared use path.

If there are multiple recommendations at a study location that apply to a specific crash type, then their collective crash reduction power must be obtained to avoid overestimating "prevented" crashes. Consider that a shared use path (CMF 0.12), curb ramps (CMF 0.12), and a mid-block crossing (CMF 0.65) are all recommended along the same corridor segment. These recommendations all apply to bike-ped crashes, so the combined CMF is simply the product of the three individual CMFs, which would be 0.00936. If there are 100 total crashes and 40 bike-ped crashes, the implementation of those three recommendations would "prevent" 39 crashes over their service life. If we had not combined the three CMFs, it would have appeared that 84 crashes had been prevented, which is not possible because there were only 40 bike-ped crashes to begin with.

This method – the individual CMFs, combined CMF method, and application of CMFs to particular crash types – comes from the Caltrans Local Roadway Safety Manual, which guides California practitioners on proactive safety analysis to ensure they have the best opportunity to secure HSIP safety funding during Caltrans calls-for-projects. Guidance was taken from Caltrans, as opposed to TxDOT, because data was more readily available for each of the recommended improvements. This guidance is compatible with Federal Highway Safety Improvement Program (HSIP) funding and is regarded as a national standard.

Crash data was collected from TxDOT's Crash Records Information System (CRIS) over the five years before the beginning of this study, between January 2015 and January 2020. It is assumed that these crash rates will remain constant over the next twenty years, so the total number of crashes over the next twenty years is four times the number of crashes that have occurred over the past five years. For example, if there were 100 crashes at a location between 2015 and 2020, it is assumed there will be 400 crashes there between 2020 and 2040. By the same logic, if there were 2 fatal bike-ped crashes at a location in the past, there will be 8 fatal bike-ped crashes there in the future. Additionally, the service life of each recommended improvement is assumed to be twenty years.

Once the number of "prevented" crashes has been determined, the benefits of the recommended improvements must be translated to a dollar amount to compare directly against costs. The monetized value of a crash, according to the US Department of Transportation (USDOT), corresponds to its severity, as shown in the ***Table W***.

Table W – Value of Reduced Fatalities and Injuries

CRASH SEVERITY	MONETIZED VALUE
K – Fatal	$11,600,000
A – Incapacitating Injury	$554,800
B – Non-Incapacitating Injury	$151,100

The cost of recommended improvements are construction costs in present day dollars, whereas the prevented crash cost savings – the benefits – are accrued over 20 years (the assumed service life of all improvements). To analyze costs and benefits in truly comparable terms, the benefits must be discounted into present-day dollars at a rate of 7% (per USDOT) for twenty years. If an improvement will prevent 1 fatal crash every year for the next twenty years, the cost savings in present day dollars would not be $232,000,000 ($11,600,000 twenty times), but rather $122,890,565, per ***Equation 1*** below. Not discounting the annual cost savings would not account for the time value of money and would greatly overestimate the benefits in this analysis.

Equation 1
Discounted Cash Flows

Total time, **N** = 20 years
Interval time periods, **n** = 1-20 years
Discount rate, **r** = 7% or 0.07

$$\text{Discounted Crash Cost Savings} = \sum_{n=1}^{N} \frac{\text{Crash Cost Savings}_n}{(1+r)^n}$$

Crash reduction savings were computed for all scales of study: areawide, corridor, and intersection. Areawide crash reduction savings is valued at about 244 million.

Both monetary crash reduction savings and percentage of total reduced crashes were considered to determine a qualitative score for each study location. ***Table X*** outlines the breakdown of the Safety Score based on these factors for intersections and corridors.

Table X - Safety Score Criteria

CRASH REDUCTION	CRASH SAVINGS	SAFETY SCORE
50% - 100%	50% - 100%	A
0% - 50%	0% - 50%	B
0%	0%	C
< 0%	< 0%	F

Exhibits 8.2.3a and ***8.2.3b*** illustrate the distribution of overall safety scores for study intersections and corridors, respectively. Additionally, corridors were scored "N/A" if no data was available to evaluate the safety of the facility. These are corridors that do not exist as of 2022 and are recommended to not be constructed.

Exhibit 8.2.3a
Intersection Safety Score Distribution

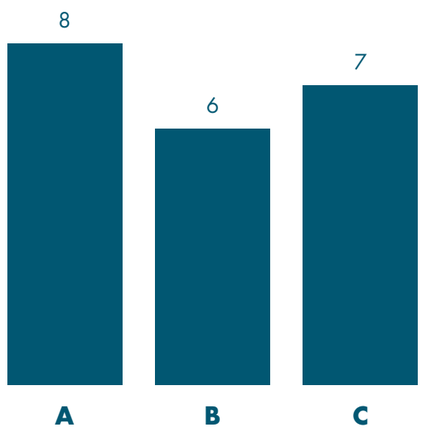
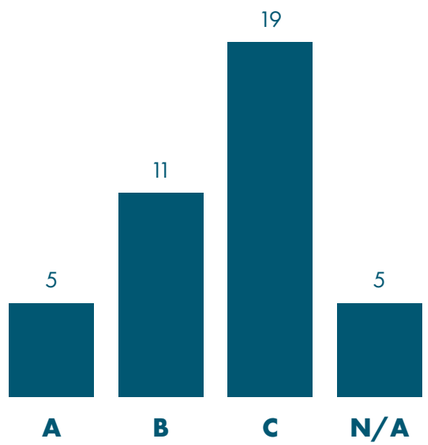


Exhibit 8.2.3b
Corridor Safety Score Distribution



MOBILITY BENEFITS

Mobility benefits were evaluated on all three different scales – areawide, corridor, and intersection – using the following performance measures:

1. Network Connectivity and Circulation
2. Network Travel Time Savings
3. Corridor Volume-to-Capacity Ratios
4. Vehicle Delay at Intersections

NETWORK CONNECTIVITY AND CIRCULATION

Connectivity and circulation are measured to determine ease and efficiency of traveling throughout an area given the connectivity of the transportation network. For the purposes of this section, connectivity refers only to roadways for motor vehicles. To determine countywide connectivity and circulation, an analysis was performed using Geographic Information Systems (GIS) and an existing roadways shapefile provided by the Texas Department of Transportation (TxDOT). All intersections with a minimum of four legs were considered to provide a minimum of one-mile connectivity. All intersections with fewer than four legs were considered to provide a half-mile. Therefore, a one mile and half-mile buffer were created for all intersections, depending on the number of legs within the intersection.

The result of this analysis is discussed in ***Section 4.1.4***.

After the connectivity areas were determined, the next step was to determine where future roadway construction was most probable within the unconnected areas. Given the physical and environmental barriers that currently exist within the County, not all areas are suitable for future roadway construction. To determine the more suitable areas, a gap and barrier analysis was performed using existing GIS data. The data was separated into two categories: "limited corridor opportunity" and "barrier to corridor". Limited corridor opportunities were deemed as restrictive in that it would not be easy to construct a roadway through the area, but that it would not be impossible to do so. Barriers to corridors were seen as very restrictive in that it would be highly unlikely to obtain right-of-way or to construct a future roadway in the area.

Barrier Type	Data Used	Providing Agency
Limited Corridor Opportunity	100-year floodplain	Federal Emergency Management Association (FEMA) via H-GAC
	*Industrial and hazardous waste sites	Texas Commission on Environmental Quality (TCEQ)
	*Cleveland School Sites – Potential	Cleveland Independent School District (ISD)
Barrier to Corridor	Incoming development	Cleveland ISD, City of Dayton, Colony Ridge
	*Cleveland School Sites – Existing and Proposed	Cleveland ISD
	Existing Land Use – Parks / Open Space, Water	H-GAC R-LUIS
	Water Features – Freshwater Wetlands, Open Water	H-GAC
	Flood Zones – Floodway	FEMA via H-GAC
	Existing Land Use – Institutional (Government / Medical / Educational)	H-GAC R-LUIS

**Some of the data was provided as a point. The actual land area that each point represented is not specified. For these data points, a half-mile buffer was created to account for a larger land area.*

In addition, locations of pipelines and railroads were provided by H-GAC and TxDOT, respectively. These two features require additional coordination and levels of approval prior to constructing roadway crossings. These locations were taken into consideration in the gap/barrier analysis, as well.

A map displaying the locations of the data listed above is provided in ***Section 4.1.4*** as ***Exhibit 4.1.4b***. A map showing the data as a category of barrier type is also provided in ***Section 4.1.4*** as ***Exhibit 4.1.4c***.

Using the connectivity analysis and the gap/barrier analysis, recommendations were made for future roadway connections. These recommendations can be found in ***Section 4.3.2*** and were made solely based on these analyses. The designated roadway "classification" on the map is generally based on the length of the connection, with the higher roadway classifications serving longer distances. Liberty County should undertake a full thoroughfare plan update process to analyze future traffic and to designate roadway widths and appropriate cross-sections. At that time, these recommendations should be reevaluated.

NETWORK TRAVEL TIME SAVINGS

Travel time across the entire network is computed by Synchro™ in hours experienced by all vehicles entering the study area during a peak hour. To compare travel time savings to other benefits and costs in the study, travel time savings must be quantified as a dollar amount.

Based on USDOT Benefit-Cost Analysis Guidance, passenger car drivers value their travel time at about $17.80 per person-hour, whereas commercial vehicle operators value their travel time at about $32.00 per person-hour. An assumption was made that 6% of vehicles entering the study area are commercial vehicles and 94% are passenger cars.

Because Synchro reports delay for a single peak-hour period, a k-factor was applied to estimate travel time for an entire weekday. 10% of total trips were assumed to occur during a single peak hour, therefore, a k-factor of 10 was selected.

Equation 2 below explains how travel time is quantified as a dollar amount.

Equation 2 – Cost of Travel Time

$$\text{Travel Time Cost} \left(\frac{\$}{\text{year}} \text{ per hour of delay} \right) = D * k * T * \left((P_{PC} * O_{PC} * V_{PC}) + (P_{CV} * O_{CV} * V_{CV}) \right)$$

Peak Hour Delay, **D** (hours)
Passenger Car Portion in Study Area, $\mathbf{P_{PC}}$ = X%
Average Passenger Car Occupancy, $\mathbf{O_{PC}}$ = 1.48
Value of Travel Time for Passenger Car Occupant, $\mathbf{V_{PC}}$ = $17.80
Commercial Vehicle Portion in Study Area, $\mathbf{P_{CV}}$ = Y%
Average Commercial Vehicle Occupancy, $\mathbf{O_{CV}}$ = 1.0
Value of Travel Time for Commercial Vehicle Occupant, $\mathbf{V_{PC}}$ = $32.00
K-Factor, **k** = 10
Time, **T** = 260 weekdays per year

Synchro™ reports network delay for individual analysis scenarios – years 2021 and 2045 – which was used to interpolate delay for the years between. The travel time cost per year, per hour of delay, is then multiplied by the delay for each year. The procedure described in the Safety Benefits section is used to discount all twenty years of travel time costs.

Finally, the total present-day value of travel time savings for the existing scenario is compared to that for the improved scenario. The difference between the two values is the mobility benefit incurred by the recommended improvements.

CORRIDOR VOLUME-TO-CAPACITY RATIO

As described in ***Section 3.1.3***, volume-to-capacity ratios (V/C) were estimated for study corridors using roadway classification and cross-section. With the addition of recommended through-lanes, V/C along study corridors are expected to reduce. A greater reduction of V/C proves that the recommendations are more effective, earning them a better evaluation.

Additionally, corridors were scored "N/A" if no data was available to evaluate the volume or the capacity of the facility. These are corridors that do not exist as of 2022 and are recommended to not be constructed; or they are corridors where no historical data has been collected by TxDOT.

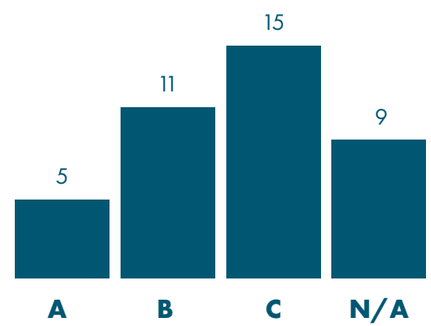
The percent reduction between the V/C under existing conditions and that under recommended conditions was given a score as enumerated in ***Table Y*** below.

The distribution of Corridor Mobility Scores across Liberty County is illustrated in ***Exhibit 8.2.3c***.

Table Y – Corridor Mobility Score Criteria

V/C REDUCTION	MOBILITY SCORE
> 50%	A
0% - 50%	B
0%	C
< 0%	F

Exhibit 8.2.3c
Corridor Mobility Score Distribution



INTERSECTION VEHICLE DELAY

As described in Chapter 4 – Methodology, average delay experienced by vehicles was used to evaluate the performance of each study intersection. Recommendations such as additional lanes and changes to signal timing and phasing caused delays at study intersections to reduce. A greater reduction of delay proves that the recommendations are more effective, earning them a better evaluation.

Additionally, the travel time savings at intersections were also taken into consideration. The calculations from the previous section on Network Travel Time were applied to each intersection to determine the value of time saved due to the recommended improvements.

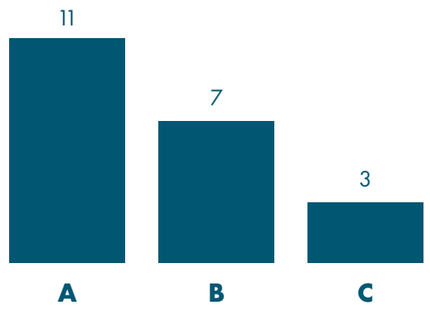
The percent reduction in delay combined with the dollar value of time saved was given a score as enumerated in ***Table Z***.

Table Z
Intersection Mobility Score Criteria

DELAY REDUCTION	TRAVEL TIME SAVINGS	MOBILITY SCORE
> 50%	> $100M	A
0% - 50%	$0 - $100M	B
0% - 32%	$0	C
< 0%	< $0	F

The distribution of Intersection Mobility Scores across the network is illustrated in ***Exhibit 8.2.3d***.

Exhibit 8.2.3d
Intersection Mobility Score Distribution



ECONOMIC BENEFITS

At specific study locations, economic gain is quantified using an overall benefit-to-cost ratio (BC), which is the sum of all benefits divided by the sum of all costs. When BC is less than 1.0, the costs of implementing recommended improvements outweigh the benefits. When BC is greater than 100.0, the benefits far outweigh the costs. In both cases, it is recommended that improvements at those locations are investigated further, as indicated by an asterisk (*). Additionally, intersections scored "N/A" had no costs and/or benefits associated with their recommendations and corridors scored "N/A" either had no improvements recommended or did not have enough data associated with them to calculate benefit information.

Exhibits 8.2.3e and ***8.2.3f*** illustrate the distribution of overall economic scores for study intersections and corridors, respectively.

Table AA
Economic Score Criteria

B/C	ECONOMIC SCORE
>100.00	*
50.00-100.00	A
1.00-50.00	B
0.00-1.00	C
0.00	N/A

The benefit-cost ratio of intersections and corridors was given a score as enumerated in Table Z.

Exhibit 8.2.3e
Intersection Economic Score Distribution

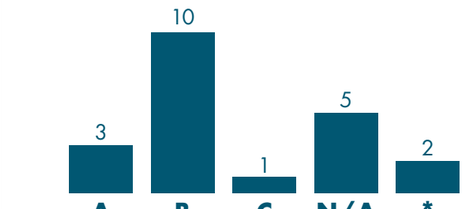
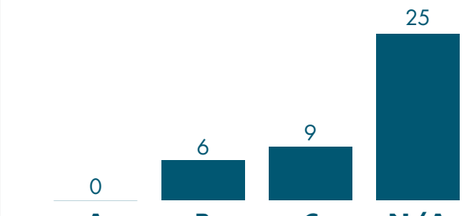


Exhibit 8.2.3f
Corridor Economic Score Distribution



OVERALL EVALUATION

Each corridor and intersection were evaluated using the performance measures described in this chapter and were given a score on how the recommendations there fulfilled each goal. The individual goal scores contributed to an overall score of the study location, ***Exhibits 8.2.3g*** and ***8.2.3h*** illustrate the distribution of overall scores for study intersections and corridors, respectively.

Benefits are generally greater for intersections than corridors because they are more readily quantifiable. Corridor projects should be studied in greater detail to identify potential benefits that this study is unable to determine.

Scores and benefit-cost ratios for all corridors and intersections are summarized in Recommendation Matrices.

The Recommendation matrices can be found in ***Appendix E***.

Exhibit 8.2.3g
Intersection Overall Score Distribution

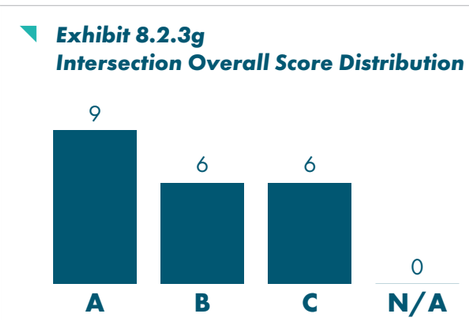
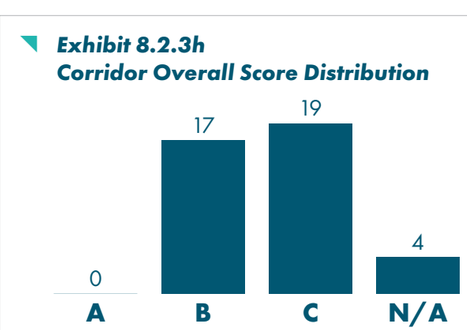


Exhibit 8.2.3h
Corridor Overall Score Distribution



8.3 FUNDING OPTIONS

The cost of constructing and maintaining mobility improvements can be significant, particularly for communities that are also responsible for a myriad of other roadways and services. Following are different methods for financing construction and maintenance of improvements under local control.

The implementation of any of these recommendations should start with coordination with H-GAC. More information is provided below regarding specific funding available through H-GAC, however, a preliminary meeting with H-GAC and the communication of implementation timeline can assist H-GAC in becoming an overall partner and resource for Liberty County. In addition, as part of its cyclical Transportation Improvement Program (TIP) Call for Projects process, H-GAC requests a Statement of Project Interest for regional applicants to communicate their long-term needs so that they can better execute their regional vision.

A variety of local, state and federal funding sources (including, for example, FTA Section 5311 funds for rural public transit) may be available for expanded transit services in Liberty County. Any discussions involving potential additional transit funding sources should include H-GAC, the Brazos Transit District, TxDOT's Public Transportation Division, and the Federal Transit Administration (FTA).

8.3.1 LOCAL FUNDING STRATEGIES

No revenue stream is more local and locally controlled than those directly available to the community or county because of local taxes and fees. Three methods most commonly used for funding local mobility improvements include:

- General fund includes revenues available through the annual collection of taxes and fees, including ad valorem taxes.
- Bonds or Certificates of Obligation allow communities to issue debt for purposes of public works, including recommendations made by this study. Bonds typically require voter approval whereas Certificates of Obligation may be issued without a vote of the general public.

Traditionally, local funds are only used on roads and rights-of-way where the local government is charged with maintenance, unless the city's interests are furthered by providing a matching portion of funding. For that reason, it would be more likely that the responsibility for acquiring the majority of funding for improvements along a roadway maintained by Liberty County would be borne by Liberty County.

Other examples of local funding sources are as follows:

Developer-funded Improvement Projects (381 Agreements) – Chapter 381 of the Local Government Code allows counties to provide incentives encouraging developers to build in their jurisdictions. A county may administer and develop a program to make loans and grants of public money to promote state or local economic development and to stimulate, encourage and develop business location and commercial activity in the county. The county also may develop and administer a program for entering into a tax abatement agreement. This tool allows counties to negotiate directly with developers and businesses.

County Assistance Districts – any county may adopt this sales tax, in all or part of the county, if the new combined local sales tax rate would not exceed 2 percent at any location within the district. The commissioners court serves as the board of directors. County assistance district funds can be used for safety and roadway projects.

Special Finance Districts. Special finance districts are permitted through the Texas State Legislature for purposes of making or maintaining improvements that spur private development or maintain the quality of an area.

- *Tax Increment Reinvestment Zone.* A tax increment reinvestment zone, more commonly known as TIRZ, is a creation of a municipality or county and may be created either by the government entity or by petition. A TIRZ begins by establishing a "base value". The taxes gained by an increase in value above the base value is the "increment" that is available annually to a reinvestment zone for purposes of making capital improvements. Capital improvements can include mobility improvements such as those recommended in this study. A TIRZ can use both annual allotment and bonds as methods for financing improvements. A TIRZ expires by a set date at which time both the base value and increment are collected by the municipality. Other government entities such as counties and emergency districts can participate in a TIRZ. Each entity can determine percentage of "participation" in which case only a percentage of increment is available for use by the TIRZ.
- *Municipal Management District.* A municipal management district is a government entity created by the State of Texas either through specific legislation or through the Texas Commission for Environmental Quality. A management district is funded through an annual assessment (in the same manner as a Homeowners Association), a property tax or a sales tax. While created by the state, a management district is only funded through petition of property owners (in the case of an assessment) or by vote (in the case of a sales or property tax). A management district can pay for the cost of construction of improvements in the right-of-way; however, the amount of available revenue typically limits the scale of construction allowed. On the other hand, a management district is an excellent tool for ongoing maintenance of improvements beyond major road reconstruction.

8.3.2 STATE FUNDING SOURCES

TxDOT TA and SRTS Program – TxDOT administers Transportation Alternatives Set-Aside (TA) and Safe Routes to School (SRTS) Program funds for locally sponsored bicycle and pedestrian infrastructure projects in communities less than 200,000.

TxDOT HSIP – formulaic funds for safety related projects based on crash history. Formulaic funds safety projects that are consistent with the State's strategic highway safety plan (SHSP) and that correct or improve a hazardous road location or feature or address a highway safety problem.

Texas Enterprise Zone – a state sales and use tax refund program to encourage private investment and job creation in economically distressed areas of the state. Nominated companies that meet minimum capital investment thresholds can receive up to $3.75 million.

8.3.3 FEDERAL FUNDING SOURCES

There are many Federal funding sources currently available; some are long-standing programs and others have recently been made available. When considering potential funding sources for implementation of recommendations, the County and cities should consider potential partnerships, any required local matches, and the required timeline for planning or construction.

Local funding matches can be steep for some of the funding sources. Applicants within Liberty County should consider partnering with other entities to apply for funding in these cases. Potential funding partners for Liberty County include its incorporated cities, H-GAC, TxDOT, the Port of Houston, the Union Pacific and BNSF Railroads, as well as private companies that operate within the County.

The Port of Houston is the largest port in the United States by tonnage and is currently undergoing improvements that will enhance the international impacts of the Houston-Galveston region.

While the Port of Houston and its 125-member Industrial Districts are 25 miles from Liberty County, the possible partnerships may be needed to meet critical demands for mobility improvements. These special districts may all be possible partners. The special districts can be co-applicants with Liberty County and its member cities, in partnership with H-GAC, for a regional application to support the growth of the Port of Houston.

POTENTIAL FEDERAL FUNDING SOURCES INCLUDE:

- **H-GAC Transportation Improvement Program (TIP)** – finances transportation improvement projects using US Department of Transportation funds over a period of four years. This study is intended to inform the TIP. Communities and the county can submit projects for funding through the TIP as part of the competitive process. Projects require matching funds and are selected based upon a variety of criteria. Communities and the county can also utilize local funds, including those available through special finance districts, as leverage to pursue federal funding for projects, both within the TIP and through other grants that may become available from time to time.
- **Community Development Block Grant (CDBG)** – funds are available through the US Department of Housing and Urban Development for purposes of meeting three national objectives including benefit to low- and moderate-income persons, preventing or eliminating slums or blight, and meeting urgent needs. While it is unlikely that projects associated with this study meet the latter two criteria, several would be eligible for funding in an effort to benefit low- and moderate-income persons. Other resources are often available through the CDBG program to address major events, including CDBG-DR funds (disaster recovery) for Hurricane Harvey. However, those funds serve a very specific purpose and are managed through the State of Texas.
- **Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grant (previously known as BUILD and TIGER grants)** – funds projects that: (1) support transportation projects that focus on creating good-paying jobs, improving safety, applying transformative technology, and explicitly addressing climate change and advancing racial equity; (2) build, repair, rebuild, and revitalize freight and passenger transportation networks; and/or (3) improve access to reliable, safe, and affordable transportation
- **Infrastructure for Rebuilding America (INFRA) Grant** – funds projects that improve the safety, efficiency, and reliability of the movement of freight and people in and across rural and urban areas (emphasis on freight-related projects).
- **Consolidated Rail Infrastructure and Safety Improvement (CRISI) Program** – funds the deployment of railroad safety technology, capital projects that address congestion challenges, facilitate ridership growth, and increase multimodal connections, railway and roadway safety improvements such as signals and barriers, safety programs, corridor service development plans, and workforce development activities.
- **Safe Streets and Roads for All Program** – developing "Vision Zero" action plans and other improvements to reduce crashes and fatalities, especially for cyclists and pedestrians.
- **NHTSA Highway Safety Programs** – formulaic funds for programs for improving driver behavior and safety. These include programs to reduce injuries and death from crashes, improve driver education, provide proficiency testing and physical and driving examination, and improve pedestrian performance and bicycle safety
- **Infrastructure Investment and Jobs Act** – funds improvements to surface, air, and marine transportation systems; energy systems; water and wastewater systems; environmental programs; and broadband networks. Approximately $284 billion has been allocated for transportation systems alone, which includes road safety, public transit, and ports.

A

Data Collection

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B

Meetings

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C

Public Engagement

D

Synchro

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E

Recommendations and Implementation

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Houston-Galveston Area Council