SH 21 Relief Route Feasibility Study

From West of Madisonville to IH 45

CSJ: 0917-31-014

October 2014

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Executive Summary

Study Purpose and Need

The purpose of this study is to connect regional traffic traveling to/from the west side of Madisonville to IH 45. SH 21 through downtown Madisonville has always been a major transportation corridor for traffic heading towards Bryan/College Station. Significant numbers of large freight trucks create conflicts with the local traffic circulation because of limited roadway space.

Relief along SH 21 through downtown Madisonville is needed because the current roadway configuration cannot accommodate high volumes of both passenger vehicles and large trucks, with volumes projected to continue increasing through 2035. Significant queuing and delays occur at intersections along SH 21, including Spur 174 in downtown and SH 75 just east of downtown. These intersections contribute to an overall delay of traffic in the downtown area and decrease the quality of life for the residents and businesses that conduct local trips on the surrounding roadway network.

Existing Conditions

In order to fully understand the context of the issues along SH 21 it is critical to evaluate it in context to its surrounding environment. During this process, elements such as the physical study area, existing roadway network and current traffic conditions were evaluated.

As a part of this evaluation a traffic study was conducted to determine the existing (Year 2014) and forecasted (Year 2035) traffic volumes and level of service (LOS), and confirm the local traffic movements and its make-up. This was done by conducting a LOS analysis and an Origin and Destination (O&D) analysis.

The findings from the traffic study validate the description of traffic described by TxDOT and the City of Madisonville. The findings are as follows:

- Existing LOS for roadway segments within the study area have an acceptable LOS of C or greater.
- Forecasted 2035 LOS within the study area for SH 21 at FM 1452, SH 75 north of Madisonville, Spur 174 and SH 90, will remain at an acceptable of LOS C or greater.
- Forecasted 2035 LOS for the segment of SH 21 west of IH 45 (Point G) would not have an acceptable LOS (LOS E).
- SH 21 is the main thoroughfare for vehicles traveling to and from SH 75, SH 90 and IH 45.
- SH 75 is the main north-south thoroughfare used for vehicles traveling west along SH 21 and south to SH 90.
- Truck traffic is especially significant along SH 75, SH 21, and SH 90.

Development of Preliminary Alternatives

After the existing conditions evaluation eight preliminary relief route alternatives (including a No-Build alternative) were developed to address the purpose and need of this study. Five north alternatives and two south alternatives were developed. These alternatives are labeled A through G and can be viewed in **Figure ES-1: Preliminary Relief Route Alternatives**. Each alternative route was evaluated as an 800-foot study corridor. This corridor, which includes a proposed 250-foot ROW, gives the general location of the proposed relief route alternatives and allows room for alignment adjustments during the development of the schematic.

In addition to the preliminary alternatives, typical sections were developed to show the configuration of the proposed relief route within these alternatives. The relief route would be constructed in an interim and ultimate phase. These typical sections are shown in **Figure ES-2: Interim and Ultimate Typical Sections.**

Recommended Alternative

After the preliminary relief route alternatives were developed, meetings with TxDOT and a Workgroup were held to review the alternatives. From these meetings, it was decided that Alternatives E and F would be combined to create one western reliever route around Madisonville. This alternative was displayed at a public meeting in July 2014 and revised based on comments received at the meeting.

Combining the two alternatives provide the most comprehensive and effective characteristics to provide traffic relief in downtown Madisonville. By locating a route to the north and south of Madisonville that connects to IH 45, vehicles that travel on SH 21 through downtown Madisonville have access to SH 90, SH 75, or SH 21 west toward Bryan-College Station. This would allow non-local/freight traffic to avoid the downtown area on a more direct route and at a higher rate of speed. Overall, this relief route would reduce the load on the local roadway network and as a result minimize accidents and decrease congestion and intersection delays. Unlike other relief route alternatives, the proximity of the routes to Madisonville and their connection location at IH 45 are consistent with the City's Comprehensive Plan and TxDOT's planned improvements to IH 45. These locations accommodate future plans by increasing the mobility in the downtown area while maintaining its current economic conditions and as well as facilitates the conversion of IH 45 frontage roads to one-way operation. Although there would be some environmental impacts, the location of these alternatives makes the most efficient use of existing roadways and parcel boundaries to minimize further impacts. The recommended alternative can be viewed in **Figure ES-3: Recommended Relief Route Alternative**.

SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

PRELIMINARY ROUTE ALTERNATIVES

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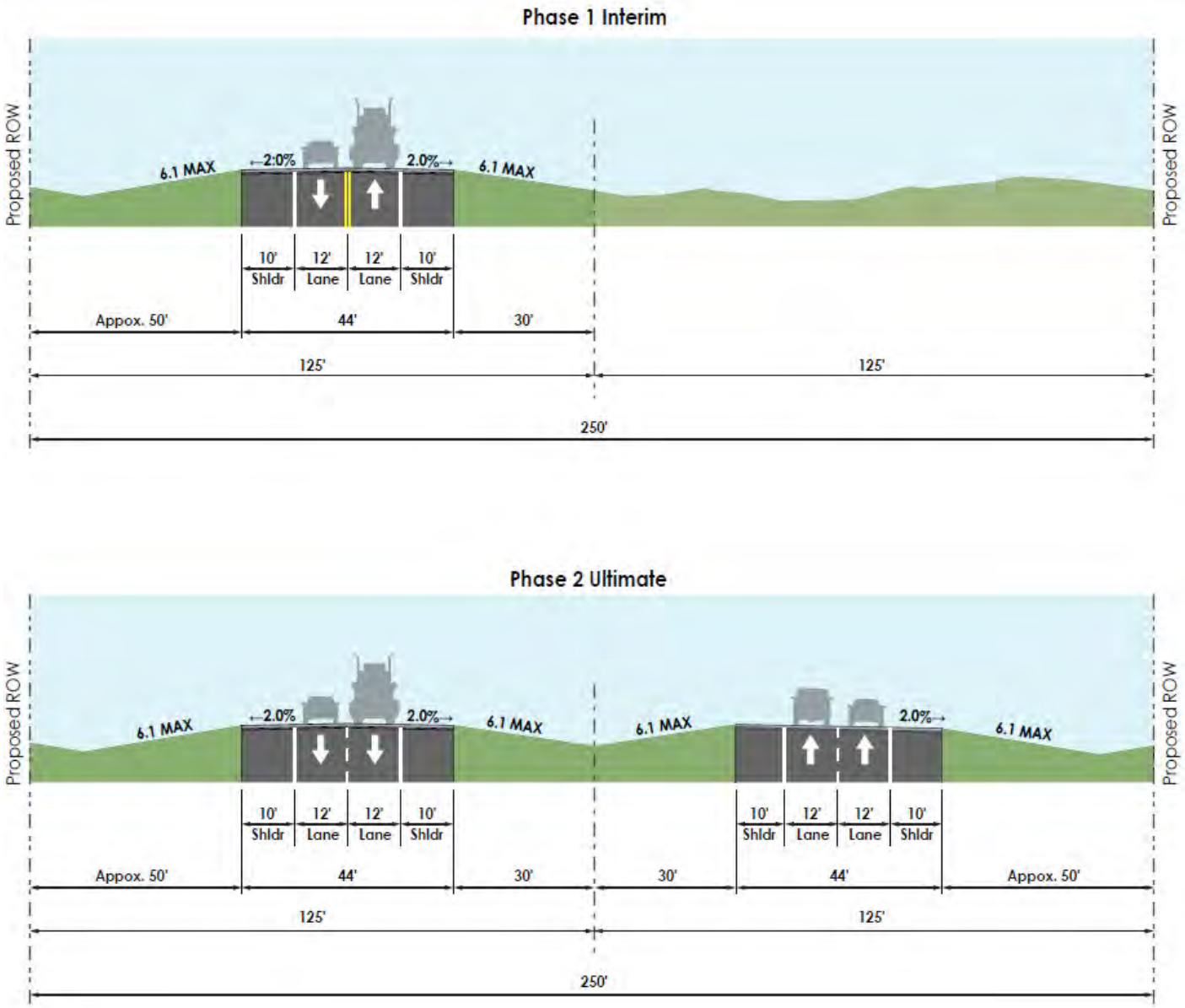
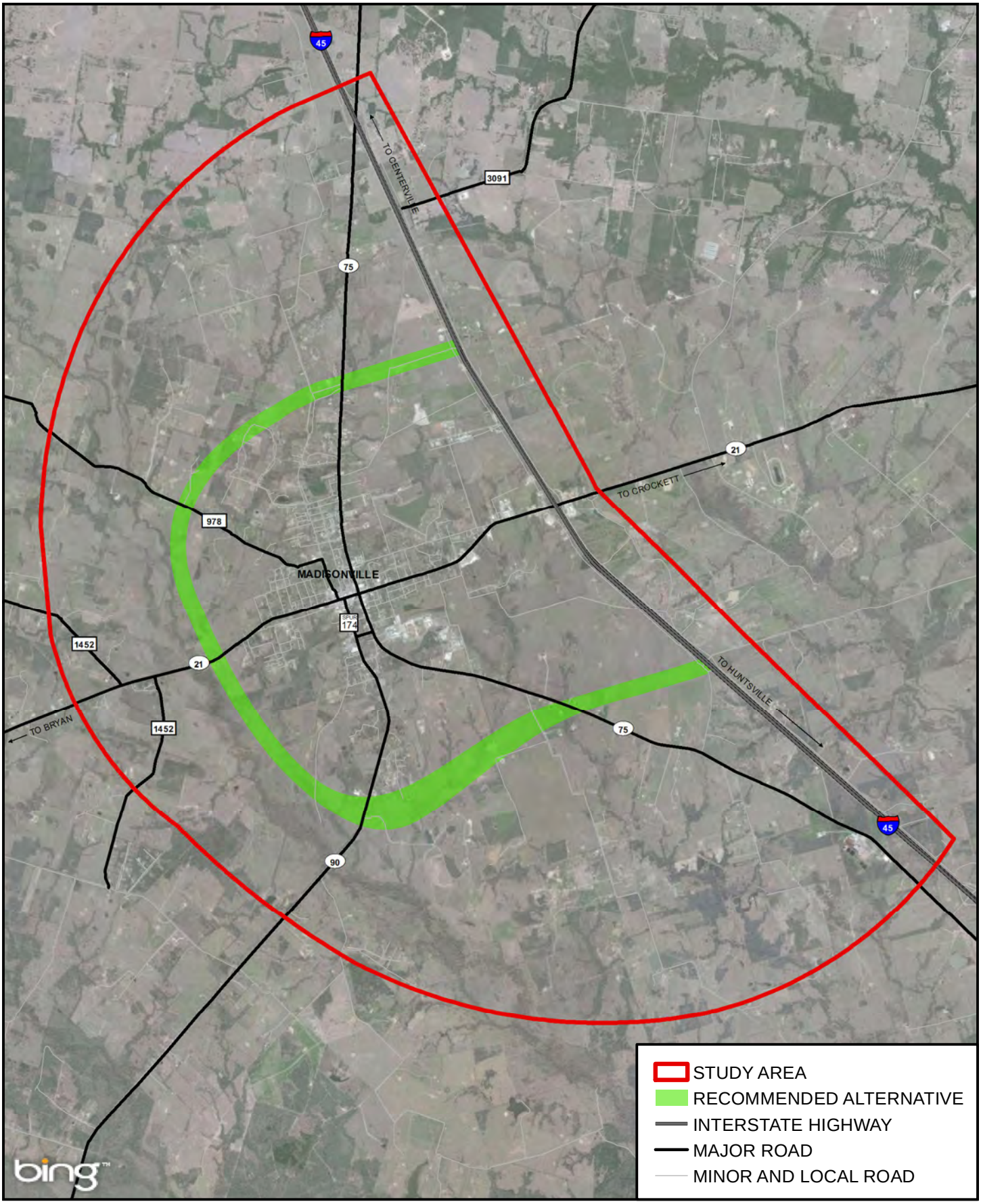
FIGURE ES-1

Figure ES-2: Interim and Ultimate Typical Sections





SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

RECOMMENDED ROUTE ALTERNATIVE

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FIGURE ES-3

Identification and Prioritization of Segments of Independent Utility (SIU)

Once the recommended relief route alternative was determined, segment limits within the recommended alternative were developed to help identify the priority of construction for each segment. At the Workgroup meeting it was decided to segment the recommended alternative based on logical termination points, such as major intersecting roadways. The segments of the recommended alternative are as followed:

- Segment 1: IH 45 to SH 75 North
- Segment 2: SH 75 North to SH 21
- Segment 3: SH 21 to SH 90
- Segment 4: SH 90 to SH 75 South
- Segment 5: SH 75 South to IH 45

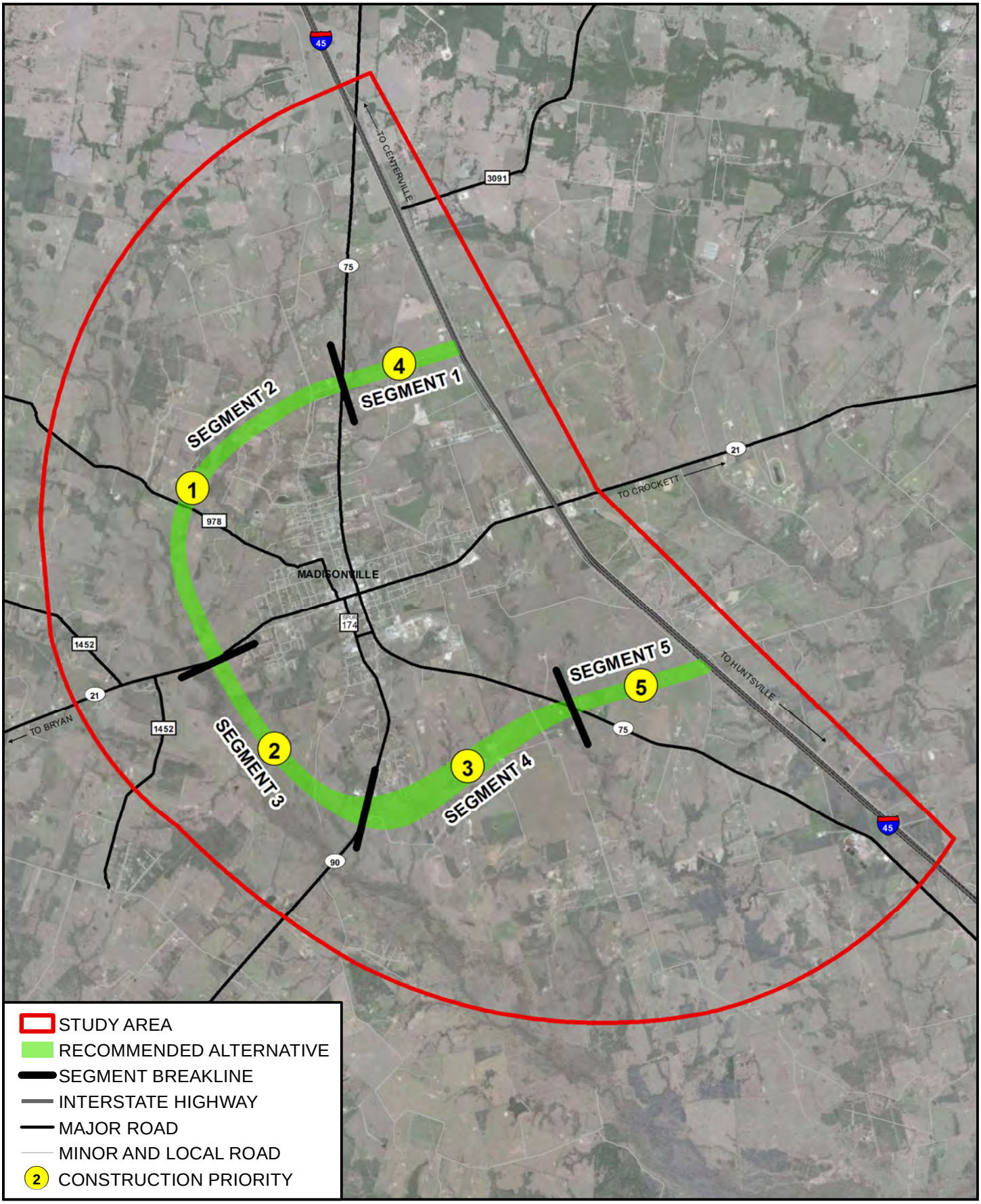
The recommended segments were evaluated using four specific criteria that are key to the development and construction of each segment: Transportation Mobility, Environmental Impacts, Engineering and Project Costs. For each criterion, the segments were compared and prioritized in order of construction from first to last. Each segment's rank is shown in **Table ES-1: Traffic Diverted by Construction Priority (Year 2035)** and on **Figure ES-4: Recommended Relief Route SIUs and Construction Prioritization.**

Interim Improvements

The construction of a relief route around Madisonville is a long-range solution to divert the amount of projected through trips along SH 21 in downtown Madisonville. In the meantime, improvements may be made to the street network to better accommodate existing and projected traffic. Recommended improvements include improving the geometry of the existing roadway network to improve traffic flow, safety and alleviate congestion. A detailed analysis of four locations with specific recommendations was conducted and can be found in **Section 5** of the Feasibility Study.

Preliminary Cost Estimates

The completion of the proposed SH 21 relief route to the ultimate configuration requires construction to each of the identified segments for the project. The ultimate configuration is based on the proposed typical section discussed in **Section 3**. The relief route is broken down into its five segments with construction costs associated with each of them. **The total preliminary cost of the interim SH 21 Relief Route is estimated at $44.5 million. The total cost for the ultimate is approximately $88.2 million.** However, the construction costs shown are for comparison purposes only. **Tables ES-2** and **ES-3** break down the preliminary cost estimates for the interim and ultimate relief routes.



SH 21 RELIEF ROUTE FEASIBILITY STUDY
MADISON COUNTY, TEXAS
RECOMMENDED ROUTE SIUS AND CONSTRUCTION PRIORITIZATION

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FIGURE ES-4

Table ES-1: Traffic Diverted by Construction Priority (Year 2035)

Priority	Segment	2035 Traffic in Downtown (vpd)	2035 Traffic Diverted from Downtown (vpd)
#1	Segment 2 SH 75 North to SH 21	18,515	957
#2	Segment 3 SH 21 to SH 90	18,515	1,232
#3	Segment 4 SH 90 to SH 75 South	18,515	636
#4	Segment 1 IH 45 to SH 75 North	18,515	0*
#5	Segment 5 SH 75 South to IH 45	18,515	414
Total			**3,239**

Note: 2035 volumes are based on the forecasted projections from the Traffic Report in Appendix A.
* No additional traffic is diverted. This segment would accommodate traffic traveling to Segment 2 (957 vpd) and Segment 3 (1,232 vpd).

Table ES-2: Preliminary Cost Estimate – Interim SH 21 Relief Route

Roadway Element	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
	IH 45 to SH 75 North	SH 75 North to SH 21	SH 21 to SH 90	SH 90 to SH 75 South	SH75 South to IH 45
Mainlanes	$2,990,000	$9,280,000	$5,530,000	$6,010,000	$3,550,000
Right of Way	$880,000	$2,730,000	$1,630,000	$1,770,000	$1,050,000
Ramps	$0	$0	$0	$0	$0
Bridges	$500,000	$2,000,000	$500,000	$1,500,000	$1,000,000
Utilities	$176,000	$546,000	$326,000	$354,000	$210,000
Subtotal	**$4,546,000**	**$14,556,000**	**$7,986,000**	**$9,634,000**	**$5,810,000**
Engineering	$209,400	$676,800	$361,800	$450,600	$273,000
Segment Total	**$4,755,400**	**$15,232,800**	**$8,347,800**	**$10,084,600**	**$6,083,000**
Total Cost					**$44,503,600**

Table ES-3: Preliminary Cost Estimate – Ultimate SH 21 Relief Route

Roadway Element	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
	IH 45 to SH 75 North	SH 75 North to SH 21	SH 21 to SH 90	SH 90 to SH 75 South	SH75 South to IH 45
Mainlanes	$4,730,000	$14,680,000	$8,740,000	$9,500,000	$5,620,000
Right of Way	$880,000	$2,730,000	$1,630,000	$1,770,000	$1,050,000
Ramps	$1,800,000	$2,400,000	$1,200,000	$1,200,000	$600,000
Bridges	$2,000,000	$7,000,000	$2,000,000	$4,000,000	$3,000,000
Utilities	$176,000	$546,000	$326,000	$354,000	$210,000
Subtotal	**$9,586,000**	**$27,356,000**	**$13,896,000**	**$16,824,000**	**$10,480,000**
Engineering	$511,800	$1,444,800	$716,400	$882,000	$553,200
Segment Total	**$10,097,800**	**$28,800,800**	**$14,612,400**	**$17,706,000**	**$11,033,200**
Total Cost					**$82,250,200**

Conclusion

The proposed SH 21 relief route would improve local and regional mobility by allowing motorists that travel between IH 45, SH 90 and SH 21 west of Madisonville to bypass downtown Madisonville. Local and non-local motorists would experience improved traffic flow and safety. Local traffic would see a reduction in congestion, delays, accidents and structural impacts to the roadway network. Non-local, through traffic, would experience reduced congestion and see an increase in travel times. Without the proposed relief route, SH 21 and its surrounding street network will continue to experience a decline in LOS, deteriorating roadway conditions and increased safety concerns.

1. Introduction

The Department of Transportation (TxDOT) – Bryan District, city officials, and members of the public have recognized the need to improve traffic along SH 21 (Main Street) through downtown Madisonville, TX. Due to its location, the downtown area (SH 21) is the primary conduit tor traffic that travels between IH 45 and US 190 towards Bryan/College Station to the west of Madisonville.

Currently, the existing design of SH 21 and its surrounding street network results in the slowing of traffic through the downtown area and creates conflicts between large freight trucks and smaller vehicles. It also adversely impacts adjacent properties. The physical/urban characteristics of downtown Madisonville, specifically buildings with limited setback from the existing SH 21 alignment, provide few opportunities for widening the roadway without displacing existing developments to add capacity.

Therefore, a relief route around Madisonville has been studied to provide direct connections to IH 45, SH 90, and SH 21/US 190 west of Madisonville to alleviate the amount of traffic in the downtown area.

The following sections of this report will clearly identify the purpose and need of this project, describe the study process, analyze and compare alternatives using specific criteria, and present recommended alternatives.

1.1 Purpose and Need

The purpose of this study is to connect regional traffic traveling to/from the west side of Madisonville to IH 45. SH 21 through downtown Madisonville has always been used as a through route tor traffic that travels between IH 45, SH 90, and SH 21/US 190 west of Madisonville towards Bryan/College Station. Of this traffic, the significant numbers of large freight trucks create conflicts with the local traffic circulation due to the tight confines of the existing roadway and its adjacent buildings.

Relief along SH 21 downtown is needed as the current roadway configuration is not able to accommodate high volumes of both passenger vehicles and large trucks. Significant queuing and delays occur at the intersections along SH 21 including Spur 174 in downtown and SH 75 just east of downtown. These intersections contribute to an overall delay of traffic in the downtown area and decrease the quality of life for the residents and businesses that conduct local trips on the surrounding roadway network.

Described in a past study (SH 21 Relief Route Engineering Summary Report, 2000) discussed in Section 1.3, options for adding capacity to SH 21 or widening the roadway are not feasible as the adjacent buildings would be displaced adversely affecting the historic characteristics of the area. In an attempt to alleviate truck traffic through the downtown area, TxDOT has installed a truck detour

sign along northbound SH 90 before SH 21 to divert trucks traveling north on SH 90 away from downtown by way of E. South Street (SH 90) to SH 75 west of Madisonville.

The construction of a western relief route around Madisonville was evaluated in 2000 and the traffic (including trucks) has continued to increase. According to TxDOT's Transportation Planning and Programming Department (TP&P) Division, traffic is expected to increase from 11,300 vehicles per day (vpd) in 2010 to 16,300 vpd by 2030.

1.2 Local Planning Efforts

City of Madisonville Comprehensive Plan, 1988

The City's comprehensive plan describes the local concerns regarding congestion and traffic in the downtown area. It supports a relief route around Madisonville and has recommendations for future land use regarding the type of development that should be encouraged if a relief route is constructed. More specifically, the Plan identifies a location of a northwest bypass between Burr Road and IH 45.

Of the 13 goals established by the City, Objective 2 of Goal 12 states the need of an alternative truck route to relieve the traffic in downtown Madisonville and reduce environmental impacts. The goal is listed as follows:

> **Goal 12:** To create a transportation system which will accommodate future growth while sustaining existing economic base.
>
> > **Objective 2**: To establish alternate truck routes to reduce environmental and noise pollution, as well as the loading problem on the existing road system.

This study is consistent with the issues and planning efforts described in Madisonville's comprehensive plan.

TxDOT-Bryan District Existing and Planned Projects

Currently there are three projects (one existing and two planned) that are listed by TxDOT-Bryan District within the study area (**Table 1-1**). This study is consistent with the planning and construction efforts established by TxDOT.

Table 1-1: Existing and Planned Projects for the TxDOT-Bryan District[1]

Highway	Project ID	Bid Date	Description
SH 21	011704040	2015-03	Widen and Rehabilitate Roadway
SH 21	011705046	2015-04	Install Pavement Stripes/Markers
IH 45	067505082	2015-07	Remove and Replace Freeway Ramps; Convert Frontage Roads to One-Way
SH 75	016607057	2013-03	Widen Roadway
US 190	011704038	2014-08	Roadway Repair

1.3 Previous Studies

SH 21 Relief Route Engineering Summary Report, 2000

In 2000, an engineering summary report was developed to study the feasibility of a relief route for SH 21. The report evaluated three alternative routes around Madisonville – one north alternative and two south alternatives. Based on the evaluation criteria outlined in the engineering report, the north option was recommended.

In addition to the results of its own study, the engineering summary report references a traffic study that was conducted in 1997 for the City of Madisonville. The study area was an eight square-mile area centered on the central business district focused on east-west mobility, specifically SH 21 from FM 1452 to IH 45. The study provided four alternatives which included a No-Build, widening SH 21 through downtown, creating one-way pairs through downtown, and relief routes to the north or south side of Madisonville. This study recommended a north relief route around Madisonville.

[1] http://www.txdot.gov/apps-cq/project_tracker/projectquery.htm,

1.4 Goals and Objectives

The goal of this study is to identify a location for a relief route around the west side of Madisonville. In order to achieve this goal, a feasibility study was conducted to determine the best alternative. This report was produced to describe the process and identify a recommended route. The objectives of this report can be summarized as follows:

- Identify a recommended route for the relief route
- Divide the relief route into segments for phased constructed
- Prioritize the relief route segments
- Begin environmental documentation for the NEPA process
- Develop a plan to be included in the State Transportation Improvement Plan (STIP)
- Develop a cost estimate in order to establish a basis for funding to develop a schematic and begin construction

These objectives were considered in all phases of development of this report.

1.5 Study Development Process

The following sections of this report will discuss the study process for this relief route feasibility study. A brief outline of the phases of the study process is outlined below.

Step 1	**Determine Existing Conditions:** An assessment of the general study area and roadway network was conducted to develop a project baseline to measure against in the alternative development and analysis steps of the study. This step included a traffic analysis that included traffic projections and an origin and destination (O&D) study.
Step 2	**Develop Preliminary Alternatives:** Preliminary alternatives were developed on the north and south sides of Madisonville west of IH 45. These alternatives were evaluated and developed using qualitative constraints data and the baseline information that was established in determining in the existing conditions.
Step 3	**Conduct Workgroup Meeting:** The traffic study findings and preliminary alternatives were presented to a community Workgroup. The meeting provided the Workgroup an opportunity to ask questions and comment in detail about the preliminary alternatives and evaluation process.
Step 4	**Develop Recommended Alternative:** Based on Workgroup comments, refinements were made to the preliminary alternatives and a recommended alternative was established.
Step 5	**Conduct Public Meeting:** An open house-style public meeting was held after the recommended alternative was developed for the general public to view. This meeting provided the public an opportunity to ask questions and comment about the study.
Step 6	**Segment and Prioritize Construction Order of Recommended Alternative:** In order to determine the most effective way to construct the recommended alternative, it was necessary to segment and prioritize the alternative based on both the qualitative and quantitative data established throughout the process of this study.
Step 7	**Develop Feasibility Report:** The final step in the study process was to prepare the final report to display the final recommendation of the relief route location and prioritized segments, and cost estimates.

A detailed description of the process, its methodology, and the results for each step are described in **Sections 2 through 6**.

2. Existing Conditions

In order to fully understand the context of the issues along SH 21 it is critical to evaluate it in context to its surrounding environment. This section details a description of the physical study area, including the roadway network and its related traffic conditions.

2.1 Description of Study Area

Madisonville is a community of approximately 4,400 people (2010 Census) that is located along the IH 45 corridor between the cities of Centerville and Huntsville. The study area encompasses SH 21/US 190 (which is the main east-west route in the community), SH 75, SH 90, Spur 174, FM 1452, and FM 978. The area that is experiencing the worst congestion and adverse traffic impacts is along SH 21 between FM 1452 (just west of downtown) and SH 75 (near the center of Madisonville). The conditions are described in more detail in the following paragraphs. The study area is shown in **Figure 2-1: Project Study Area**.

2.2 Roadway Network

Local Streets

The local street network is a typical grid network with only SH 21 providing a continuous east-west traffic route and provides access to the community's neighborhoods, schools, churches, and businesses.

State Highways and Farm-to-Market Roads

SH 21

From IH 45 to Travis Street, SH 21 is a four-lane divided (two lanes in each direction) arterial roadway with a two-way turn lane in the median. It transitions into a two-lane undivided arterial from Travis Street through downtown and continuing west past FM 1452. SH 21 is the only continuous east-west route through town and provides access to businesses and public facilities.

Truck traffic facing eastbound on SH 21 near downtown Madisonville between Spur 174 and SH 75.

Traffic facing westbound on SH 21 in downtown Madisonville.

SH 75

SH 75 is the pre-interstate regional highway, parallel to Interstate 45, connecting to the towns of Leona and Centerville to the north and the town of Huntsville to the south. Freight vehicles use this roadway as a relief route (up to 10% of the total vehicles on the facility are heavy trucks) to access SH 21 to the west instead of using IH 45 as it "cuts the corner" into Madisonville. Outside the city limits SH 75 is a two-lane undivided roadway and within the city limits it transitions to a four-lane undivided roadway.

SH 75 northbound from SH 21.

SH 90

SH 90, located in the southwestern quadrant of the city, functions as a collector/local street but is currently being used as a truck route (up to 10% of the total vehicles on the facility are heavy trucks) for freight from south Texas to IH 45 to the north. This roadway is a two-lane undivided highway that terminates into SH 75 at the end of E. South Street. Currently, truck traffic is detoured to from SH 90 to SH 75 via E. South Street. Smaller vehicles continue north along Spur 174 to access the downtown area.

Truck detour facing northbound at Spur 174 and E. South Street (SH 90).

Facing west on E. South Street (SH 90).

Spur 174

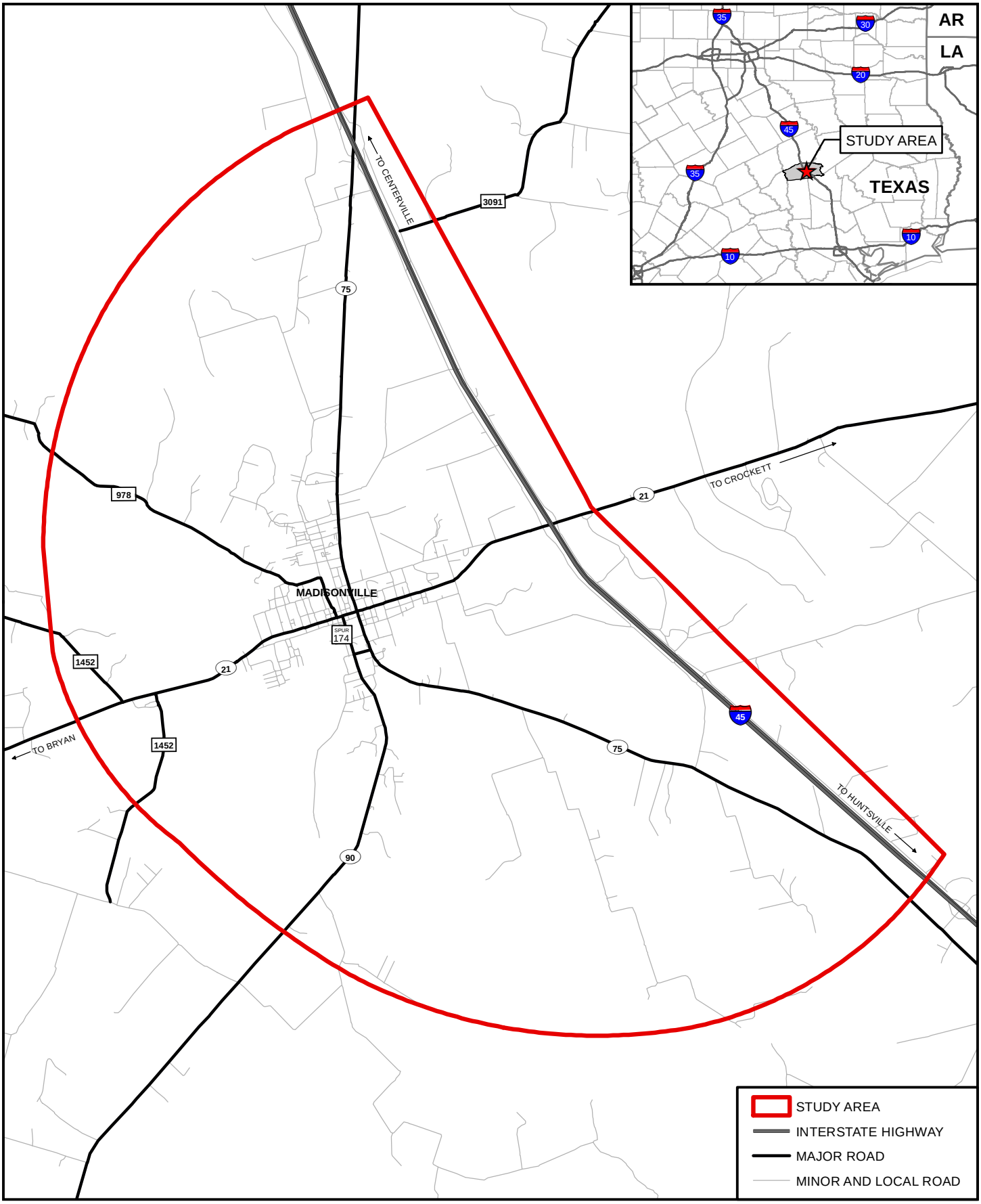
Spur 174 is a small two-lane undivided segment of roadway between SH 90 and SH 21 that provides access to the downtown area. This route is primarily used by local traffic and smaller through traffic vehicles.

FM 978

FM 978, located in the northwest quadrant of Madisonville, functions as a collector/local street for traffic heading toward Nomangee. Within the study area, FM 978 is a two-lane undivided rural roadway.

FM 1452

Like FM 978, located in the northwest quadrant of Madisonville, functions as a collector/relief route for FM 21 traffic heading to the west. This is a two-lane undivided rural roadway that predominately traverses east and west north of SH 21 and intersects SH 21 on the west side of Madisonville.



SH 21 RELIEF ROUTE FEASIBILITY STUDY
MADISON COUNTY, TEXAS
PROJECT STUDY AREA

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FIGURE 2-1

2.3 Traffic Analysis

Before the development of preliminary alternatives, a traffic study was conducted to determine the existing (Year 2014) and forecasted (Year 2035) traffic volumes and level of service (LOS) and confirm the local traffic movements and its make-up. This study was important for two primary reasons:

1. It provided baseline and forecasted traffic information that can be measured against a No-Build Alternative. This is important because it identifies potential traffic impacts to the area if no relief route is constructed.
2. It guides the decision of the location of a relief route alternative to the north or south of Madisonville.

The following text summarizes the volume, LOS, and O&D components of the traffic study and present its key findings. The full traffic study can be viewed in **Appendix A**.

Existing and Forecasted Traffic Volumes and Level of Service

Twenty-four hour traffic volumes (average annual daily traffic (AADT)) were obtained at nine locations within the study area. These locations were chosen because they reflect sections of the roadway system that people use on a consistent basis. Volumes obtained at these locations are needed to determine what the future need study area would be and also established the limits for the for the O&D study that is discussed later in this section.

Traffic facing northbound at the intersection of SH 21 and SH 75.

As shown in **Table 2-1: Existing and Forecasted Traffic Volumes**, existing traffic volumes are expected to grow an estimated 42% by 2035[2], which would create a significant burden on the transportation network of Madisonville, especially in the downtown area. **Figure 2-2: Traffic Volume Collection Points** depicts the locations traffic volume data was collected.

[2] The estimated growth rate is 1.69% annually based on review of the TxDOT Statewide Planning Map.

Table 2-1: Existing and Forecasted Traffic Volumes

Location	Direction	Existing Year 2014[3] (AADT)	Forecast Year 2035 (AADT)
SH 21 at FM 1452 (Point A)	NB	7,965	11,325
SH 75 West of IH 45 (Point B)	NB and SB	3,201	4,548
IH 45 Southbound Exit Ramp (Point C)	SB	2,393	3,402
IH 45 Southbound Entrance Ramp (Point D)	SB	3,678	5,229
IH 45 Northbound Entrance Ramp (Point E)	NB	2,916	4,146
IH 45 Northbound Exit Ramp (Point F)	NB	3,283	4,668
SH 21 West of IH 45 (Point G)	WB and EB	13,022	18,515
Spur 174 (Point H)	NB and SB	2,800	3,981
SH 90 (1.1 mile south of SH 21) (Point I)	NB & SB	4,100	5,829

The traffic volume data was used to determine the peak hour (7 a.m.-9 a.m. and 4 p.m.–6 p.m.) LOS of selected roadway segments within the study area. It is important to note that the LOS for these segments (SH 21, SH 75, SH 90 and Spur 174) was determined by using the methodologies defined in the 2010 Highway Capacity Manual (HCM 2010) for Class III, two-lane highways. Typical LOS, a measure of operating conditions along a roadway segment, is usually measured on a scale of A through F. The LOS for this study is the ability of vehicles to travel near or at the posted speed

[3] AADTs for Spur 174 and SH 90 were obtained from the TxDOT Statewide Planning Map.

limit and is measured on a scale of A through E. **LOS A represents the best operating conditions and LOS E represents the worst.**

As shown in **Table 2-1: Existing and Forecasted Traffic Volumes**, there is a direct correlation between the forecasted increase in traffic volumes and the forecasted decrease in LOS for the same location. Without relieving Madisonville's roadway network from future traffic growth, the existing traffic LOS would continue to decrease (especially along SH 21) creating more congestion and longer delays.

Table 2-2: Existing and Forecasted Level of Service, lists the LOS for present and forecasted peak hours for SH 21, SH 75, SH 90, and Spur 174. **Figure 2-2: Traffic Volume Collection Points** depicts the segments where LOS was evaluated.

Table 2-2: Existing and Forecasted Level of Service

Location	Limits	Existing Year 2014	Forecast Year 2035
SH 21 at FM 1452 (Point A)	From FM 1452 to Pine Street	LOS B	LOS C
SH 75 West of IH 45 (Point B)	West of IH 45 to approx. 3 miles south of IH 45	LOS A	LOS B
SH 21 West of IH 45 (Point G)	West of IH 45 to E. Collard St.	LOS C	LOS E
Spur 174 (Point H)	E. South St. to SH 21	LOS B	LOS C
SH 90 (Point I)	From 1.1 mile south of SH 21 to E. South St.	LOS B	LOS C

Origin and Destination Analysis

In order to understand where traffic is traveling to and from within the study area an origin and destination analysis was performed. Vehicles passing through set O&D study points (see **Figure 2-2: Traffic Volume Collection Points**) were captured on video and processed to generate a database documenting fields such as the vehicle license plate, time, state, vehicle type, location, and direction. Like the LOS analysis, data was collected from vehicles during the peak hours. The data collected during this time frame made it possible to identify the traffic patterns within the study area and determine the percentage of vehicles that were trucks.

As a result of the O&D analysis, it was recognized that the majority of the peak-hour through traffic that uses SH 21 make the following three movements through Madisonville:

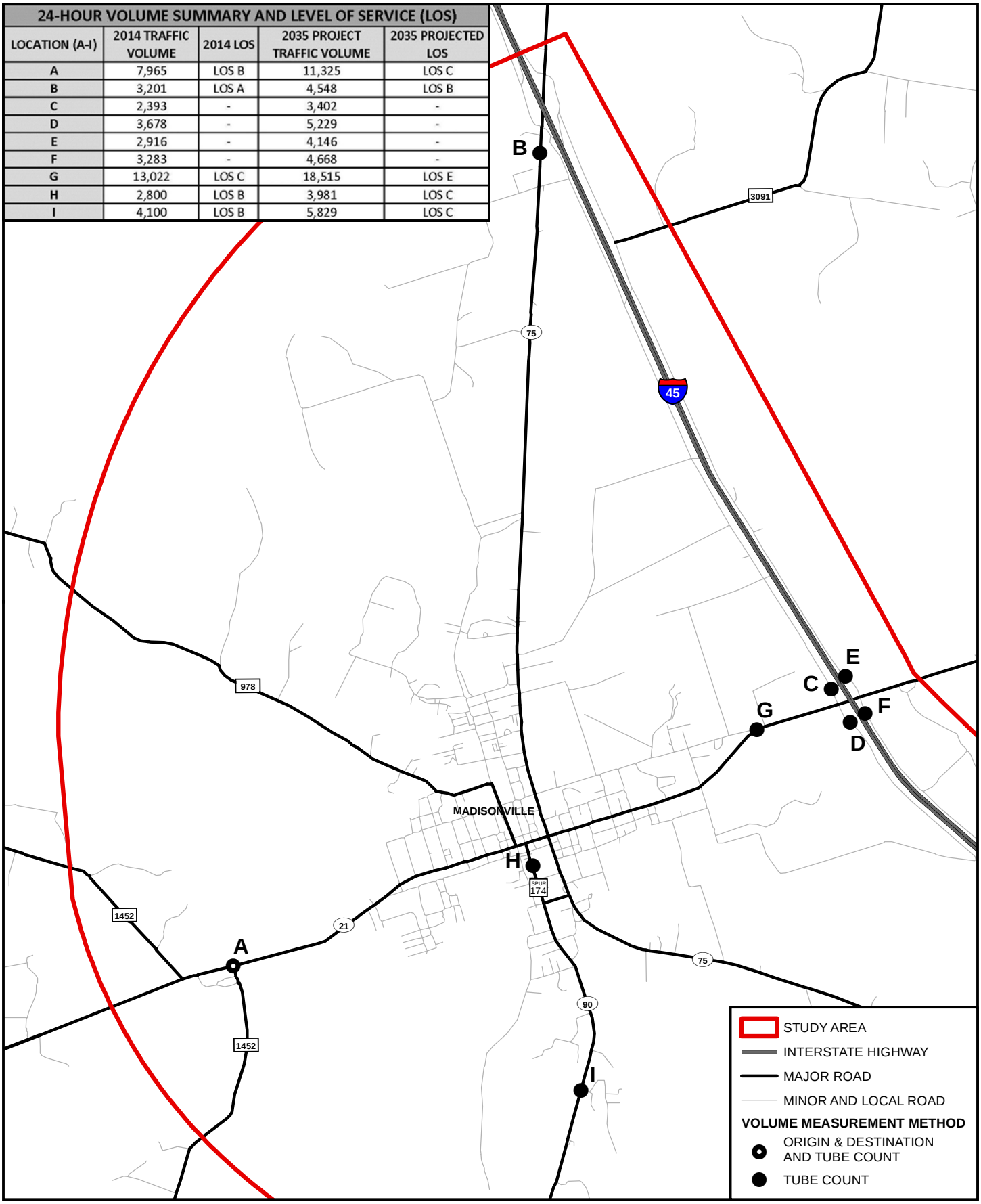
1. Vehicles that travel southbound on IH 45 that want to travel west to Bryan-College Station exit north of Madisonville onto SH 75 southbound and then travel west on SH 21 through downtown.
2. Vehicles that travel southbound on IH 45 that want to travel south utilizing SH 90 exit north of Madisonville onto SH 75 southbound and then travel west on SH 21 through downtown to connect to SH 90.
3. Vehicles that travel eastbound on SH 21 from Bryan-College Station prefer to travel north to IH 45 continue by connecting to SH 75 northbound.

These movements are displayed in **Figure 2-3: Primary Peak-Hour Traffic Flow**. A detailed breakdown of the O&D analysis can be viewed in the traffic study in **Appendix A**.

The intersection of SH 21 and IH 45 east of downtown Madisonville (facing eastbound).

The intersection of SH 75 and IH 45 north of downtown Madisonville (facing northbound).

24-HOUR VOLUME SUMMARY AND LEVEL OF SERVICE (LOS)				
LOCATION (A-I)	2014 TRAFFIC VOLUME	2014 LOS	2035 PROJECT TRAFFIC VOLUME	2035 PROJECTED LOS
A	7,965	LOS B	11,325	LOS C
B	3,201	LOS A	4,548	LOS B
C	2,393	-	3,402	-
D	3,678	-	5,229	-
E	2,916	-	4,146	-
F	3,283	-	4,668	-
G	13,022	LOS C	18,515	LOS E
H	2,800	LOS B	3,981	LOS C
I	4,100	LOS B	5,829	LOS C



SH 21 RELIEF ROUTE FEASIBILITY STUDY
MADISON COUNTY, TEXAS
TRAFFIC VOLUME COLLECTION POINTS

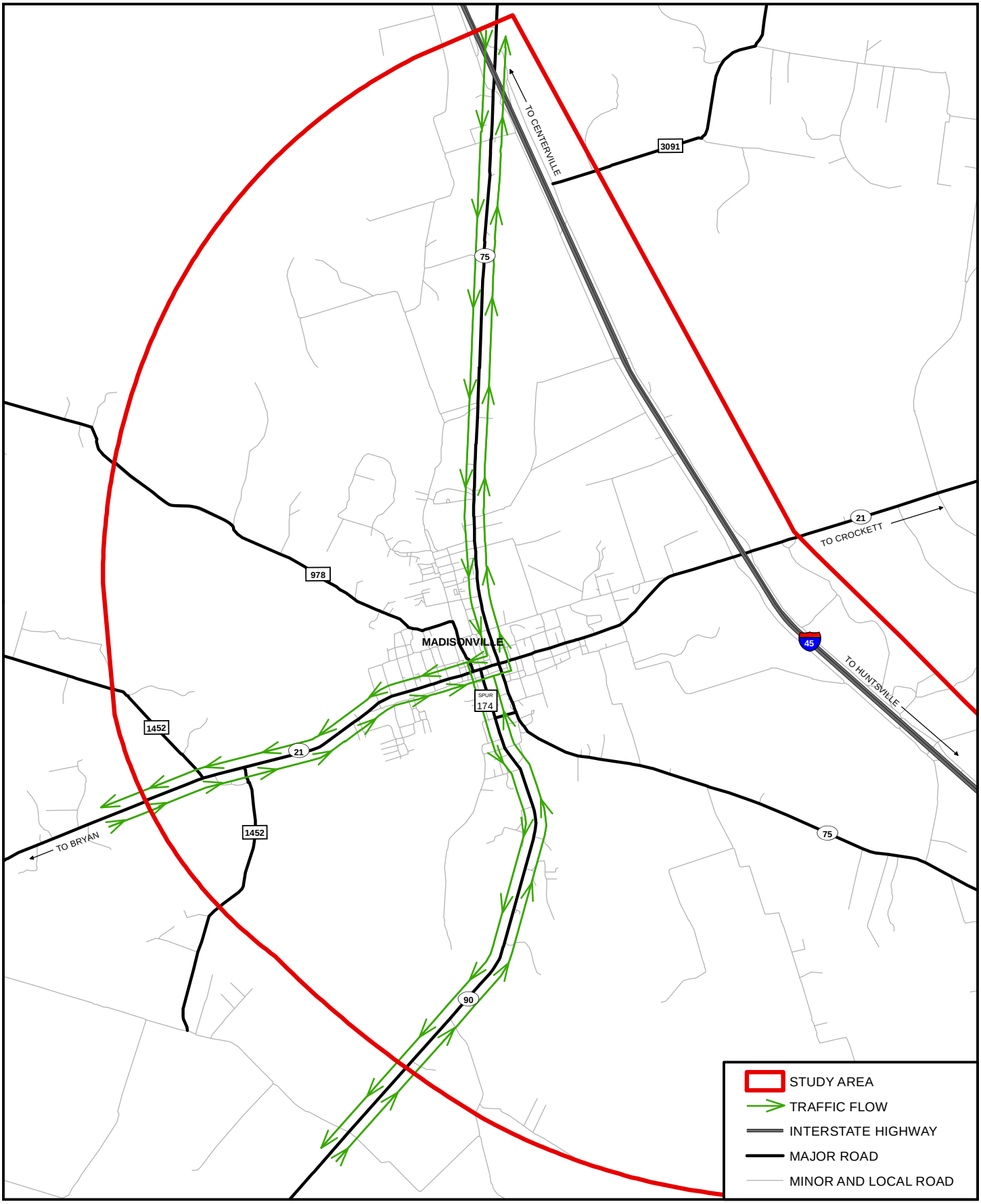
N
0 2,500 5,000
FEET

Texas Department of Transportation

HDR

SEPT 2014

FIGURE 2-2



SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

PRIMARY PEAK-HOUR TRAFFIC FLOW

N

0 0.5 1

MILES

Texas Department of Transportation

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SEPT 2014

FIGURE 2-3

Traffic Study Findings

The findings below from the O&D study are important because they assist in the decision making process of where connections are needed for relief route alternatives around Madisonville. The following findings from the traffic study validate the description of traffic described by TxDOT and the City of Madisonville. The findings are as follows:

Existing LOS for roadway segments within the study area have an acceptable LOS of C or greater. Although through capacity is currently sufficient along these roadways, volumes are expected to increase by 2035 and could reduce the LOS as local circulation and intersection delays continue to reduce through capacity.

Forecasted 2035 LOS within the study area for SH 21 at FM 1452, SH 75 north of Madisonville, Spur 174 and SH 90, will remain at an acceptable LOS C or greater. Given the 2035 traffic volumes and existing roadway configuration, the LOS for roadway segments, with the exception of SH 21 west of IH 45 (Point G) would only be reduced one level of service grade.

Forecasted 2035 LOS for the segment of SH 21 west of IH 45 (Point G) would not have an acceptable LOS (LOS E). Vehicles make through trips coming from Bryan-College Station, SH 90 or SH 75 from the south use SH 21 to access SH 75 or IH 45. This reduction of LOS (LOS B to LOS E) is consistent with existing traffic patterns and 2035 traffic volumes.

SH 21 is the main thoroughfare for vehicles traveling to and from SH 75, SH 90 and IH 45. In addition to the descriptions of traffic movements given by the City of Madisonville and TxDOT, the results of the traffic study also verify that the majority of traffic in Madisonville travels along SH 21 to and between these locations.

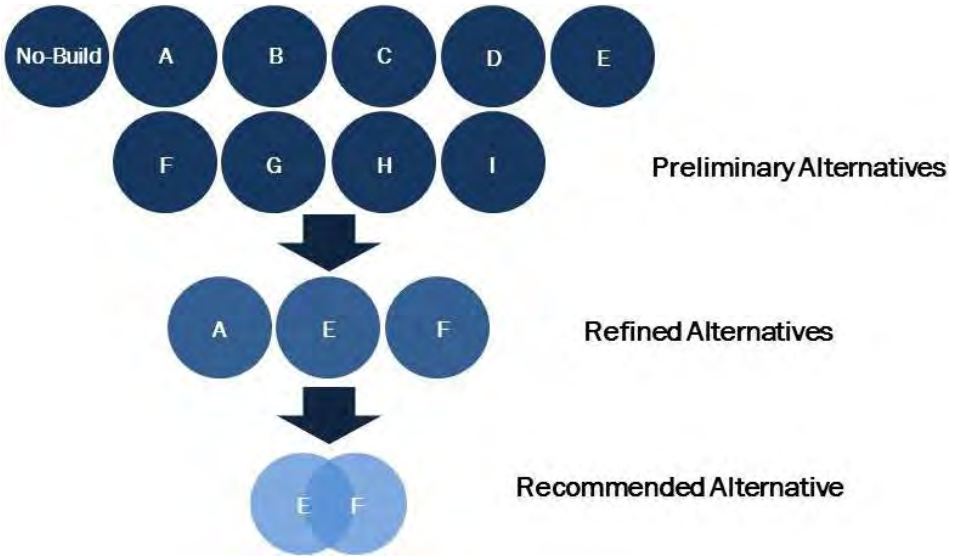
SH 75 is the main north-south thoroughfare used for vehicles traveling west along SH 21 and south to SH 90. As recognized in the O&D analysis, the majority of southbound vehicles exit IH 45 at SH 75 instead of SH 21 which is four miles further south.

Truck traffic is especially significant along SH 75, SH 21, and SH 90. As shown in the O&D analysis, the majority of trucks travel between or to these points within Madisonville. In addition, the majority of the freight truck movement is within the morning timeframe. This validates the assumption that most truck traffic in Madisonville is through traffic (non-local) as the trucks are generally not making return trips in the evening.

3. Development of Alternatives

Based on the results of the traffic study, it has been recognized that there is a need for relief from traffic in downtown Madisonville. The next step was to develop preliminary alternatives along the north and south sides of Madisonville west of IH 45. These alternatives were evaluated and developed using environmental and demographic constraints along with the baseline data that was established in determining in the existing conditions. Once the alternatives were evaluated, recommendations were made to TxDOT and public officials at a Workgroup meeting. Based on the comments and refinements from the Workgroup meeting a final recommended alternative identified. **Figure 3-1: Alternatives Evaluation Process** generally illustrates the process of refinement and screening of the alternatives beginning with the evaluation of preliminary alternatives and ending with the selection of the recommended alternative.

Figure 3-1: Alternative Evaluation Process



The details of the alternatives development process are discussed throughout the remainder of this section.

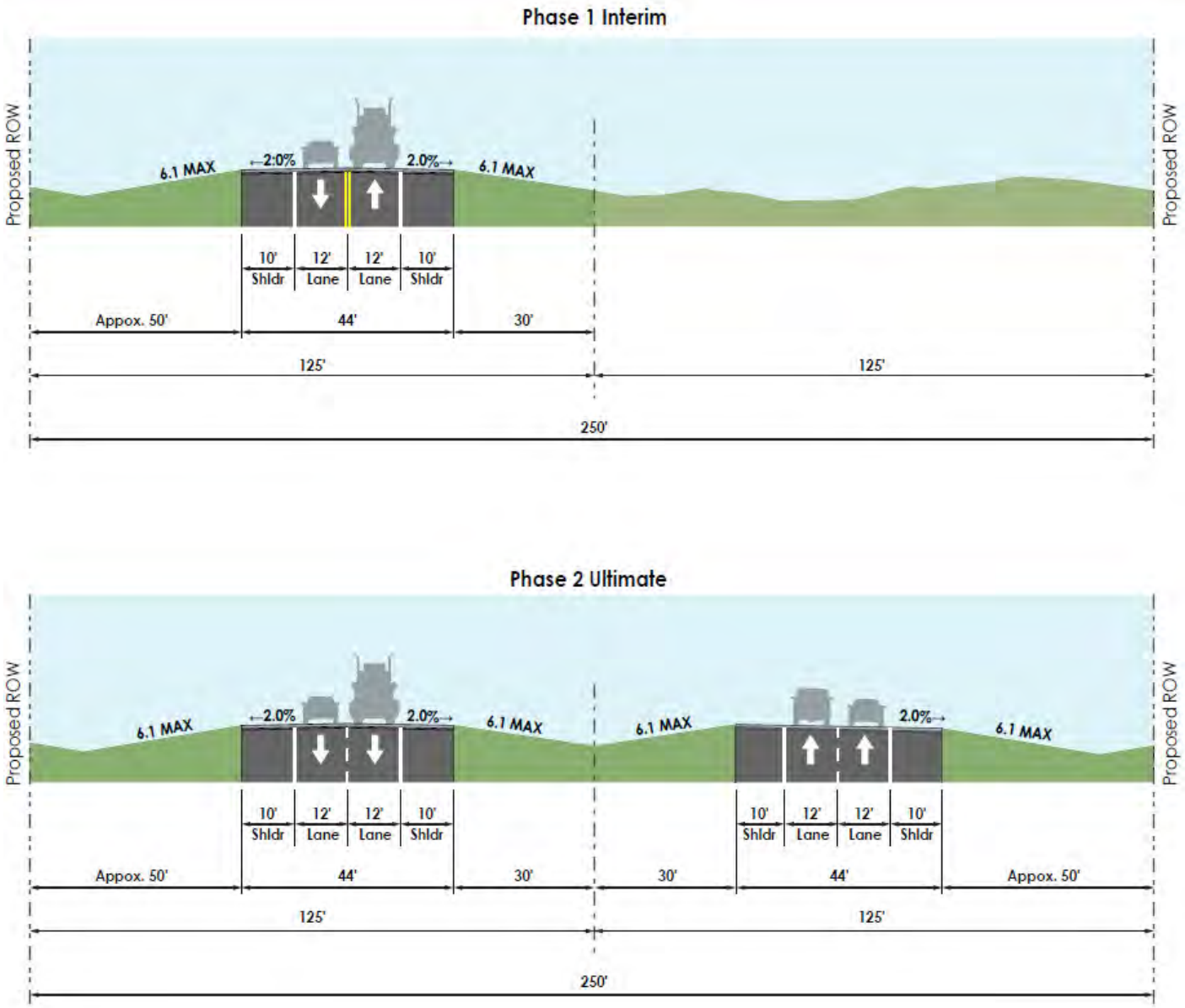
3.1 Proposed Typical Section

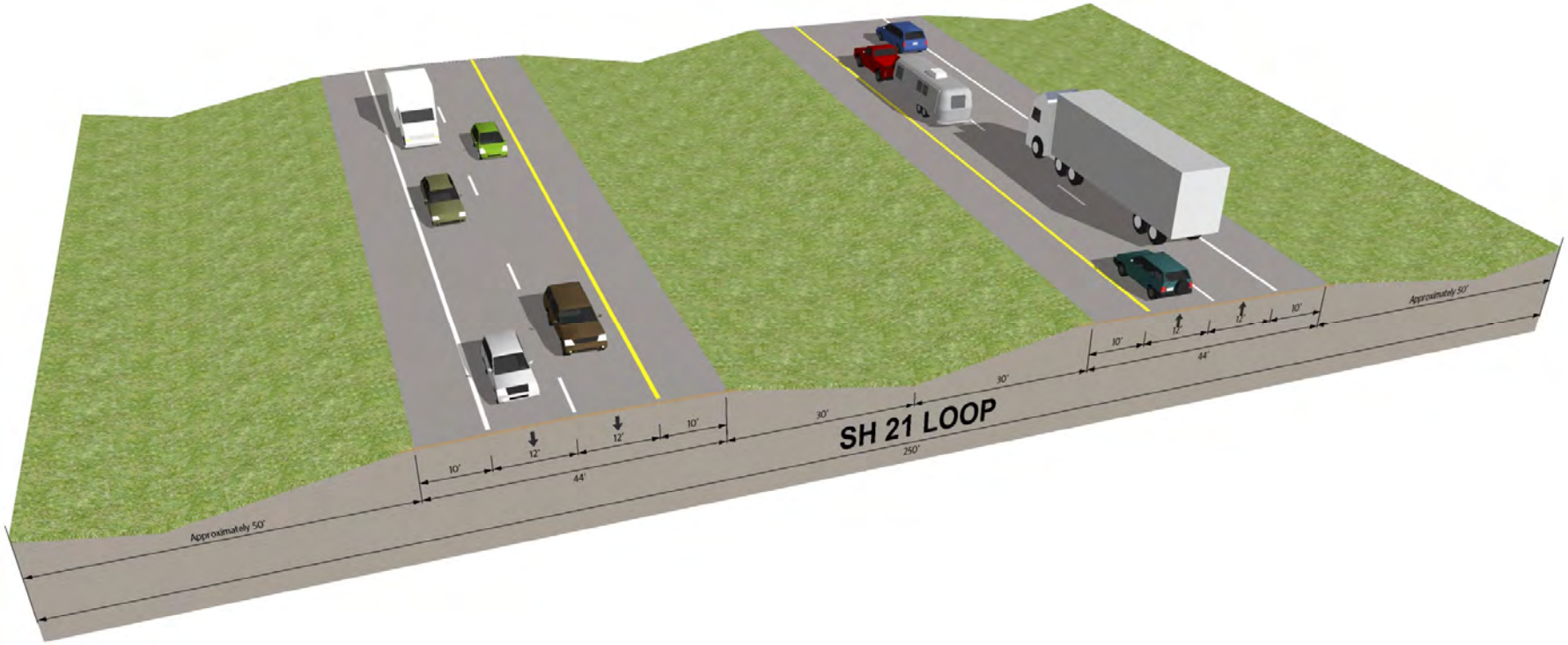
Due to factors such as traffic and population growth, existing traffic volumes, and cost/funding constraints, the roadway could be constructed in two separate stages; an interim configuration and an ultimate configuration. This would allow for the recommended alternative to provide immediate relief to Madisonville and then build the ultimate configuration as traffic volumes warrant improvements. Since the right-of-way (ROW) would already be established (250 feet) in the interim stage, staging construction would not adversely impact adjacent development patterns and the staged relief route would accommodate short-term growth in population and traffic volumes while accommodating the ultimate facility construction as funding is identified.

Figure 3-2: Interim and Ultimate Typical Sections show the configurations of both stages of construction. The interim roadway would be a rural two-lane undivided limited access roadway with 10-foot shoulders and limited access. All intersections would be at-grade and bridges would only be anticipated over stream crossings. The interim roadway would be constructed on one half of the proposed 250-foot ROW to allow room to construct the ultimate in the future.

The ultimate roadway would be a rural four-lane limited access roadway divided be a grass median and have 10-foot shoulders. Stage 2 improvements would be constructed on the other one half of ROW and the interim roadway lanes would change to one direction. During this phase all major intersections would be grade separated and require mainlane bridges and entrance and exit ramps. Additional ROW may be needed to accommodate the side slopes for the mainlane bridges and ramps at each intersection.

Figure 3-2: Interim and Ultimate Typical Sections





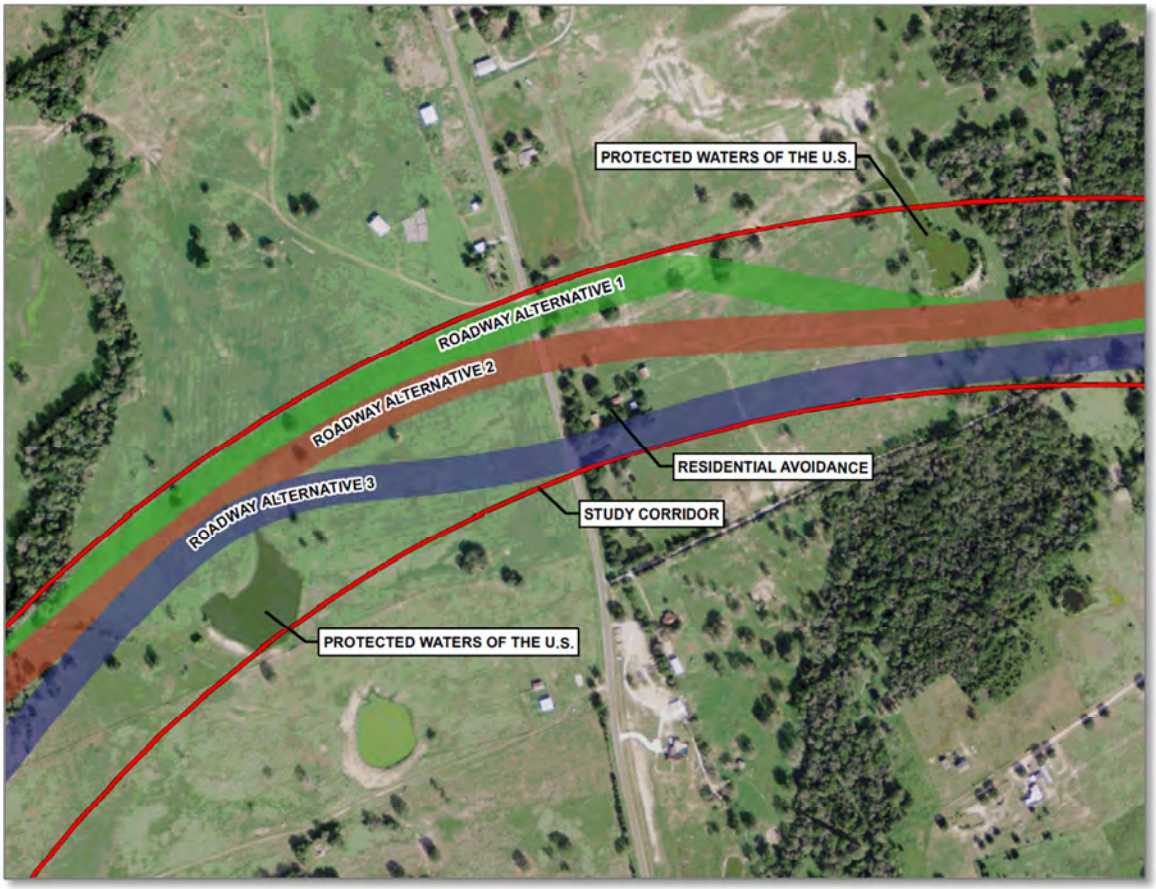
3D SH 21 Relief Route Ultimate Typical Section

3.2 Constraints and Right-of-Way Analysis

At the alternative development stage, the relief route alternative routes were based on regionally identifiable environmental impacts. The criteria that were used to locate routes were based on avoiding sensitive environmental and demographic areas, connectivity to the existing roadway network, and to maximize the usage of existing ROW and property boundaries. In addition, the City of Madisonville's Comprehensive Plan was evaluated (Section 1) to identify potential local criteria which could be incorporated.

Each alternative route was evaluated as an 800-foot study corridor. This corridor, which includes the proposed 250-foot ROW, gave the general location of the proposed relief route alternatives and allows room for alignment adjustments during the development of the schematic.

The below graphic shows an example of how alternatives can be located within a study corridor while avoiding existing constraints.



An example of roadway alternatives within a study corridor.

Environmental and Demographic Constraints

An effort was made to avoid flood plains, large ponds, and stream crossings. In locations where stream crossings were unavoidable, measures were taken to cross each stream perpendicularly in order to minimize impacts and construction costs. Areas of potential concentration of minority populations, heavily vegetated areas, and areas of suitable habitat for endangered species such as the Navasota Ladies'-tresses (Spiranthes parksii) were avoided where identified. Additionally, impacts to cultural and historic sites such as schools, cemetery's churches were also avoided or minimized.

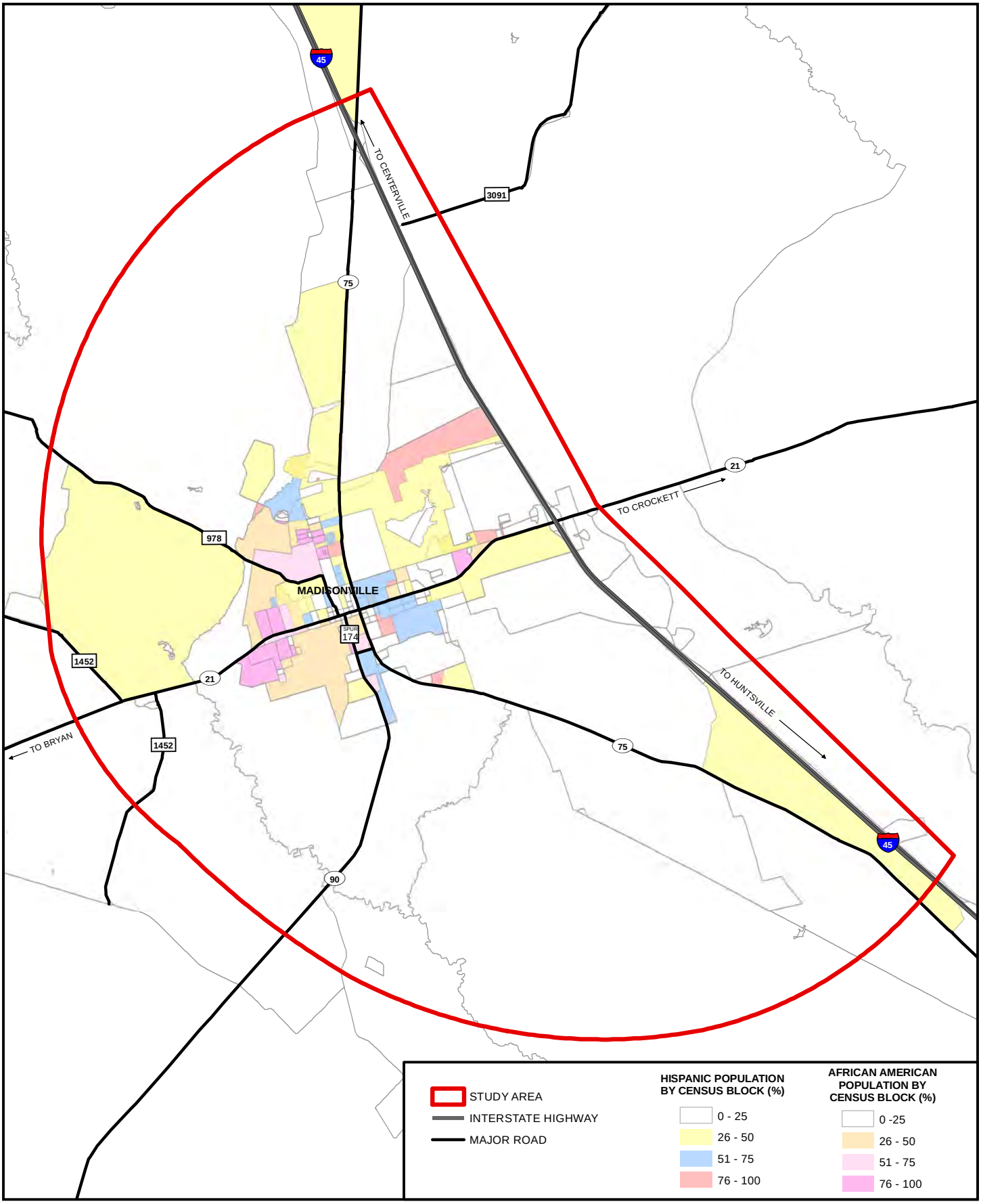
Mobility and Connectivity

Although the proposed relief route would be a limited access roadway, access to major roadways such as farm-to-market roads and state highways was critical to promote mobility to major destination points within the study area. Tying into existing roadways and infrastructure such as roadways and intersections at IH 45 was also viewed as an opportunity as they reduce the cost of construction.

Right-of-Way Factors

The alternative identification process also included existing utility ROWs (e.g. high voltage and major pipelines) and parcel boundaries. Right-of-way impacts were also adjusted by using the edge of ROWs and parcel boundaries where possible, as well as utilizing existing ROW in order to minimize the adverse impacts to properties.

Figures 3-3 and 3-4 show the constraints that were considered within the study area.



SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

DEMOGRAPHIC CONSTRAINTS

N

0 0.5 1

MILES

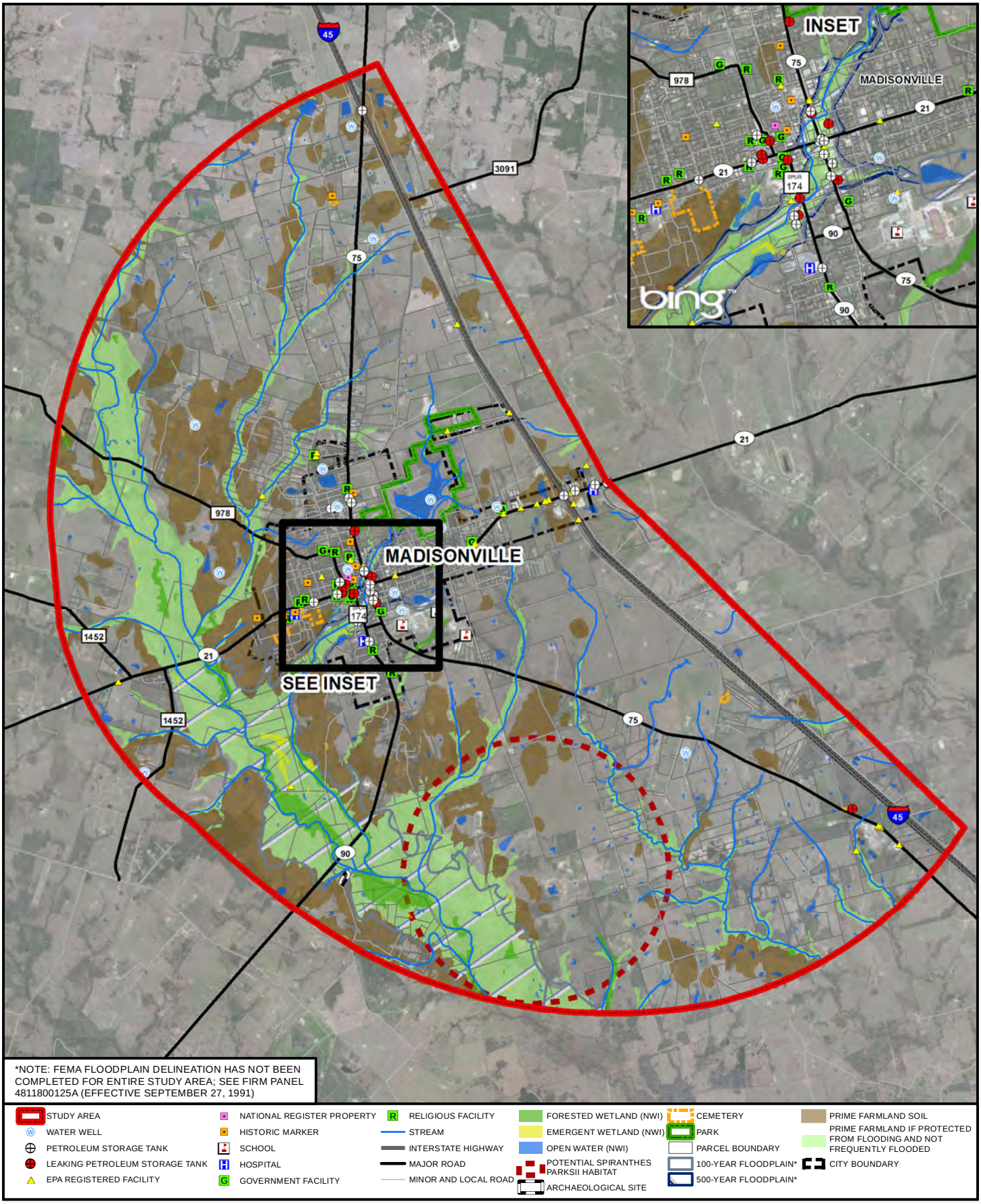
Texas Department of Transportation

HDR

SEPT 2014

FIGURE 3-3

SOURCE: CENSUS (2010)



SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

ENVIRONMENTAL CONSTRAINTS

N

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MILES

Texas Department of Transportation

HDR

SEPT 2014

FIGURE 3-4

AERIAL: MICROSOFT AND ITS SUPPLIERS (2013)

3.3 Preliminary Relief Route Alternatives

A total of eight preliminary relief route alternatives (including the No-Build) were developed to address the need and purpose of this study. There are five north build alternatives and two south build alternatives. The alternatives are labeled A through G and the No-Build alternative is self titled. The alternatives are as follows:

- No-Build
- Alternative A
- Alternative B
- Alternative C
- Alternative D
- Alternative E
- Alternative F
- Alternative G

These alternatives can be viewed in **Figure 3-5: Preliminary Relief Route Alternatives**. Each alternative can be viewed independently as well in **Figure 3-6: Individual Preliminary Relief Route Alternatives**.

After the preliminary relief route alternatives were developed a meeting was held with TxDOT on April 27, 2014 to review the alternatives. From this initial coordination meeting, three alternatives were selected to be presented at the Workgroup meeting. At the Work Group meeting the three alternatives were refined based upon local knowledge of topography and constraints information.

The alternative evaluation process, including a detailed description of each alternative and the rational behind its selection or recommendation, will be described below. A summary table of the rational for inclusion and constraints for each alternative is listed in **Table 3-1: Preliminary Relief Route Alternatives Evaluation**.

No-Build

The No-Build alternative was evaluated to provide a baseline for comparison. It consists of leaving the existing SH 21, US 90, and SH 75 in place as it is, making no improvements. This alternative is used for comparison of how much each build alternative could improve existing conditions. Due to the anticipated increase in traffic volumes and corresponding reduction in level of service/increased congestion, **this alternative was not selected as a viable alternative**.

Alternative A

Alternative A connects from SH 21 east of FM 1452 northward to SH 75 (where a projection of FM 3091 would connect to SH 75) south of the connection to IH 45. This alternative utilizes SH 75 to provide a connection to IH 45 and thereby would minimize cost for construction and ROW acquisition. This alternative also traverses far enough north of Madisonville (approximately 3.5 miles) to avoid most development impacts due to Madisonville City development along IH 45. This alternative does not improve the existing low capacity connection between the IH 45 frontage roads and SH 75. Alternative A could be extended to tie into IH 45 and to the east along FM 3091, if desired. Because of these factors, **this alternative was selected as a viable alternative**.

Alternative B

Alternative B connects from SH 21 east of FM 1452 northward to SH 75 (at Winters Road) south of the connection to IH 45. Alternative B is similar to Alternative A in that it utilizes the existing SH 75 corridor to provide a connection to IH 45, but it uses Winters Road to tie into SH 75 instead of taking new ROW. The connection to SH 75 is approximately a half-mile south of the Alternative A connection and only has minimal demographic impacts (along Winters Road). This alternative does not improve the existing low capacity connection between the IH 45 frontage roads and SH 75. Alternative B could eventually tie into IH 45 if desired, but it would create additional environmental impacts including impacting an existing oil well. **This alternative was not selected as a viable alternative** because this alternative does not allow for a future direct connect to IH 45 due to the proximity to the SH 75 or connect to existing roadways east of IH 45.

Alternative C

Alternative C connects from SH 21 east of FM 1452 northward to SH 75 (at Burr Road) south of the connection to IH 45. This alternative would use Burr Road to connect to SH 75. The connection at SH 75 is closer to Madisonville than Alternatives A and B and follows along existing property boundaries perpendicular to SH 75. This alternative could be extended to tie into IH 45 and to the east along FM 3091 but the connection with IH 45 would be skewed, increasing construction costs and limiting connections from northbound IH 45. Due to the anticipated constraints, **this alternative was not selected as a viable alternative**.

Alternative D

Alternative D connects from SH 21 east of FM 1452 northward to SH 75 (at Burr Road) south of the connection to IH 45. Alternative D uses an extension of Concord Road to connect to IH 45. This connection is consistent with TxDOT planning efforts of converting the IH 45 frontage roads to one-way. A connection at this location is approximately half way between the SH 75 and SH 21 exits. This tie in, provided a grade separation is constructed, allows motorists to conduct a U-turn along the frontage instead of having to make the movement at SH 75 or SH 21. This alternative would eliminate the need for traffic to travel through Madisonville and would and provide for a full western relief route and opportunity for an eastern extension. **This alternative was not selected as a viable alternative** because the indirect route of this alternative to IH 45 to avoid Mustang Creek creates a longer corridor compared to the more direct and efficient Alternative E.

Alternative E

Alternative E connects from SH 21 east of FM 1452 northward to SH 75 (at Burr Road) south of the connection to IH 45. Similar to Alternative D, this alternative uses the existing property boundaries and Concord Road to connect to IH 45. Instead of avoiding Mustang Creek, this alternative intersects it providing a direct route to IH 45. A connection at this location is approximately half way between the SH 75 and SH 21 exits. This tie in, provided a grade separation is constructed, allows motorists to conduct a U-turn along the frontage road instead of having to make the movement at SH 75 or SH 21. This connection is consistent with TxDOT planning efforts of converting the IH 45

frontage roads to one-way. This alternative would eliminate the need for southbound IH 45 traffic to travel through Madisonville in order to reach SH 21 west of Madisonville and would and provide for a full western relief route and opportunity for an eastern extension. Because of these benefits **this alternative was selected as a viable alternative**.

Alternative F

Alternative F connects from SH 21 east of FM 1452 southward to IH 45 at Boyd Road. This alternative's connection to IH 45 is consistent with TxDOT planning efforts and provides for a full western relief route and opportunity for an eastern extension. Since this alternative ties into an existing grade separation, construction of an additional intersection at IH 45 would not be necessary. Like Alternatives D and E, the location of the IH 45 tie in at Boyd Road is between SH 21 and Spur 67 south of Madisonville accommodating TxDOT's proposed one-way frontage roads. Alternative F also follows existing property boundaries and can be easily segmented for construction and still provide relief in the downtown area from vehicles traveling north on SH 90 toward IH 45. Although the constraints for this alternative include potential property owner impacts and several stream crossings **this alternative was selected as a viable alternative**.

Alternative G

Alternative G which connects from SH 21 east of FM 1452 southward to tie into SH 75, near CR 110 (Pee Dee Lane), is similar to Alternative A as it utilizes SH 75 to connect to IH 45 at Spur 67/CR 124. While this connection utilizes the existing interchange at CR 124, it is significantly out of the way for motorists that want to connect directly from SH 21 to IH 45. This alternative does not facilitate a full western relief route or position the relief route for an eastern extension. In addition a grade separation would need to be reconstructed to provide sufficient access to IH 45. For these reasons **this alternative was not selected as a viable alternative**.

Preliminary North and South Relief Route Evaluation

After the preliminary alternatives were developed the north alternatives were compared to the south alternatives to determine their potential affects on the Madisonville roadway network. This comparison was done to determine if only a north route was needed or if a south relief route was also needed. A summary of this comparison is shown in **Table 3-2: Preliminary North and South Relief route Opportunities and Constraints.**

Using 2014 and 2035 traffic volumes, the No-Build alternative was compared against the north and south alternatives, which both demonstrated a reduction in congestion within downtown Madisonville. If only a north relief route was constructed to IH 45, it would remove an estimated 673 vehicles per day from SH 21 and SH 75 while SH 90 through traffic utilizing SH 21 (estimated 1,606 vehicles per day) would still remain. If only a south relief route was constructed it would remove an estimated 1,606 vehicles per day through the downtown area and would continue to have a significant amount of through traffic (673 vehicles per day) along SH 75 and SH 21. Because of the benefits of both a north and south relief route have on the study area, it is

recommended that both the north and south alternatives should be combined into one western reliever route.

SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

PRELIMINARY ROUTE ALTERNATIVES

N

0 0.5 1

MILES

Texas Department of Transportation

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SEPT 2014

FIGURE 3-5

SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

PRELIMINARY ROUTE ALTERNATIVE A

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0 0.25 0.5

MILES

Texas Department of Transportation

HDR

SEPT 2014

FIGURE 3-6
SHEET 1

SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

PRELIMINARY ROUTE ALTERNATIVE B

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0 0.25 0.5

MILES

Texas Department of Transportation

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SEPT 2014

FIGURE 3-6
SHEET 2

SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

PRELIMINARY ROUTE ALTERNATIVE C

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0 0.25 0.5

MILES

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FIGURE 3-6
SHEET 3

SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

PRELIMINARY ROUTE ALTERNATIVE D

N

0 0.25 0.5

MILES

Texas Department of Transportation

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SEPT 2014

FIGURE 3-6
SHEET 4

SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

PRELIMINARY ROUTE ALTERNATIVE E

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0 0.25 0.5

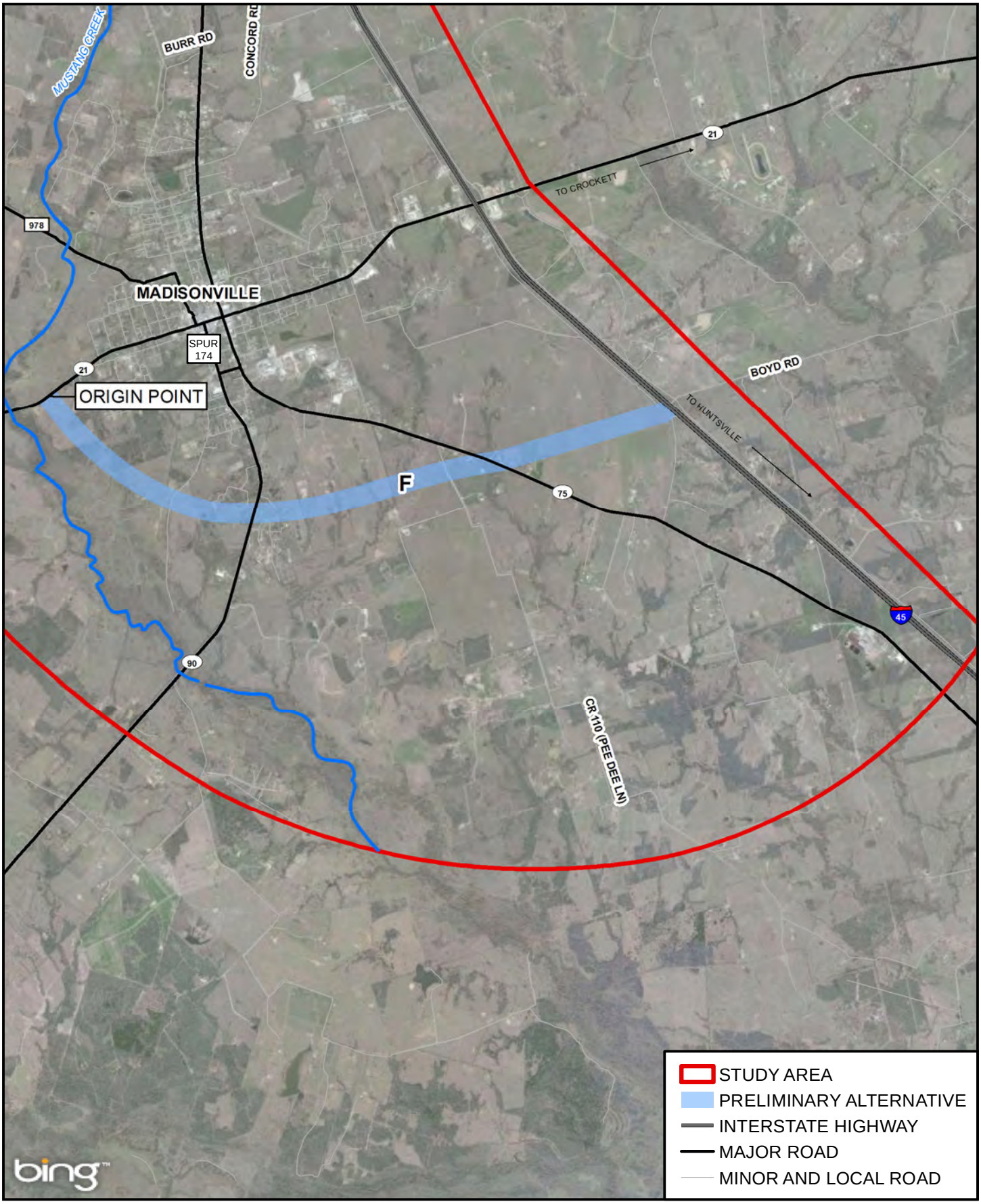
MILES

Texas Department of Transportation

HDR

SEPT 2014

FIGURE 3-6
SHEET 5



SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

PRELIMINARY ROUTE ALTERNATIVE F

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Texas Department of Transportation

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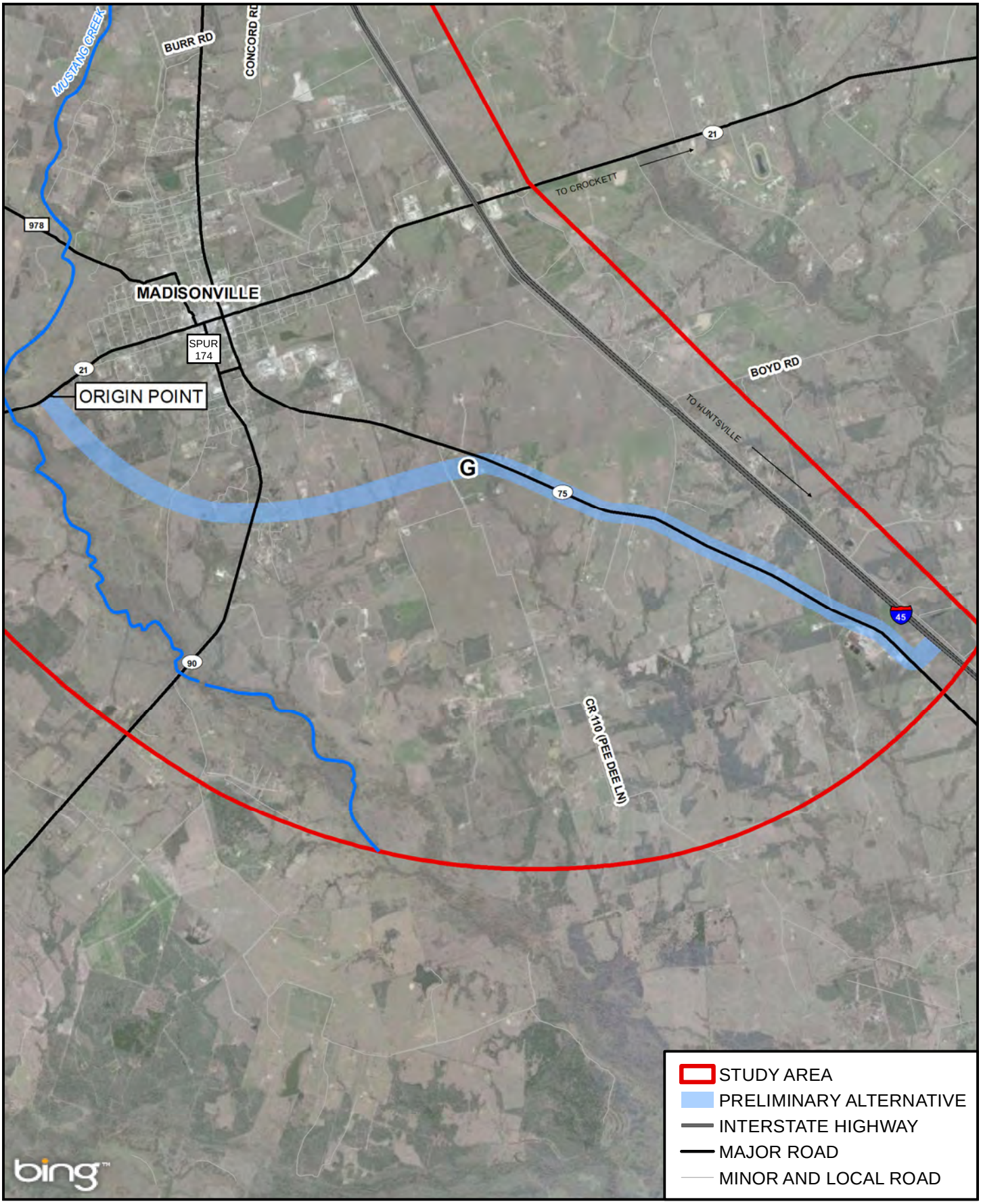
SEPT 2014

FIGURE 3-6
SHEET 6



SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

PRELIMINARY ROUTE ALTERNATIVE G

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0 0.5 1

MILES

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FIGURE 3-6
SHEET 7

Table 3-1 – Preliminary Relief Route Alternatives Evaluation

Preliminary Evaluation	Benefits	Constraints	Result
Alternative A	• Uses existing SH 75 North corridor • Provides connections to SH 75, FM 978 and SH21 • Far enough north of Madisonville to avoid most socioeconomic impacts • Leaves the option to connect to IH 45 at FM 3091 in the future • Eliminates the need for thru traffic to use local infrastructure	• Does not connect to IH 45 to help develop a full western loop or position the loop for an eastern extension. • Stakeholders stated that the alternative is too far north of Madisonville and will not accommodate growth patterns to support it. • Intersects three stream crossings	Recommended
Alternative B	• Uses existing SH 75 North and Winters Rd. corridors • Provides connections to SH 21, SH 75 and FM 978 • Eliminates the need for thru traffic to use local infrastructure	• Does not connect to IH 45 to help develop a full western loop or position the loop for an eastern extension. • Like Alternative A, stakeholders stated this alternative is too far north of Madisonville • Intersects three stream crossings	Not recommended
Alternative C	• Uses the existing Burr and North Concord Rd. corridor • Provides connections to SH 21, SH 75, FM 978, and Concord Road • Eliminates the need for thru traffic to use local infrastructure	• Potential environmental justice impacts (displacements) to residences along Burr Rd. • Does not connect to IH 45 to help develop a full western loop or position the loop for an eastern extension. • Lack of existing infrastructure at IH 45 would require a grade separation • Intersects four stream crossings	Not recommended
Alternative D	• Follows property lines and uses the existing Concord Road corridor to connect to IH 45 • Connection to IH 45 is consistent with TxDOT planning efforts and provides for a full western loop and opportunity for an eastern extension • Provides connections to SH 21, SH 75 and FM 978 • Can easily be constructed in segments that would immediately relieve traffic in Madisonville • Eliminates the need for thru traffic to use local infrastructure	• Lack of existing infrastructure at IH 45 would require a grade separation • The indirect route to IH 45 to avoid Mustang Creek creates a longer corridor compared to Alternative E. • Intersects three stream crossings	Not recommended
Alternative E	• Follows property lines and uses the existing Concord Road corridor to connect to IH 45 • Connection to IH 45 is consistent with TxDOT planning efforts and provides for a full western loop and opportunity for an eastern extension • Provides connections to SH 21, SH 75 and FM 978 • Can easily be constructed in segments that would immediately relieve traffic in Madisonville • Eliminates the need for thru traffic to use local infrastructure	• Lack of existing infrastructure at IH 45 would require a grade separation • Potential environmental justice impacts (displacements) • Intersects four stream crossings	Recommended
Alternative F	• Connection to IH 45 is consistent with TxDOT planning efforts and provides for a full western loop and opportunity for an eastern extension • Would tie into the existing grade separation at IH 45. • Provides connections to SH 21, SH 90, and SH 75 • Can easily be constructed in segments that would immediately relieve traffic in Madisonville • Follows property boundaries	• Potential displacements • Intersects five streams and flood plain	Recommended
Alternative G	• Uses existing SH 75 corridor • Provides connections to SH 21, SH 90, and SH 75 • Along existing infrastructure	• Does not connect to H 45 to help develop a full western loop or position the loop for an eastern extension. • Alternative is significantly out of the way for motorist that need to directly access IH 45 • Lack of existing infrastructure at IH 45 would require a grade separation • Potential displacements • Intersects four streams and flood plain	Not recommended

Table 3-2: Preliminary North and South Relief Route Opportunities and Constraints

Relief Route Location	Alternatives	Opportunities	Constraints
No Relief Route	No Build	• No socioeconomic or environmental impacts. • No construction or engineering costs.	• Total traffic would Increase from an estimated 13,000 to 18,500 vehicles per day through Madisonville by 2035. • Truck traffic would Increase from an estimated 1,500 to 2,100 trucks per day by 2035.
North Relief Route	A, B, C, D, E	• Would remove an estimated 673 vehicles (77 trucks) from SH 75 and SH 21 per day in 2035. • Could reduce crash rates on SH 21 and SH 75. There were over 200 crashes in the past 5 years along these roadways including one fatality within the study area.	• Cut-through traffic traveling to SH 90 from IH 45 would remain. An estimated 1,606 vehicles (288 trucks) travel this route per day in 2035. • Potentially fewer environmental impacts than the South Relief Route (stream crossings, floodplains).
South Relief Route	F, G	• Would remove an estimated 1,606 vehicles (288 trucks) from SH 21 per day in 2035. • Could reduce crash rates on SH 21 and SH 90. There were over 200 crashes in the past 5 years along these roadways including one fatality within the study area.	• Madisonville would continue to have an estimated 673 vehicles (77 trucks) of cut-through traffic along SH 75 and SH 21 per day in 2035. • Construction and engineering costs potentially greater than the North Relief Route (stream crossings, corridor length).

3.4 Recommended Relief Route Alternative

Based on the results of the preliminary alternatives evaluation, Alternatives E and F provide the most comprehensive and effective characteristics to provide traffic relief in downtown Madisonville. By locating a route to the north and south of Madisonville that connects to IH 45, vehicles that travel on SH 21 through downtown Madisonville have access to SH 90, SH 75, or SH 21 west toward Bryan-College Station. This would allow non-local/freight traffic to avoid the downtown area on a more direct route and at a higher rate of speed. Overall, a north and south relief route would

reduce the load on the local roadway network and as a result minimize accidents and decrease congestion and intersection delays. Unlike other relief route alternatives, the proximity of the routes to Madisonville and their connection location at IH 45 are consistent with the City's Comprehensive Plan and TxDOT's planned improvements to IH 45. These locations accommodate future plans by increasing the mobility in the downtown area while maintaining its current economic conditions and as well as facilitates the conversion of IH 45 frontage roads to one-way operation. Although there would be some environmental impacts, the location of these alternatives makes the most efficient use of existing roadways and parcel boundaries to minimize further impacts. **Both recommended alternatives were consolidated to form one recommended alternative**. This alternative can be viewed in **Figure 3-7: Recommended Relief Route Alternative**.

3.5 Public Outreach

Workgroup Meeting

A Workgroup was developed In order to provide community input on current issues and constraints currently being experienced along SH 21 through downtown Madisonville. Workgroup membership was selected to represent a variety of interests in the community and included representatives from Madison County, the City of Madisonville and the Madison County Independent School District.

On May 22, 2014 a Workgroup meeting was held to receive input regarding the three proposed viable alternatives (A, E and F). A brief description of the findings of the traffic study and the preliminary alternatives development process was given by the TxDOT staff.

Of the three viable alternatives, the Workgroup was in agreement to exclude Alternative A and favored Alternatives E and F (see **Figure 3-5**) as preferred alternatives. Alternative A was excluded due to its lack of a connection to IH 45. The Workgroup favored Alternatives E and F because those alternatives:

- have minimal impacts to property owners and other environmental constraints;
- create connections to SH 75 and IH 45;
- are in close proximity to Madisonville;
- provide U-turn access to motorists along future IH 45 one-way frontage roads;
- provide secondary access to SH 75 for motorists who miss the primary SH 75 exit; and
- can easily be constructed by segments and still provide immediate relief to downtown Madisonville.

The Workgroup evaluated additional impacts to properties that TxDOT may have missed. Comments were given to the TxDOT staff and were addressed at the request of the Workgroup. **During this time it was agreed upon by the Workgroup that Alternatives E and F should be combined to make a complete western relief route.**

In addition, the Workgroup agreed to a preliminary concept of segments for construction for the combined alternative. The order of construction was evaluated as a part of this feasibility study and is discussed in **Section 4: Identification and Prioritization of Segments of Independent Utility (SIU)**. Detailed information about the Workgroup meeting including materials provided at the meeting can be viewed in **Appendix B**.

Citizens from Madisonville and the surrounding area review the preliminary and recommended SH 21 relief route alternatives.

Public Meeting

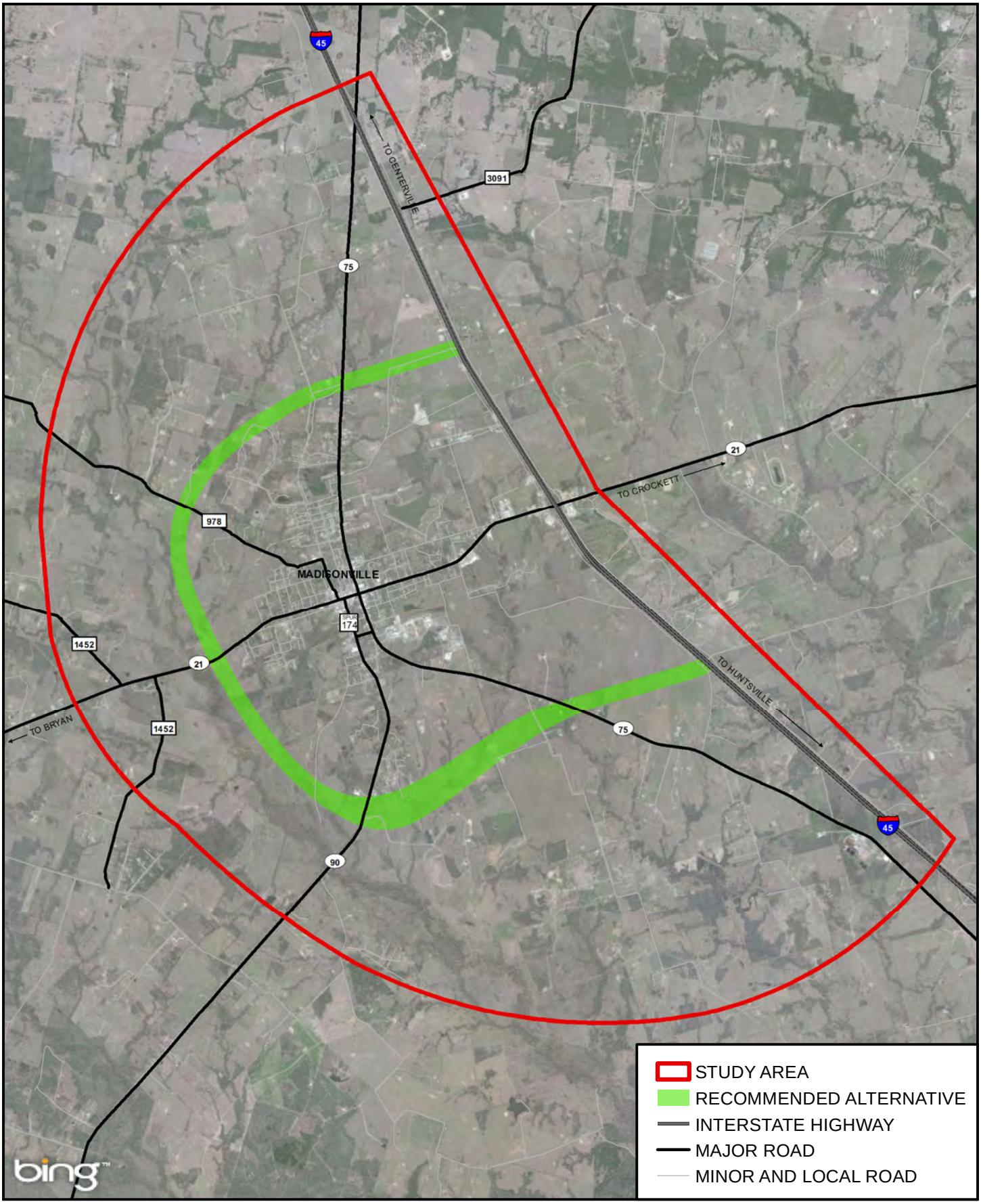
On July 22, 2014 an open house-style Public Meeting was held to present the Recommended Alternatives to the public. More than 125 people attended and 15 written comments were received.

TxDOT officials communicated the purpose and need of the study, the studies background and planning process, and the recommended alternative to the public. Questions from the public were also answered.

Typical comments and concerns from the public included:

- Project costs and timing;
- Comments about the support or objection to the project;
- Impacts to affected property owners;
- Other traffic issues that should be addressed in Madisonville; and
- Concern over the southern relief route bisecting the subdivisions on SH 90.

As a result of this feedback, TxDOT refined the recommended alternative south of Madisonville by increasing the corridor width to provide opportunities to avoid the subdivisions at SH 90. A list of short-term improvements (**Section 5**) was also developed in response to several traffic related comments about SH 21. Public meeting materials can be viewed in **Appendix B**.



SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

RECOMMENDED ROUTE ALTERNATIVE

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Texas Department of Transportation

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SEPT 2014

FIGURE 3-7

4. Identification and Prioritization of Segments of Independent Utility (SIU)

Once the recommended relief route alternative was determined, the next step was to establish the segmentation limits within the alternative in order to develop the priority of construction for each segment. At the Workgroup meeting it was decided to segment the alternative based on logical termination points such as major intersecting roadways because of the amount of traffic it would divert when constructed. The recommended segments are as follows:

- Segment 1: IH 45 to SH 75 North
- Segment 2: SH 75 North to SH 21
- Segment 3: SH 21 to SH 90
- Segment 4: SH 90 to SH 75 South
- Segment 5: SH 75 South to IH 45

4.1 Segment Evaluation Criteria

The recommended segments were evaluated using four specific criteria that are key in the development and construction of each segment. The four criteria are listed below:

- Transportation Mobility
- Environmental Impacts
- Engineering
- Project Costs

The purpose of this evaluation is to determine the most effective order to construct the segments that would remove the most amount traffic from downtown. For each criterion the segments were compared and prioritized in order of construction from first to last. A summary of the segment's criteria and rankings are shown in **Table 4-1: Segment Construction Prioritization Rankings.**

Transportation Mobility

The transportation mobility criterion involved a quantitative look at the amount of 2035 traffic that would navigate around downtown Madisonville as a result of a fully built relief route and the safety impacts diverting this traffic would have downtown. It also evaluated how effective the relief route segments would be if they were constructed independently of one other and paired with adjacent segments. The traffic movements and volumes that the criteria are based on are listed in **Table 4-2: Traffic Volumes Diverted by Movement**.

Table 4-1: Segment Construction Prioritization Rankings

Segment Criteria	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
	IH 45 to SH 75 North	SH 75 North to SH 21	SH 21 to SH 90	SH 90 to SH 75 South	SH 75 South to IH 45
Transportation Mobility					
2035 Total Traffic Volumes*	2,189	2,189	1,869	1,050	1,050
2035 Truck Volumes*	303	303	368	216	216
Traffic Diverted if Segment is Independently Constructed	0 Vehicles	957 vehicles	0 Vehicles	414 vehicles	0 Vehicles
Maximum Traffic Diverted to Segment when Constructed with an Adjacent Segment**	Segment 2 957 vehicles	Segment 3 2,189 vehicles	Segment 2 2,189 vehicles	Segment 3 636 vehicles	Segment 4 414 vehicles
Environmental					
Potential Displacements	3	18	1	12	5
Wetlands (acres)	<1	9	39	1	6
Stream Crossings	1	4	1	3	2
Potentially Endangered Habitat (acres)	None	None	None	118	None
Affected Environmental Justice Population	None	36	None	None	None
Engineering					
Intersection and Interchange Requirements	1	3	1	1	1
Right-of-Way Required (acres)	34	105	62	68	56
Project Costs					
Ultimate Segment Cost (millions)	$10	$29	$15	$18	$11
Segment Efficiency Factor	$4,110	$3,840	$3,910	$7,670	$5,720
Prioritization Order	**4**	**1**	**2**	**3**	**5**

* Volumes are based on a fully constructed relief route.

** Where more than one adjacent segment exists the higher diverted volume is listed.

2035 Total Traffic Volumes

This criterion provides an overall view of the functionality of the relief route as construction is staged. Each Segment was evaluated based on the amount of traffic each segment would divert from Madisonville if the relief route were complete. **A total 3,239 vpd would be diverted around the downtown area.** If the full relief route were constructed, Segment 1 and 2 would both account for 2,189 vpd while Segments 4 and 5 would account for 1,051 vpd. The traffic numbers for these pairs of segments are the same because they function similarly as they both divert traffic to SH 90 and SH 21 (Segment 3). Segment 3 would accommodate 1,869 vpd as most traffic would come from Segments 1, 2, 4, and 5. An illustration of how much traffic would be diverted by segment can be viewed in **Figure 4-1: Traffic Volumes Diverted by Segment**.

The total 2035 traffic reduction (3,239 vpd) for the proposed relief route would potentially reduce traffic accidents along SH 21, SH 75, and SH 90. Between the years of 2009 and 2013, over 200 crashes have been reported within the study area of which one of those was a fatality. According to TxDOT's 2013 Statewide Traffic Crash rates, diverting vehicles from a two-lane undivided roadway to a rural four-lane divided roadway would reduce accident rates approximately 55%. It is anticipated that a reduction of over 3,200 vpd from the downtown area would reduce the number of accidents within the study area.

2035 Truck Volumes

Although trucks are included in the total vehicles estimates discussed in the previous criterion, their impacts on safety and the roadways they drive on cannot be overstated. This criterion was included in this evaluation because truck traffic through Madisonville has a major impact on safety and the roadway due to their size compared to other vehicles, the types of cargo they carry, and the physical impacts they impose on the roadways in the form of turning radius at intersections and general wear and tear.

It was expected that Segment 3 would divert the most trucks per day (368) as it is a major thoroughfare for trucks -- which was reflected in the traffic report as well. Segments 1 and 2 and Segments 4 and 5 would divert the same amount of truck traffic at 303 and 217 trucks per day, respectively.

Table 4-2: Traffic Volumes Diverted by Movement

Location	2014 Vehicles	2014 Trucks	2035 Vehicles	2035 Trucks
From Point A to Point B	234	21	332	29
From Point A to Point D	247	79	351	113
From Point A to Point E	131	10	187	14
From Point B to Point A	206	29	293	41
From Point B to Point I	469	98	667	139
From Point C to Point A	102	18	145	25
From Point C to Point I	62	3	88	4
From Point F to Point A	200	43	285	62
From Point F to Point I	259	28	368	40
From Point I to Point B	289	34	411	48
From Point I to Point D	32	1	46	2
From Point I to Point E	46	2	66	3
Total	**2,279**	**365**	**3,239**	**519**

Note: 2014 and 2035 vehicle volumes include trucks.

Traffic Diverted if Segment is Independently Constructed

The purpose of this criterion was to evaluate how effective each relief route segment would be if it was constructed independently of the other relief route segments. In other words, "if this segment was the only segment built how much traffic would it remove from downtown Madisonville?" Establishing the most effective segment played a role in determining which segment would be recommended to be constructed first. Although this criterion was important, it wasn't the only factor to determine the construction order as it was dependent on the effectiveness of adjacent segments as well.

As shown in **Table 4-1**, if constructed independently of the other segments, Segment 2 would divert 957 vehicles per day (vpd) from the downtown area. Segment 4 would divert less than half as many vehicles (414), and Segments 1, 3, and 5 would not divert any vehicles. Since a significant amount of through traffic downtown is northbound and eastbound, Segment 2 would have the most impact because it provides direct access to SH 75 and SH 21, which are primary destination points of traffic in the area.

Maximum Traffic Diverted to Segment when Constructed with an Adjacent Segment

To get the most out of how the relief route is constructed, it was important to place an emphasis on diverting the most traffic as early as possible in the sequence. Evaluating the maximum amount of traffic diverted from downtown Madisonville based on the construction of paired segments showed the dependency of each segment to one another. As discussed previously, only two segments would be able to function independently, while the other three segments would have no impact on the downtown area if constructed by themselves. But by pairing adjacent segments together and evaluating the amount of traffic they divert from downtown, it became evident that pairing segments together during construction would divert the most traffic from Madisonville.

Constructing Segment 3 and Segment 2 together would have the greatest impacts diverting 2,189 vpd. Segment 1 constructed with Segment 2 would divert 957 vehicles from downtown. This was expected as both segments accommodate the same traffic pattern. Constructing Segment 3 with Segment 4 would divert the fourth highest amount of traffic at 636 vpd. Lastly, constructing Segment 5 with Segment 4 would only divert 414 vehicles.

Environmental Impacts

Each segment will have a specific impact to its surrounding environment. These impacts primarily include; property displacements, as well as impacts to wetlands, stream crossings, endangered species, and environmental justice (EJ) populations. These criteria are imperative to project planning because they can have a significant impact on construction timing and schedule as avoidance, remediation or mitigation efforts may be needed to fulfil NEPA guidelines. More information about the environmental impacts can be viewed in the environmental constraints analysis report in **Appendix C**.

Wetlands

Wetland impacts are classified as Waters of the US and are protected by federal statues and typically include areas adjacent to rivers and streams. The National Wetland Inventory (NWI) was used to evaluate impacts within the study area.

According to the NWI, the study area for Segment 3 encompasses the most wetlands at 39 acres. This is because the alignment of this segment almost runs parallel with the waterway (Town Branch) it crosses. The study area for Segment 1 would encompass the least amount of wetland (less than one acre), while the remaining segments would encompass between one and nine acres within their study area.

Stream Crossings

In addition to environmental impacts, stream crossings are important to consider in a corridor study because they affect the permitting cost and type of construction used to cross each waterway.

Segments 1 and 3 would cross one crossing each. Segment 2 affects the most streams (4), Segments 4 (three crossings) and 5 (two crossings).

Threatened and Endangered Species

Only Segment 4 would have potential impacts to endangered species habitat as this segment's study area runs through a potential Navasota Ladies' Tresses habitat. As shown if **Figure 3-4: Environmental Constraints**, a radius determined by the Texas Parks and Wildlife Department (TPWD) does not mean that Navasota Ladies' Tresses exists in this area, but the deemed area has physiographic characteristics would make a suitable habitat for the species. Approximately 118 acres of Segment 4 of the study corridor traverses through this area.

Environmental Justice Populations

Segments 1, 3, 4, and 5 would not have disproportionate impacts to minority or low income population (Environmental Justice (EJ) impacts) impacts. Segment 2 would impact a total of three U.S. Census blocks possibly affecting minority or low income population (total EJ population of 36 people out of 98 (37%)).

These three census blocks have potentially substantial Hispanic populations. The 2010 U.S. Census indicates that the Hispanic population of Block 1046 (Burr Rd. and areas to the north) is approximately 30 percent (7 persons out of a population of 23), that of Block 1030 (Mustang Loop) is approximately 40 percent (22 persons out of a population of 55), and that of Block 1034 (FM 978 and areas to the south) is approximately 35 percent (7 persons out of a population of 20).

Potential Displacements

Potential displacements in this study only refer to existing residences or commercial establishments located within the study corridor and does not necessitate that the residences or commercial properties will be displaced. Impacts to residential properties may be less because the width of the study corridor (800 feet) provides the ability to miss these potential displacements. With the study corridor Segments 1, 3 and 5 would have the least residential impacts at 3, 1 and 5, respectively. Segments 2 (18) and 4 (12) would have the most impacts. The location of these impacts can be viewed in **Figure 4-2: Potential Displacements and Impacted Parcels**.

Engineering

Required ROW and intersection and interchange requirements were evaluated to determine the amount of bridge structures, intersection construction and additional right-of-way which would be needed to construct each segment. These elements are important to consider because they are directly related to the cost of each segment and can affect the timing of construction due to the time need for right-of-way acquisition procedures.

Intersection and Interchange Requirements

The entire relief route would intersect with four major roadways (IH 45, SH 75, FM 978, and SH 21) and would require the construction of seven grade separated intersections. Segment 2 would require three bridges (SH 75 North, FM 978 and SH 21) and the remaining segments would only require one. Since this proposed relief route would be a limited access roadway and driveways would not be grade separated, only interchange requirements at each major roadway were evaluated. Additional ROW (greater than 250 feet) may be needed to accommodate the grade separated intersections and their ramps.

Right-of-Way

For Segments 1, 2, 3, and 5 the study corridor width is 800 feet. In segment 4 the study corridor width increases to approximately 1,800 feet to provide options for future alignments to avoid the subdivisions near SH 90. The ROW needed within each segment includes the total length of each segment and width of the ultimate typical section (250 feet).

Segment 2 would require the most ROW (105 acres) as it is the longest of the segments and Segment 1 would require the least amount of ROW (34 acres) because it the shortest. Segment 3, 4, and 5 would require approximately the same amount of ROW at 62, 68 and 52 acres, respectively.

Project Cost

The cost of a project plays a significant role in the planning, timing and financing of a project. The cost criteria discussed below evaluate the cost of each individual segment and its efficiency factor in relation to the other segments. The elements that make up the cost estimate can are located in Section 5 and Appendix D.

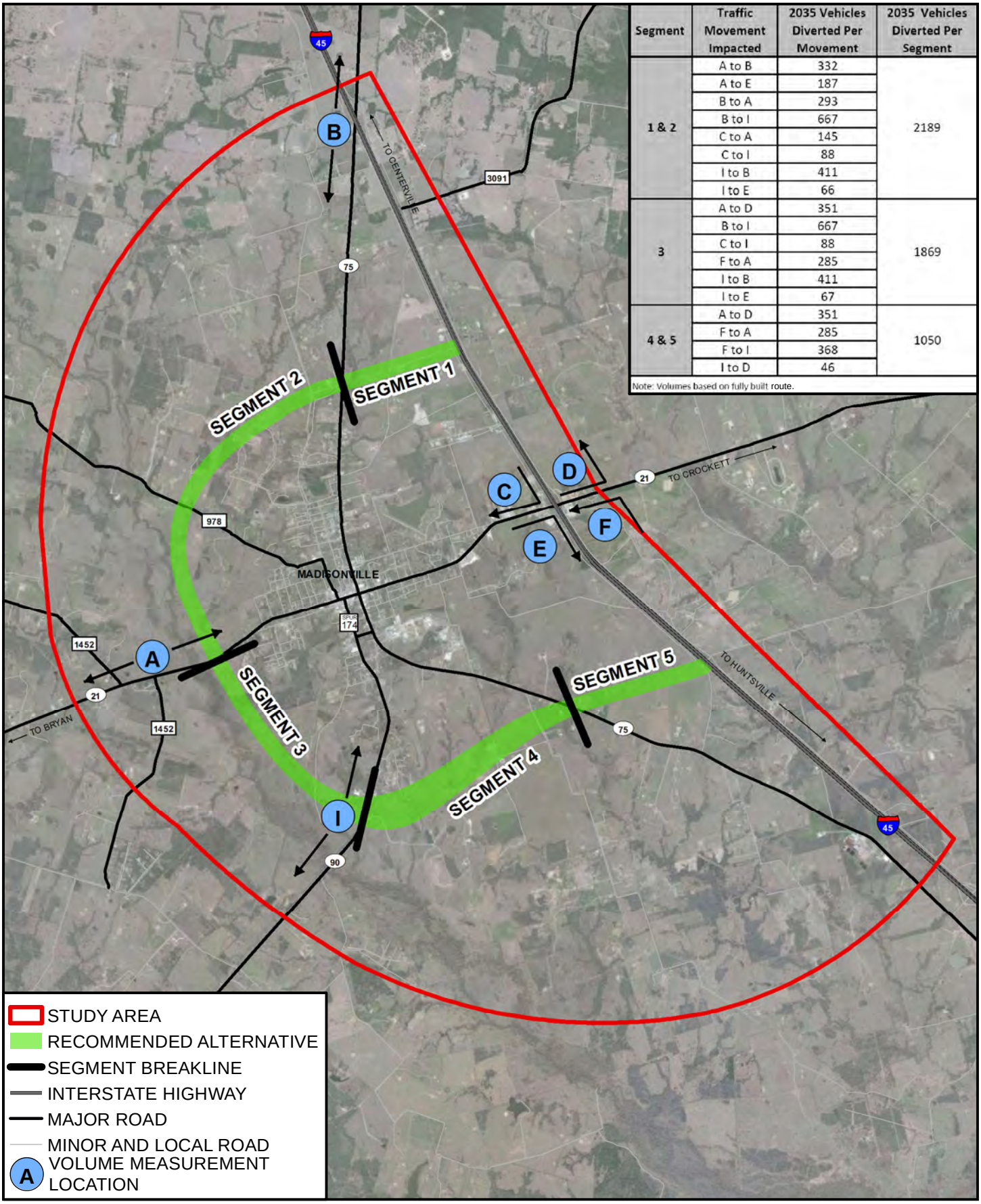
Segment Cost

The most costly of the five segments is Segment 2. Segment 2 would cost approximately $29 while the other segments cost between $10 million and $18 million to construct. The disparity in costs between Segment 2 and the rest of the segments is due to its length. Segment 2 is approximately 3.5 miles long which is over twice as long as the next longest segment (Segment 4).

Segment Efficiency Factor

The segment efficiency factor was used as a criterion to evaluate the return on investment per vehicle per mile for each segment of the fully constructed relief route. Factors that affect it were length of each segment, the traffic volumes diverted from Madisonville and cost of each segment.

Segment 2 has the best efficiency factor at $3,840 per vehicle per mile because although costly, it removes a majority of through traffic from the downtown area. Segments 1 and 3 have slightly worse factors ($4,110 and $3,910, respectively) even though they are shorter segments and cost less than Segment 2 they still contribute to diverting a significant amount of traffic around Madisonville. Segments 4 and 5 ($7,670 and $5,720, respectively) have the highest factors because the cost is significant relative to the length of each segment. Elements such as interchanges, bridges at stream crossings and required ROW contribute to the total cost.



Segment	Traffic Movement Impacted	2035 Vehicles Diverted Per Movement	2035 Vehicles Diverted Per Segment
1 & 2	A to B	332	2189
	A to E	187	
	B to A	293	
	B to I	667	
	C to A	145	
	C to I	88	
	I to B	411	
	I to E	66	
3	A to D	351	1869
	B to I	667	
	C to I	88	
	F to A	285	
	I to B	411	
	I to E	67	
4 & 5	A to D	351	1050
	F to A	285	
	F to I	368	
	I to D	46	

Note: Volumes based on fully built route.

SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

TRAFFIC VOLUMES DIVERTED BY SEGMENT

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Texas Department of Transportation

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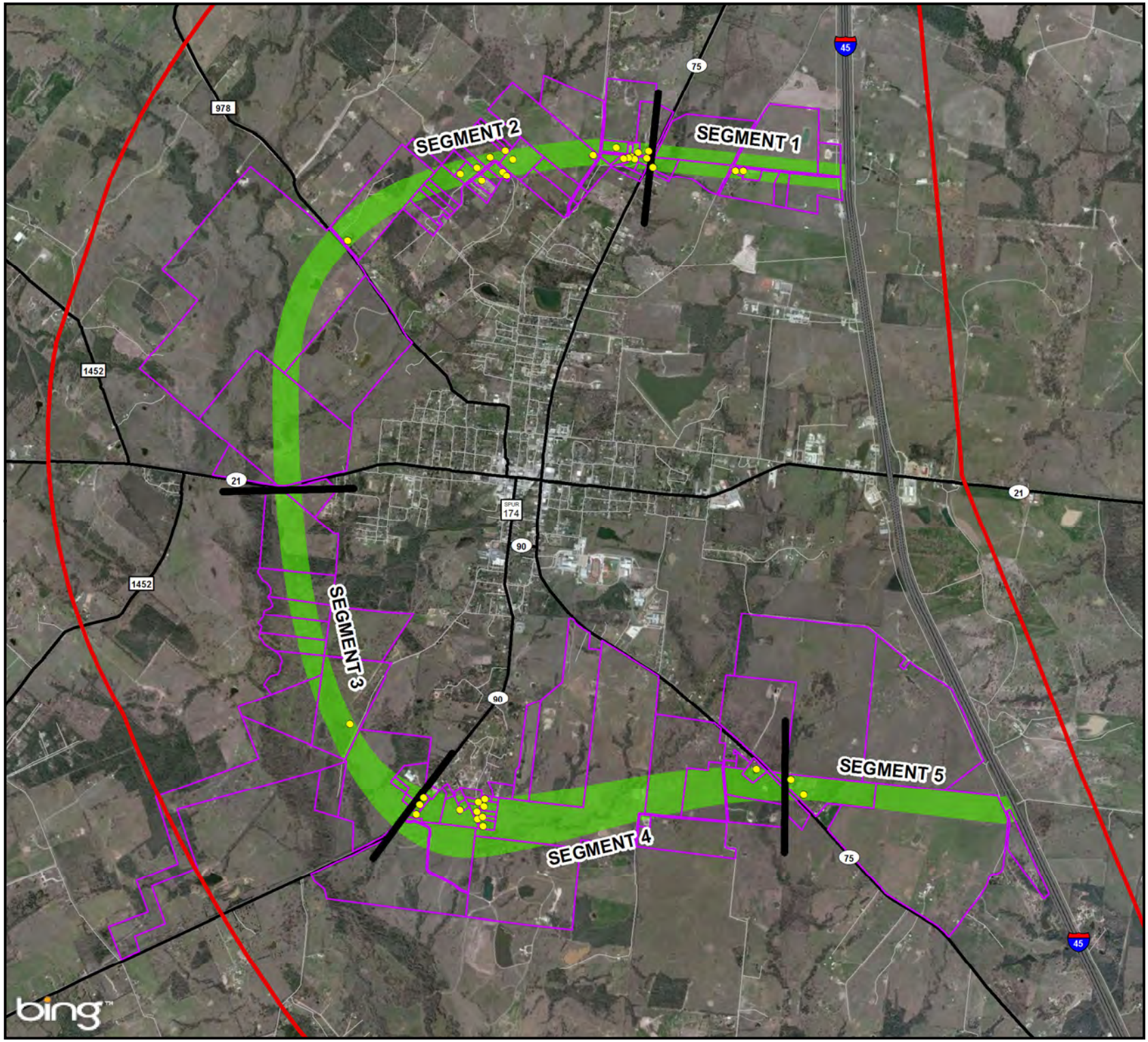
SEPT 2014

FIGURE 4-1



SH 21 RELIEF ROUTE FEASIBILITY STUDY

MADISON COUNTY, TEXAS

POTENTIAL DISPLACEMENTS AND IMPACTED PARCELS

- STUDY AREA
- RESIDENTIAL STRUCTURE
- PARCEL BOUNDARY
- RECOMMENDED ALTERNATIVE
- SEGMENT BREAKLINE
- INTERSTATE HIGHWAY
- MAJOR ROAD
- MINOR AND LOCAL ROAD

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Texas Department of Transportation

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4.2 Prioritization Recommendation

This section discusses each segment's justification for recommended construction priority based on the results of the segment's prioritization rankings. Each segment and is construction priority is shown in **Figure 4-3: Recommended Relief Route SIUs and Construction Prioritization**.

Priority #1: Segment 2 – SH 75 North to SH 21

It is recommended that of the five segments Segment 2 be constructed first because it would divert the most through vehicles around Madisonville if either constructed by itself (957 vpd) or as a part of the fully constructed relief route (2,189 vpd).

If constructed with Segment 1, this segment would not divert any additional through traffic from downtown. But when constructed with Segment 3, an additional 1,232 vpd through trips would be diverted, maximizing the benefit to Madisonville traffic. Because of the effects Segment 3 would have on traffic diversion, it is recommended that Segment 2 be constructed before Segment 3.

Although Segment 2 would require the most additional ROW, no environmental justice populations or areas of threatened endangered species habitat would be affected.

Priority #2: Segment 3 – SH 21 to SH 90

As stated in the previous paragraphs, it is recommended that Segment 3 be constructed after Segment 2 because when combined they would divert most of the through traffic (2,189 vpd) out of downtown. If Segment 3 were constructed by itself it would not relieve any traffic from downtown, and when constructed with Segment 4 only 636 vpd would be diverted away from Madisonville.

When constructed after Segment 2, 10 of the 12 traffic movements analyzed in this study would be avoided. Motorists that would typically exit SH 75 North from IH 45 would use this segment to connect to SH 90 and motorists that would typically travel SH 21 from SH 90 would use this segment to connect to SH 75 North. In addition, since Segment 3 is also a major truck route, combined with Segment 2 it would increase safety and reduce roadway maintenance cost through the downtown segment. Segment 4 would require the second most additional ROW (68 acres) of which several acres could be in a habitat for the Navasota Ladies' Tresses, a federally listed endangered plant.

Priority #3: Segment 4 – SH 90 to SH 75 South

Segment 4 should be built after Segment 3 because it would account for the remaining two traffic movements analyzed and would complete the final link in fully diverting traffic that would cut through Madisonville. Constructing this segment third would allow motorists that are travelling northbound on IH 45 to SH 21 west of Madisonville and eastbound on SH 21 west of Madisonville to bypass the downtown area by using SH 75 South.

If built independently, this segment would only divert 414 vpd (mostly from SH 90) from Madisonville. If built independently then combined with Segment 5 no additional vehicles would be diverted. Segment 3 would divert an additional 222 vpd when Segment 4 is constructed.

Priority #4: Segment 1 – IH 45 to SH 75 North

Segment 1 is recommended to be built after Segment 4 because it would accommodate the same traffic volume as Segment 3 (2,189 vpd) and provide an alternative crossing that may include a U-turn option) for motorists on IH 45 between SH 75 North and SH 21 should the frontage roads in this area be converted to one-way. Currently TxDOT has plans to create one-way frontage roads south of SH 21 along IH 45 to Boyd Road. North of SH 21 two-way frontage roads would remain. Constructing Segment 1, which would tie into IH 45, would create an alternative crossing for motorists approximately half way between SH 75 North and SH 21 and would eliminate motorists from having to use the SH 21 bridge for a turnaround location.

Priority #5: Segment 5 – SH 75 South to IH 45

Segment 5, independently constructed would not have an impact diverting vehicles from Madisonville, and combining it with Segment 4 would divert 414 vpd. However, the amount of traffic that would be diverted around Madisonville would not outweigh the operational benefits of constructing Segment 1 before Segment 5, as constructing Segment 1 would provide a direct connection from IH 45 for the vehicles that would travel along Segment 2 (2,189 vpd) and provide the opportunity for motorists along IH 45 to make a U-turn should the frontage roads be converted to one-way. Because of these reasons, it is recommended that this segment be constructed as the final link in a full western relief route around Madisonville.

4.3 Recommended Prioritization Summary

The recommended order in which each segment should be constructed would provide the most efficient way of diverting traffic around Madisonville.

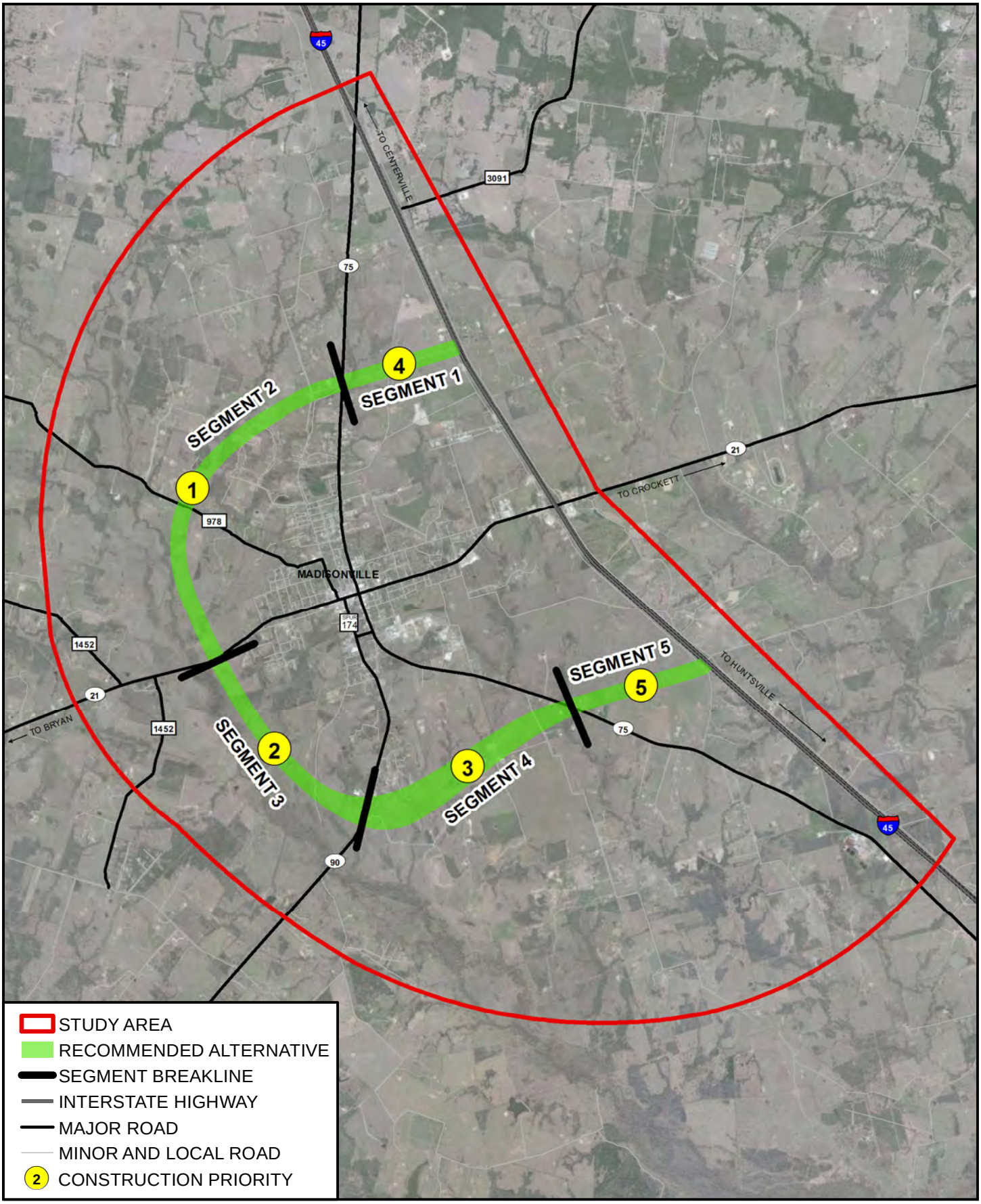
Segment 2 should be constructed first because it would divert the most vehicles from downtown Madisonville if the segment were either constructed by itself (957 vpd) or as a part of the fully constructed relief route (2,189 vpd). Segment 3 should be constructed after Segment 2 because when combined they would divert most of the through traffic (2,189 vpd) out of downtown. It is recommended that Segment 4 should be built after Segment 3 because it would divert the remaining through traffic trips from downtown Madisonville. Segment 1 is recommended to be built after Segment 4 because it would accommodate the same traffic volume as Segments 2 and 3 (2,189 vpd) and provide an alternative crossing (that may include a U-turn option) for motorists on IH 45 between SH 75 North and SH 21. Finally, Segment 5 should be constructed last because it would have minimal impact in diverting traffic around Madisonville once Segment 4 is built. However, this segment is important as it would tie into IH 45 and create the final link of the relief route.

Table 4-3: Traffic Diverted by Construction Priority (Year 2035) summarizes the amount of traffic diverted around Madisonville base on the recommended construction prioritization.

Table 4-3: Traffic Diverted by Construction Priority (Year 2035)

Priority	Segment	2035 Traffic in Downtown (vpd)	2035 Traffic Diverted from Downtown (vpd)
#1	Segment 2 SH 75 North to SH 21	18,515	957
#2	Segment 3 SH 21 to SH 90	18,515	1,232
#3	Segment 4 SH 90 to SH 75 South	18,515	636
#4	Segment 1 IH 45 to SH 75 North	18,515	0*
#5	Segment 5 SH 75 South to IH 45	18,515	414
Total			**3,239**

Note: 2035 volumes are based on the forecasted projections from the Traffic Report in Appendix A.
* No additional traffic is diverted. This segment would accommodate traffic traveling to Segment 2 (957 vpd) and Segment 3 (1,232 vpd).



SH 21 RELIEF ROUTE FEASIBILITY STUDY
MADISON COUNTY, TEXAS
RECOMMENDED ROUTE SIUS AND CONSTRUCTION PRIORITIZATION

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Texas Department of Transportation

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SEPT 2014

FIGURE 4-3

5. Interim Improvements

The construction of a relief route around Madisonville is a long-range solution to divert the amount of projected through trips along SH 21 in Madisonville. In the meantime, improvements may be made to the street network to better accommodate the existing and projected traffic. Four locations within the study area were evaluated for improvements and may include ROW acquisition and utility relocation costs and ADA (American with Disabilities Act) upgrades. These areas are shown in **Figure 5-1: Interim Improvement Evaluation Locations** and discussed in the remainder of this section.

5.1 Roadway Improvements

East South Street (SH 90)

East South Street is a two-lane, curb and gutter, asphalt street. It is signed as a truck route, routing trucks to/from SH 90 from/to SH 21 via SH 75. Roadway findings and recommendations are discussed in the following text.

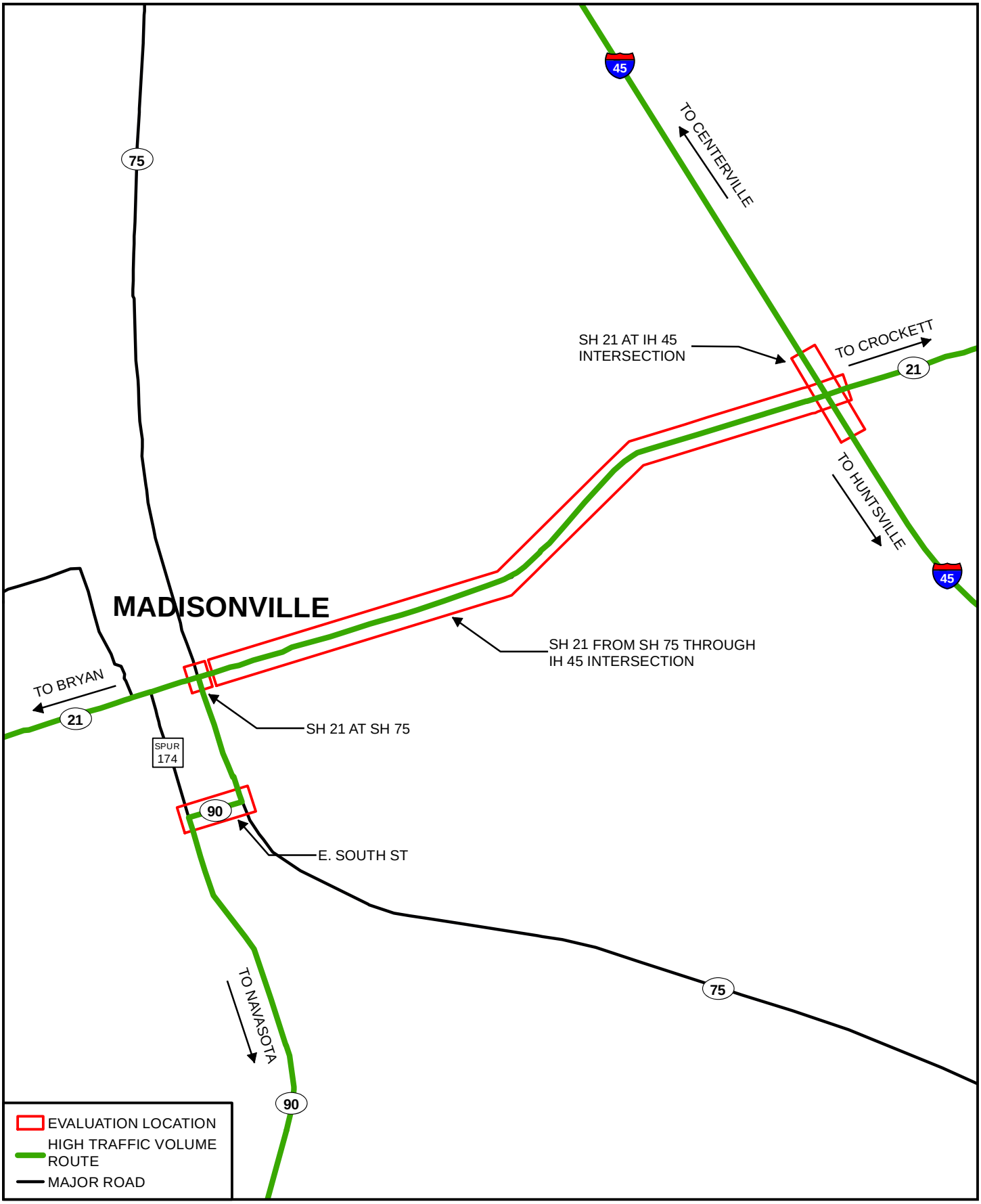
Findings

Some of the issues on East South Street include small turning radii, damage to infrastructure and traffic queuing. The findings are listed below.

- The Intersection radius on the southeast corner of SH 90 and East South Street appears to be too small to accommodate trucks turning right onto East South Street.
- The utility pole and curb on the southeast corner of SH 90 and East South Street shows damage, possibly from trucks turning onto East South Street.
- Trucks were observed making right turn from SH 90 into oncoming lane on East South Street to avoid hitting utility pole.

Damage to curb, ROW and utility pole on the southeast corner of SH 90 and East South Street.

- Trucks making right turns from SH 90 were observed waiting for traffic to clear in the oncoming lane of East South Street which caused northbound SH 90 traffic to queue.
- The intersection radius on the northwest corner of SH 75 and East South Street appears to be too small to accommodate trucks turning right onto East South Street.
- Vehicles turning right from East South Street onto SH 75 were observed to queue behind vehicles making left turn from East South Street onto SH 75.



SH 21 RELIEF ROUTE FEASIBILITY STUDY
MADISON COUNTY, TEXAS
INTERIM IMPROVEMENT EVALUATION LOCATIONS

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SEPT 2014 | FIGURE 5-1

Recommendations

Recommended improvements for East South Street include intersection modifications at SH 90 and SH 75. The improvements are listed below. Roadway improvements on East South Street are shown in **Figure 5-2.**

- Increase the radius on the southeast corner of SH 90 and East South Street intersection.
- Increase radius on the northwest corner of SH75 and East South Street intersection.
- Add another eastbound approach lane on East South Street in order to have a dedicated left and a dedicated right turn lane. The addition of a right turn lane would facilitate traffic traveling to Madisonville High School.

SH 21 from SH 75 through the IH 45 Intersection

The lane configuration of SH 21 from SH 75 through IH 45 varies. It is a two-lane, undivided, curb and gutter asphalt roadway with shoulders/parking lane from SH 75 to Barrett Street; a five-lane, curb and gutter, asphalt roadway with a continuous two-way left turn lane from Barrett Street to East Collard Street; and a two-lane, asphalt roadway with shoulders and a continuous two-way left turn lane from East Collard Street through IH 45. Roadway findings and recommendations are discussed in the following text.

Findings

The findings observed in this area consist of constant vehicle and truck traffic and inconsistent lane configuration along SH 21.

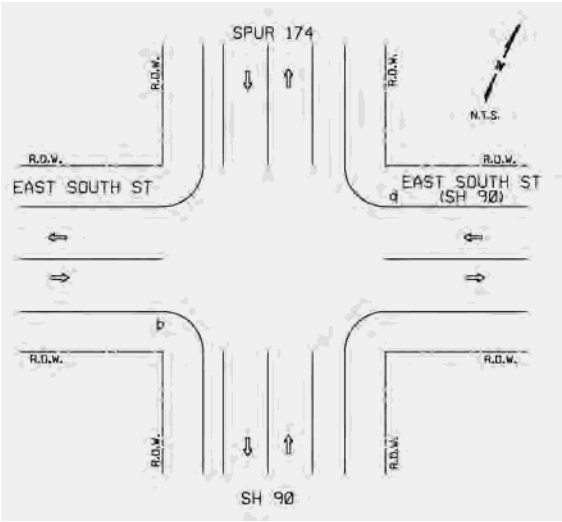
Recommendations

Recommended improvements for SH 21 include two options. These options are listed below. Roadway improvements on SH 21 between SH 75 through IH 45 are shown in **Figure 5-3.**

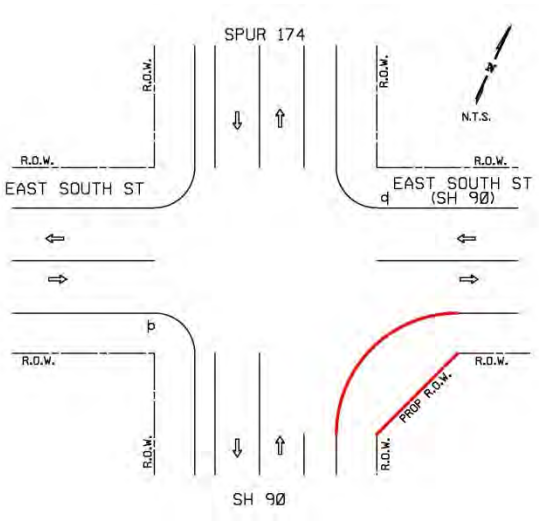
- Option 1 would be to add a continuous two-way left turn lane from east of SH 75 intersection to Barrett Street. With this option, the two-way left turn lane would transition into the existing lane configuration at the intersection of SH 21 and SH 75 within the existing ROW.

- Option 2 would add a continuous two-way left turn lane from SH 75 intersection to Barrett Street. With this option, the two-way left turn lane would be continuous from SH 75 intersection to IH 45 Interchange and would match lane configuration of SH 21 at the SH 75 Intersection. This option would require ROW at SH 75 to accommodate the dedicated left, right and thru lanes.

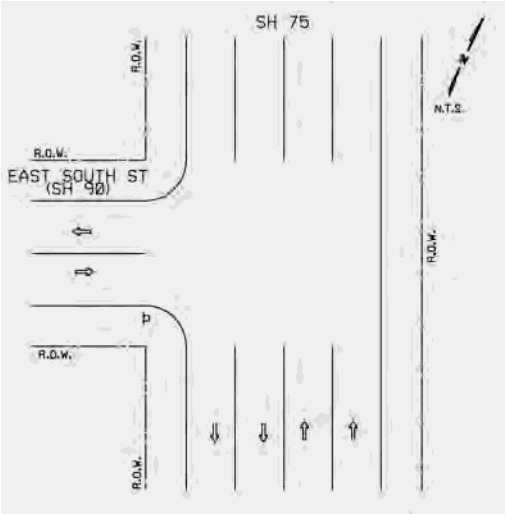
Figure 5-2: Proposed East South Street Roadway Improvements



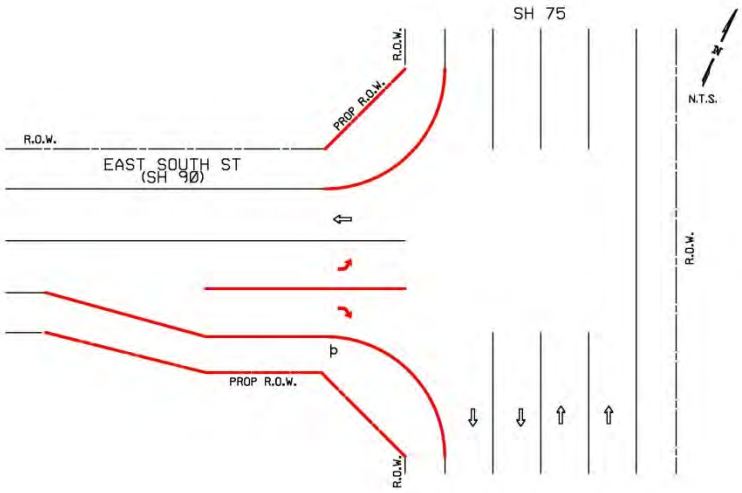
Existing Intersection Geometry
SH 90 and East South Street



Proposed Intersection Geometry
SH 90 and East South Street

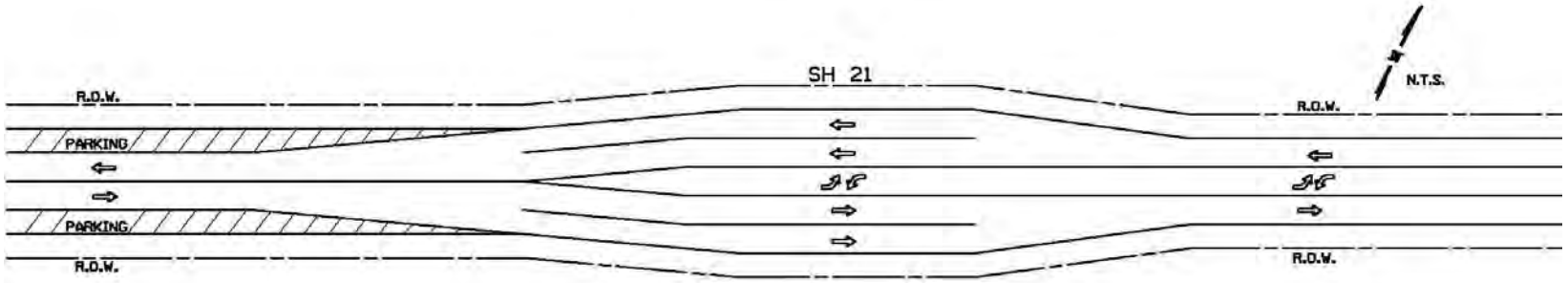


Existing Intersection Geometry
SH 75 and East South Street

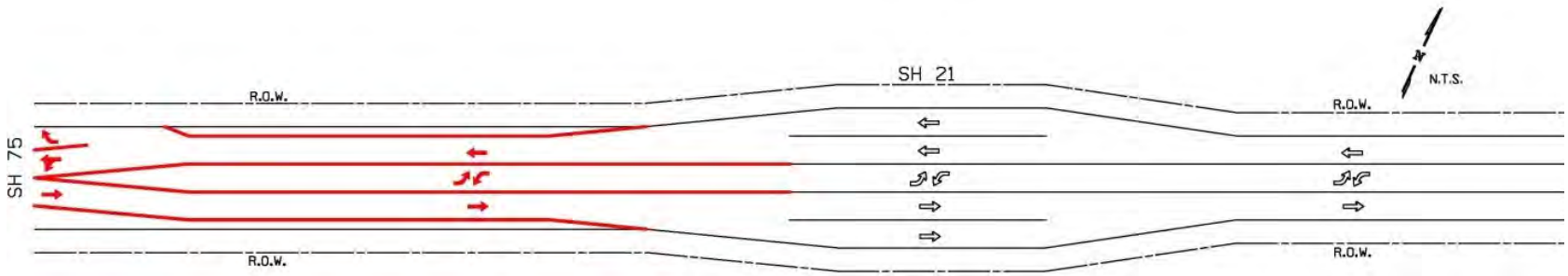


Proposed Intersection Geometry
SH 75 and East South Street

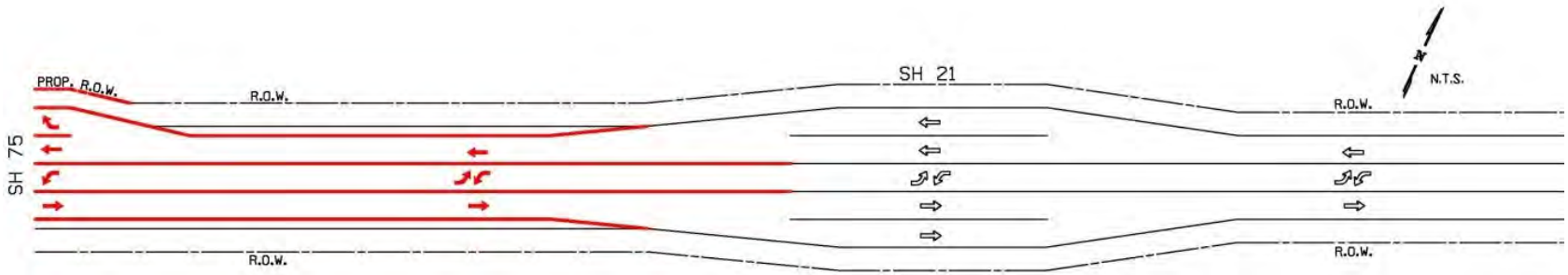
Figure 5-3: Proposed SH 21 Roadway Improvements



Existing Intersection Geometry
SH 21 Corridor SH 75 to IH 45 Interchange



Option 1 - Proposed Roadway Geometry
SH 21 Corridor SH 75 to IH 45 Interchange



Option 2 - Proposed Roadway Geometry
SH 21 Corridor SH 75 to IH 45 Interchange

5.2 Intersection Improvements

SH 21 at IH 45 Frontage Roads and Intersections

The SH 21 Bridge over IH 45 is a two-lane roadway with left turn lanes. The signalized, two-way frontage roads are two-lane roadways. Roadway findings and recommendations are discussed in the following text.

Findings

Some of the findings on SH 21 and the IH 45 frontage roads include inadequate ramp spacing along IH 45 and frequent right turns at the frontage road intersections.

- Lane configuration across the IH 45 underpass bridge matches the approaches.
- No excessive queuing on the bridge was observed.
- Frequent right turns from southbound exit ramp onto SH 21 was observed.
- Frequent right turns from eastbound SH 21 onto southbound entrance ramp were observed.
- Vehicles using the shoulder to make right turns from the northbound exit ramp onto SH 21 were observed.
- Vehicles using shoulder to make right turns from westbound SH 21 onto northbound entrance ramp were observed.
- The existing bridge is a structure type that is generally not constructed today.
- Northbound exit ramp is in close proximity to SH 21. Most non-commercial vehicle traffic makes a right turn onto the two-way frontage road to access Buc-ee's driveways.
- An unofficial exit ramp exists in northbound IH 45 ditch to access Buc-ee's driveway.

Existing closed ramps are located approximately 1800 feet south of the existing northbound exit ramp.

SH 21 bridge over IH 45.

Vehicles make right turn from northbound exit ramp.

Unofficial northbound exit ramp from IH 45 to SH 21.

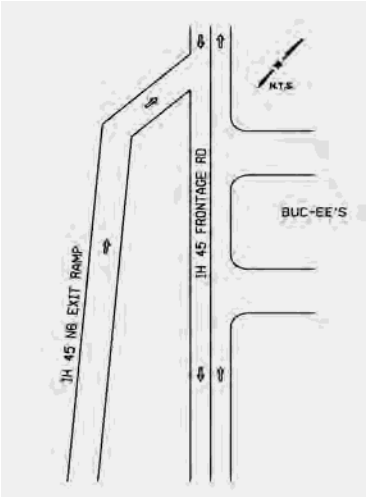
Existing closed northbound exit ramp approximately 1,800 feet south of open exit ramp.

Recommendations

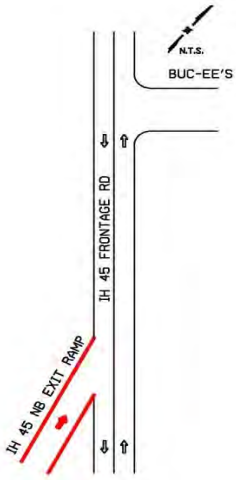
Recommended improvements for SH 21 and IH 45 frontage road intersections are described below and shown in **Figure 5-4.**

- Add a dedicated right-turn only lane southbound at southbound IH 45 frontage road and SH 21.
- Add a dedicated right-turn only lane eastbound at SH 21 and southbound IH 45 frontage road.
- At northbound IH 45 frontage road and SH 21, widen shoulder and convert to a dedicated right-turn only lane.
- At westbound SH 21 and northbound IH 45 frontage road, widen the shoulder and convert it to dedicated right-turn only lane.
- Turn lane improvements may require relocation of existing traffic signal poles.
- Do not recommend widening the bridge over IH 45. Widening would be costly since the existing bridge is a structure type that is generally not used today.
- Relocate northbound exit ramp at least 1800 feet to the south (location of existing closed ramps), preferably with control of access purchased per the Roadway Design Manual. This location is consistent with TxDOT preliminary plans for the conversion of IH 45 frontage roads SH 21 to Spur 104 to one way frontage roads (CSJ 0675-05-082).

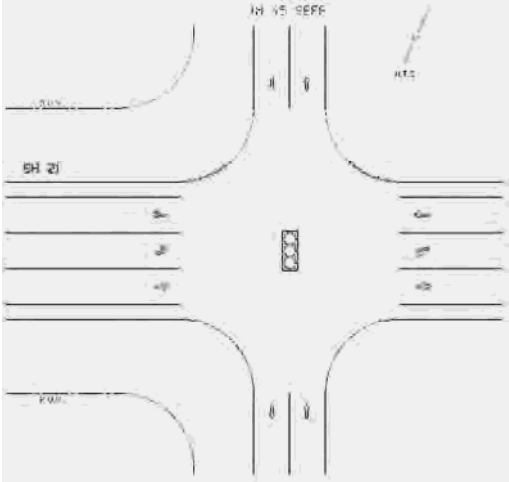
Figure 5-4: Proposed IH 45 Frontage Road and SH 21 Intersection Improvements



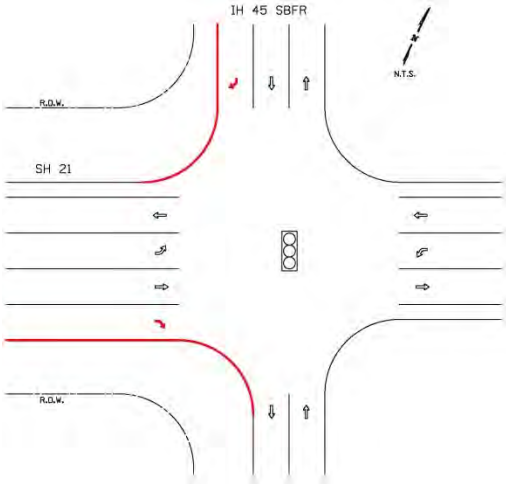
Existing Geometry
IH 45 northbound exit ramp.



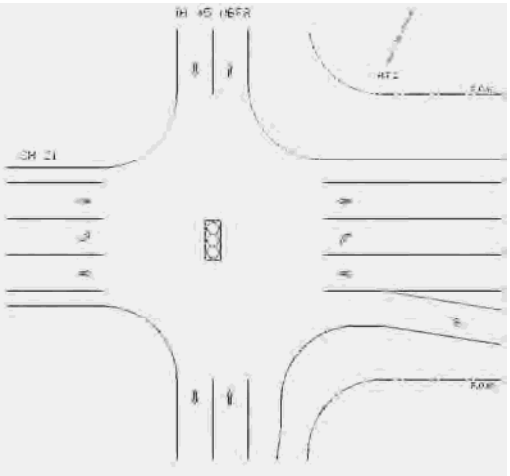
Proposed Geometry
IH 45 northbound exit ramp.



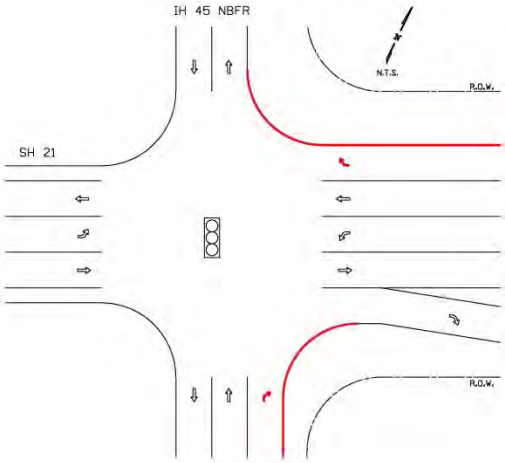
Existing Intersection Geometry
IH 45 southbound frontage road.



Existing Intersection Geometry
IH 45 southbound frontage road.



Existing Intersection Geometry
IH 45 northbound frontage road.



Existing Intersection Geometry
IH 45 northbound frontage road.

SH 21 at SH 75

At this signalized intersection SH 75 is a four-lane, undivided, asphalt roadway with curb and gutters and SH 21 is a two-lane, undivided asphalt roadway with curb and gutters. Roadway findings and recommendations are discussed in the following text.

Findings

The findings observed at this intersection consist of three things: 1) the intersection radii appear to be too small to accommodate trucks making right turns from all corners, 2) utility poles and traffic signal poles show damage, and 3) trucks were observed moving into oncoming lanes to avoid hitting poles and curbs.

Damaged utility pole at the northwest corner of SH 75 and SH 21.

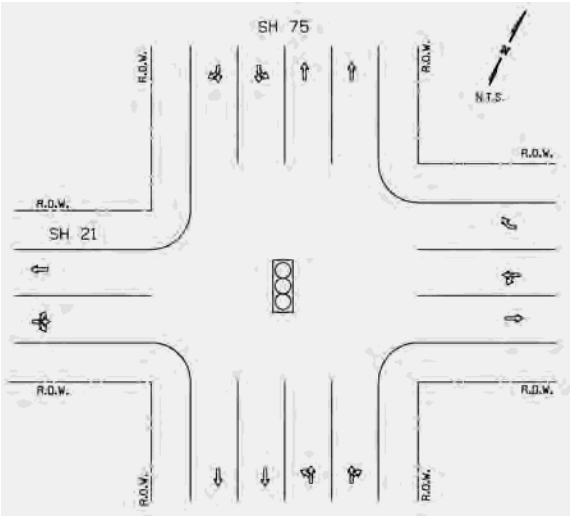
A truck makes a right turn from SH 75 onto SH 21 using the lane for oncoming traffic.

Recommendations

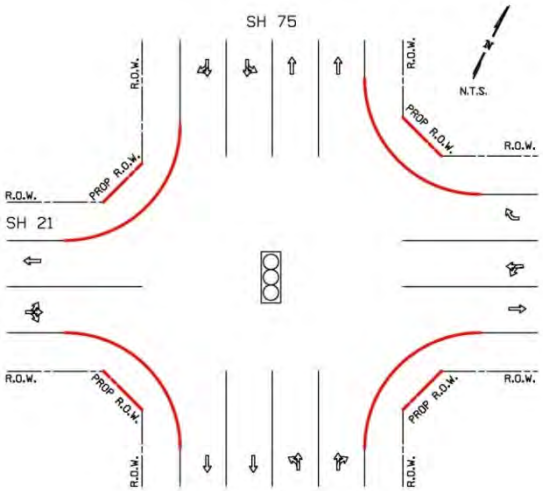
Recommended improvements for this intersection include two options. These options are listed below. Improvements are shown in **Figure 5-5.**

- Options 1 consists of increasing the radii on all corners of SH 75 and SH 21 intersection. This option would require additional ROW.
- Option 2 consists of several intersection improvements which includes increasing radii on all corners; converting eastbound shared left-turn, straight, and right-turn lane into separate left-turn, straight, and right-turn only lanes; converting westbound shared left-turn and straight lane into separate left-turn and straight only lanes; and changing phasing/timing of signalized intersection. This option would require additional ROW.

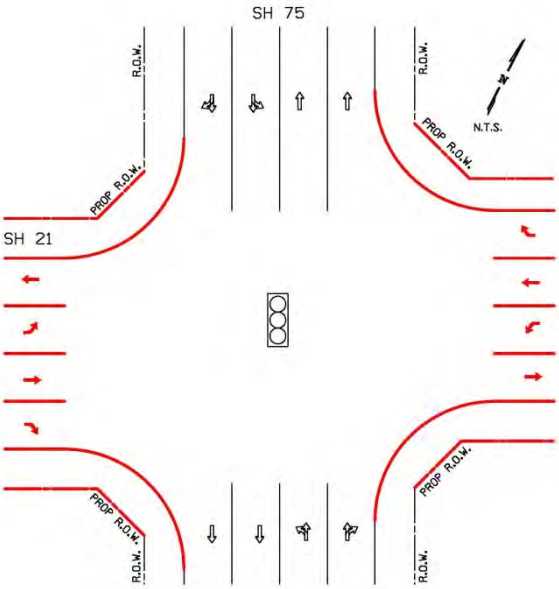
Figure 5-5: Proposed Intersection Improvements at SH 21 and SH 75



Existing Intersection Geometry
SH 75 and SH 21



Option 1
Proposed Intersection Geometry
SH 75 and SH 21



Option 2
Proposed Intersection Geometry
SH 75 and SH 21

6. Preliminary Cost Estimate

The completion of the proposed SH 21 relief route to the ultimate configuration requires construction to each of the identified segments for the project. The ultimate configuration is based on the proposed typical section discussed in **Section 3**. The relief route is broken down into its five segments with construction costs associated with each of them. **The total preliminary cost of the interim SH 21 Relief Route is estimated at $44.5 million. The total cost for the ultimate is approximately $88.2 million.** However, the construction costs shown are for comparison purposes only.

Table 6-1 lists the proposed pavement elements that were assumed in developing the approximate construction costs. **Tables 6-2** and **6-3** breaks down the preliminary cost estimates for the interim and ultimate relief routes.

Table 6-1: Assumed Pavement Design for Cost Estimation

Roadway Element	Number of Lanes	Lane Widths	Shoulders	Layer 1	Layer 2	Layer 3
Mainlanes	2	12'	10' Curb Offsets	4" HMAC	8" FL BS	8" LTS
Ramps	1	14'	4' & 8'	4" HMAC	8" FL BS	8" LTS

For the mainlanes, the pavement would consist of 4 inches Hot Mix Asphaltic Concrete, 8 inches of Flexible Base Pavement and 8 inches of Lime Treated Subgrade. Drainage costs are estimated at 20 percent of construction and the overall contingency is 30 percent of construction. Mainlane bridges would be concrete structures that are 200 feet long. The earthwork for cross street grade separations would consist of a 1000-foot approach on each side with an assumed top of bridge height of 23 foot.

The ramp pavement would consist of much the same as the mainlanes with 4 inches Hot Mix Asphaltic Concrete, 8 inches of Flexible Base Pavement and 8 inches of Lime Treated Subgrade.

Average bid costs from the TxDOT Bryan District along with statewide data were used to develop unit costs. These assumptions were developed for comparison purposes only and may vary in the final design of the alternative.

Table 6-2: Preliminary Cost Estimate – Interim SH 21 Relief Route

Roadway Element	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
	IH 45 to SH 75 North	SH 75 North to SH 21	SH 21 to SH 90	SH 90 to SH 75 South	SH75 South to IH 45
Mainlanes	$2,990,000	$9,280,000	$5,530,000	$6,010,000	$3,550,000
Right of Way	$880,000	$2,730,000	$1,630,000	$1,770,000	$1,050,000
Ramps	$0	$0	$0	$0	$0
Bridges	$500,000	$2,000,000	$500,000	$1,500,000	$1,000,000
Utilities	$176,000	$546,000	$326,000	$354,000	$210,000
Subtotal	**$4,546,000**	**$14,556,000**	**$7,986,000**	**$9,634,000**	**$5,810,000**
Engineering	$209,400	$676,800	$361,800	$450,600	$273,000
Segment Total	**$4,755,400**	**$15,232,800**	**$8,347,800**	**$10,084,600**	**$6,083,000**
Total Cost					**$44,503,600**

Table 6-3: Preliminary Cost Estimate – Ultimate SH 21 Relief Route

Roadway Element	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
	IH 45 to SH 75 North	SH 75 North to SH 21	SH 21 to SH 90	SH 90 to SH 75 South	SH75 South to IH 45
Mainlanes	$4,730,000	$14,680,000	$8,740,000	$9,500,000	$5,620,000
Right of Way	$880,000	$2,730,000	$1,630,000	$1,770,000	$1,050,000
Ramps	$1,800,000	$2,400,000	$1,200,000	$1,200,000	$600,000
Bridges	$2,000,000	$7,000,000	$2,000,000	$4,000,000	$3,000,000
Utilities	$176,000	$546,000	$326,000	$354,000	$210,000
Subtotal	**$9,586,000**	**$27,356,000**	**$13,896,000**	**$16,824,000**	**$10,480,000**
Engineering	$511,800	$1,444,800	$716,400	$882,000	$553,200
Segment Total	**$10,097,800**	**$28,800,800**	**$14,612,400**	**$17,706,000**	**$11,033,200**
Total Cost					**$82,250,200**

6.1 Interim SH 21 Relief Route

The interim route would involve two undivided mainlanes (one in each direction) along the 10.1 mile corridor. During this phase no ramps or grade separated interchanges would be constructed. All intersections would be at-grade and bridges would only be anticipated over stream crossings. During this phase all 250 feet of ROW would be procured. For this cost estimate $0.60 per square foot was assumed for ROW costs and 6% was assumed for engineering costs. In total, construction costs would be approximately $44.5 million.

6.2 Ultimate SH 21 Relief Route

The ultimate route would involve four divided mainlanes (two in each direction) along the 10.1 mile corridor. During this phase each all major intersections would be grade separated and require mainlane bridges and entrance and exit ramps. Additional ROW may be needed to accommodate the side slopes for the mainlane bridges and ramps at each intersection. For this cost estimate $0.60 per square foot was assumed for ROW costs and 6% was assumed for engineering costs. In total, construction costs would be approximately $82.2 million.

The detailed cost estimate can be found in **Appendix D.**

7. Conclusion

The proposed SH 21 relief route would improve local and regional mobility by allowing motorists that travel between IH 45, SH 90 and SH 21 west of Madisonville to bypass around downtown Madisonville instead of cutting through town to reach their destination. Local and non-local motorists would experience improved traffic flow and safety as local traffic would see a reduction in congestion, delays, accidents, and structural impacts to the roadway network; and non-local, through traffic, would experience uninterrupted travel and an increase in travel times. Without the proposed relief route, SH 21 and its surrounding street network would continue to experience a decline in LOS, deteriorating roadway conditions and increased safety concerns.

This report was written on behalf of the Texas Department of Transportation – Bryan District by:

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