Kendall Gateway Feasibility Study Report

State Highway 46, San Antonio District

City of Boerne, Kendall County, Texas

February 2019

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried-out by TxDOT pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated December 16, 2014, and executed by FHWA and TxDOT.

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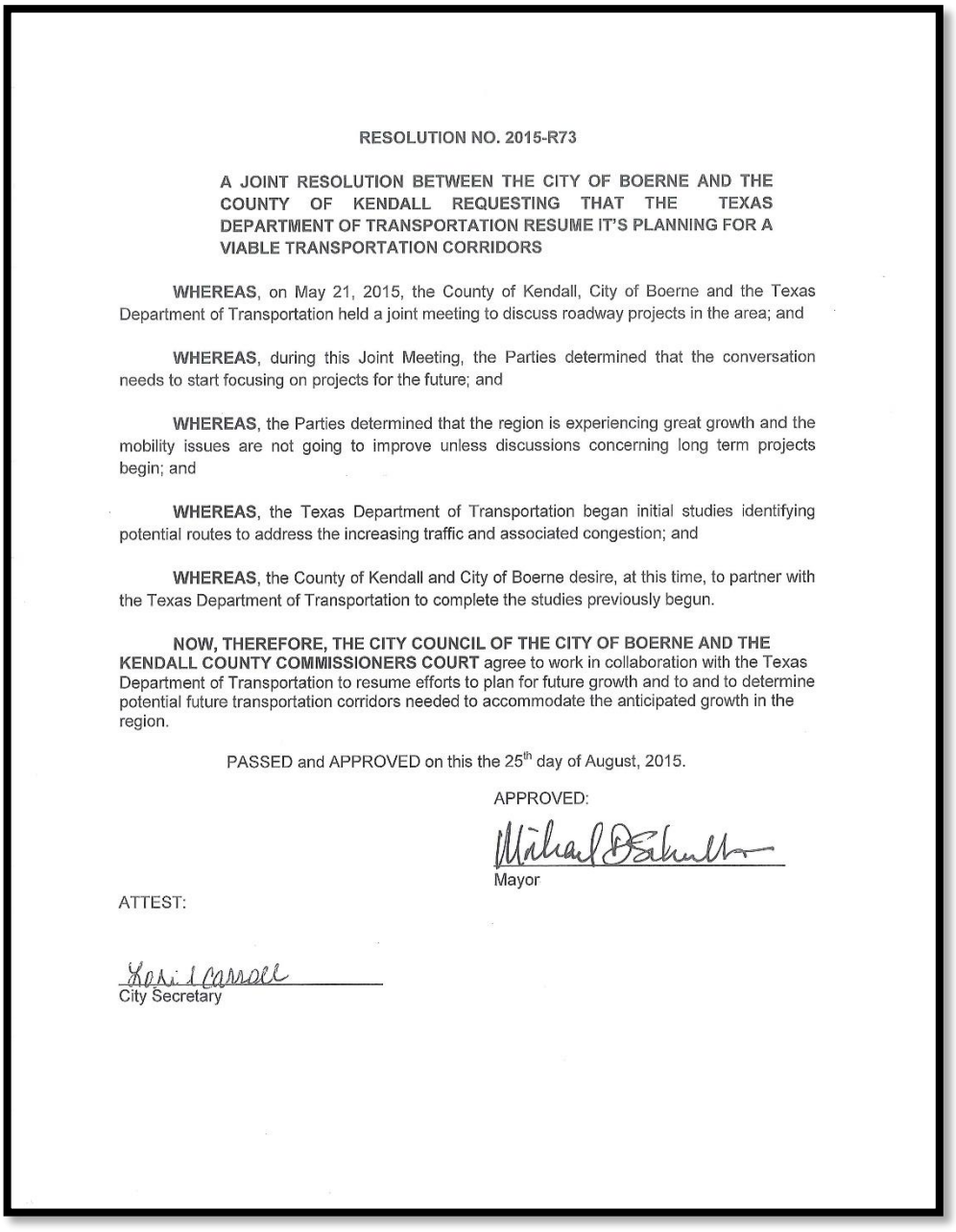
EXECUTIVE SUMMARY

On August 25, 2015, a Joint Resolution between the City of Boerne and Kendall County initiated the Kendall Gateway Study (KGS). The joint resolution requested that the Texas Department of Transportation (TxDOT) lead the planning efforts to identify viable transportation corridors for future growth. This Joint Resolution (**Figures ES-1 and ES-2**) specifically requested that TxDOT "determine potential future transportation corridors needed to accommodate the anticipated growth in the region."



RESOLUTION NO. 2015-R73

A JOINT RESOLUTION BETWEEN THE CITY OF BOERNE AND THE COUNTY OF KENDALL REQUESTING THAT THE TEXAS DEPARTMENT OF TRANSPORTATION RESUME IT'S PLANNING FOR A VIABLE TRANSPORTATION CORRIDORS

WHEREAS, on May 21, 2015, the County of Kendall, City of Boerne and the Texas Department of Transportation held a joint meeting to discuss roadway projects in the area; and

WHEREAS, during this Joint Meeting, the Parties determined that the conversation needs to start focusing on projects for the future; and

WHEREAS, the Parties determined that the region is experiencing great growth and the mobility issues are not going to improve unless discussions concerning long term projects begin; and

WHEREAS, the Texas Department of Transportation began initial studies identifying potential routes to address the increasing traffic and associated congestion; and

WHEREAS, the County of Kendall and City of Boerne desire, at this time, to partner with the Texas Department of Transportation to complete the studies previously begun.

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF BOERNE AND THE KENDALL COUNTY COMMISSIONERS COURT agree to work in collaboration with the Texas Department of Transportation to resume efforts to plan for future growth and to and to determine potential future transportation corridors needed to accommodate the anticipated growth in the region.

PASSED and APPROVED on this the 25th day of August, 2015.

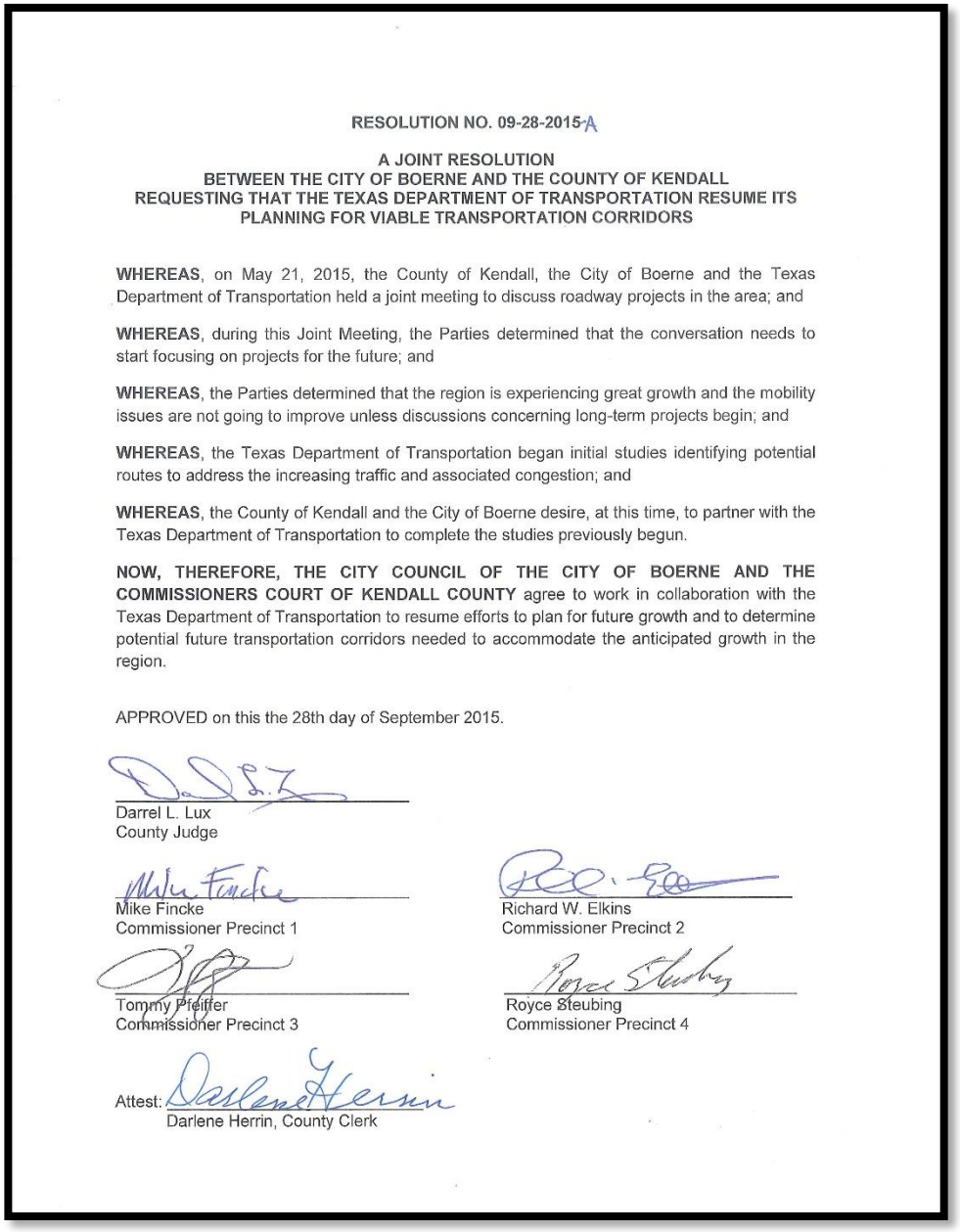
APPROVED:

Mayor

ATTEST:

City Secretary

Figure ES-1: 2015 City of Boerne and Kendall County Joint Initiation



RESOLUTION NO. 09-28-2015-A

A JOINT RESOLUTION
BETWEEN THE CITY OF BOERNE AND THE COUNTY OF KENDALL
REQUESTING THAT THE TEXAS DEPARTMENT OF TRANSPORTATION RESUME ITS
PLANNING FOR VIABLE TRANSPORTATION CORRIDORS

WHEREAS, on May 21, 2015, the County of Kendall, the City of Boerne and the Texas Department of Transportation held a joint meeting to discuss roadway projects in the area; and

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NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF BOERNE AND THE COMMISSIONERS COURT OF KENDALL COUNTY agree to work in collaboration with the Texas Department of Transportation to resume efforts to plan for future growth and to determine potential future transportation corridors needed to accommodate the anticipated growth in the region.

APPROVED on this the 28th day of September 2015.

Darrel L. Lux
County Judge

Mike Fincke
Commissioner Precinct 1

Richard W. Elkins
Commissioner Precinct 2

Tommy Pfeiffer
Commissioner Precinct 3

Royce Steubing
Commissioner Precinct 4

Attest: Darlene Herrin
Darlene Herrin, County Clerk

Figure ES-2: 2015 City of Boerne and Kendall County Joint Initiation

No major corridor analyses have been conducted in the region since 2005. As illustrated in **Figure ES-3**, subsequent and significant growth has occurred in and around the City of Boerne and Kendall County, emphasizing the need for improved mobility in the region.

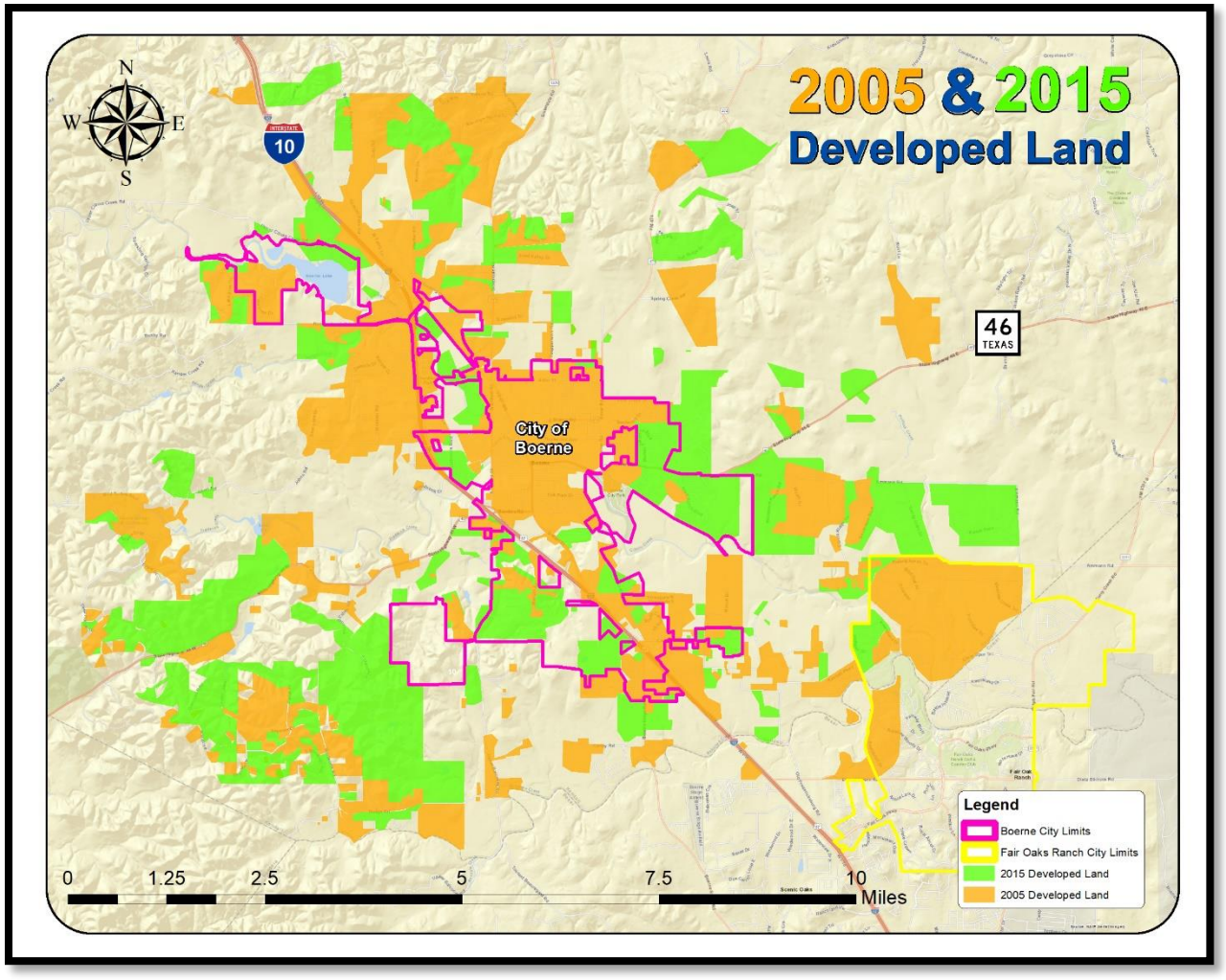

Figure ES-3: Map of Developed Parcels in Boerne per 2005 and 2015 Aerial Analysis

Study Process and Study Area

The KGS followed a process that included data collection, stakeholder input, quantitative and qualitive analysis, concept development and evaluation, and project priority identification. A study area for the KGS was developed to be of sufficient size to allow for engineering and environmental analysis to occur. As previously noted, the study was requested by the City of Boerne and Kendall County; therefore, the study area included the majority of the Boerne City Limits, Boerne Extra Territorial Jurisdiction (ETJ), and the Extended Boerne ETJ, and to minimize areas outside of Kendall County since the study was requested by the City of Boerne and Kendall County. The study area developed for the KGS is shown in purple in **Figure ES-4**.

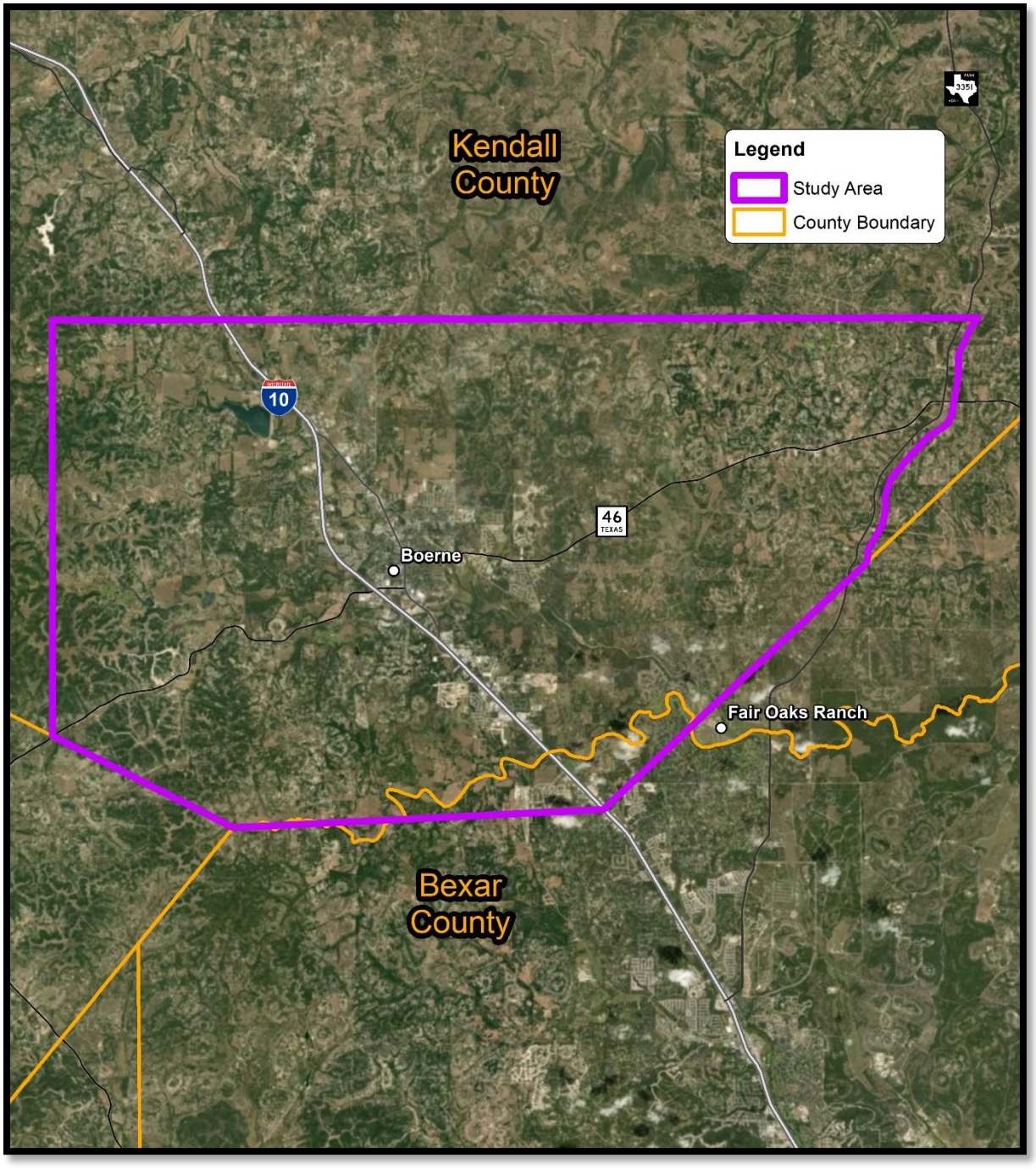

Figure ES-4: Project Study Area

KGS Purpose and Need

The **Purpose and Need** for the KGS was essential in establishing a basis for developing a range of concepts and assisted with the identification, evaluation and selection of a recommended concept.

The **Need** for transportation improvements included three key components as described below:

- **Need One: Past, present and future population growth and travel demand.** There has been substantial population growth in the study area (depicted in **Section 1.2**). From 2005 to 2015,

the Kendall County population grew from 28,604 to 40,384, respectively. From 2010 to 2040, the study area is projected to increase another 88 percent, reaching a total population of about 62,821 for the county, according to the Alamo Area Metropolitan Planning Organization's Mobility 2040 Plan and the U.S. Census Bureau.

- **Need Two: Additional east/west corridors and connectivity in the study area.** State Highway (SH) 46, the only major east/west corridor, cannot accommodate the high volumes of both passenger vehicles and large trucks projected to increase through 2040. An alternate east/west corridor is needed for system redundancy, especially during emergencies and catastrophic events, such as the flood event from Cibolo Creek that occurred in 2016 which significantly hindered emergency services along SH 46.
- **Need Three: Safety improvements in downtown Boerne**. Vehicular and truck traffic directed through Boerne along the SH 46 route poses circulation problems and conflicts with the downtown center's walkability and pedestrian use. The downtown area, an important tourist destination, lacks the capacity needed to accommodate existing and future growth. Widening SH 46 downtown would result in substantial impacts to the cultural and walkability of the community, including Cibolo Creek and park areas. Without another system link for east/west traffic, through-vehicle and heavy truck traffic travel through the downtown area.

The **Purpose** of the KGS was to identify concepts and recommend a solution to address the growing transportation demands within and around the City of Boerne and Kendall County. The objective of the study was to provide solutions for connectivity and regional linkage to the City of Boerne and Kendall County while minimizing impacts and maintaining Boerne's unique natural and cultural resources. The KGS specifically addressed east/west traffic connectivity for travelers along SH 46 and within the downtown area of Boerne.

Existing Roadway Network

As shown in **Figure ES-5** and **Section 2.1**, the roadway network in and around Boerne comprises the following major facilities:

- SH 46 is the primary east/west arterial through Kendall County with an offset through downtown Boerne, via Business (BUS) 87 or "Main Street" (St.). West of BUS 87 and east of Interstate Highway 10 (I-10), SH 46 is called Bandera Road (Rd.) and is comprised of five lanes (two lanes in each direction with a center turn lane). Continuing west of I-10, SH 46 is a two-lane rural highway (one lane in each direction). East of BUS 87 and west of the Herff/Esser Rd. intersection, SH 46 is called River Rd. and has two lanes (one lane in each direction). Continuing east of the Herff/Esser Rd. intersection, SH 46 transitions to a two-lane rural-type highway. Through downtown Boerne, SH 46 follows BUS 87 or Main St. between the east and west intersections of River Rd. and Bandera Rd., respectively. The downtown section of SH 46 consists of four lanes (two lanes each direction) with an intermittent center turn lane;
- I-10 is a four-lane divided interstate highway with a wide median and intersects with SH 46 and BUS 87;
- BUS 87 is a north/south arterial through Boerne that connects with I-10 at the northern and southern limits of the city. It is a four-lane road with a center turn lane through the southern half of those limits. North of downtown, there is no center turn lane and it is a four-lane undivided road. North of Sisterdale Rd., the typical section changes again to a two-lane

undivided road. The speed limit along BUS 87 varies, 35 mph through downtown and 55 to 50 mph at the southern and northern ends;

- Farm to Market (FM) 1376 is a north/south two-lane undivided major collector; and
- FM 474 is a north/south major collector. Between US 87 and Esser Rd., FM 474 is a four-lane (two lanes each direction) roadway with a center turn lane. Continuing north, FM 474 transitions to a two-lane road.

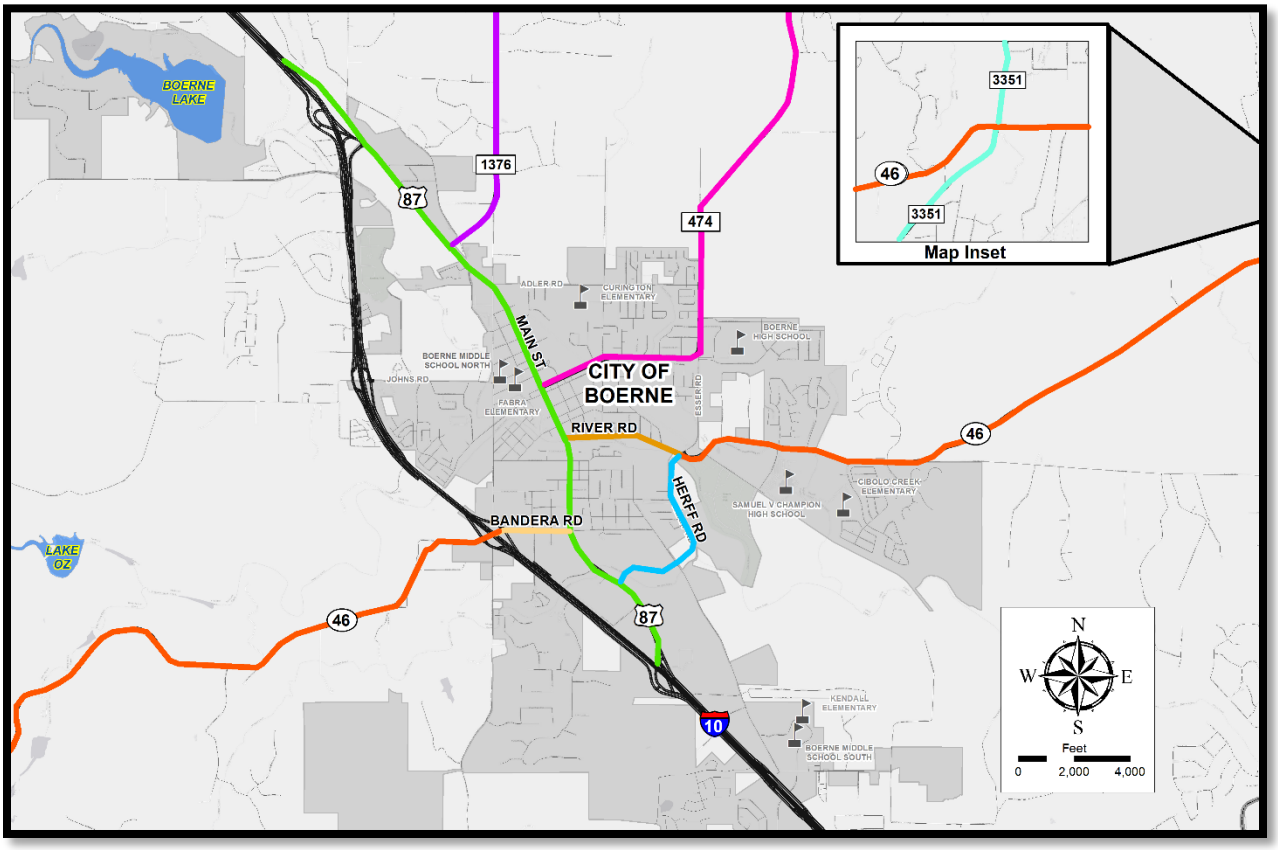

Figure ES-5: Existing Road Layout

Traffic Analysis and Findings

To fully understand the travel issues in Boerne and the Kendall County region and SH 46, it was critical to evaluate the surrounding environment. During this study process, elements such as the physical study area, existing roadway network and current traffic conditions were evaluated. As part of this analysis, a traffic study was conducted to determine the existing (Year 2016) and forecasted (Year 2040) traffic volumes and level of service, as well as confirm the local traffic movements and make-up.

The traffic study area incorporated a large portion of southern Kendall County to ensure that the most congested locations were captured and identified. Traffic data were collected along the state facilities within the study area, including I-10, SH 46, FM 3351, BUS 87 (Main St.) and FM 474 (North [N.] Esser Rd.). Traffic data collected included daily volumes, turning movement counts, origin-destination information, historical/projected traffic volumes, truck percentages and growth rates from TxDOT and the City of Boerne sources, crash data, existing roadway characteristics, and previous traffic studies.

Existing traffic conditions for 2016 are depicted below in **Figure ES-6**. Traffic projections were developed for the year 2040 and are shown in **Figure ES-7.** Most, if not all, of the major roadways in and around downtown Boerne would be at or over capacity in 2040.

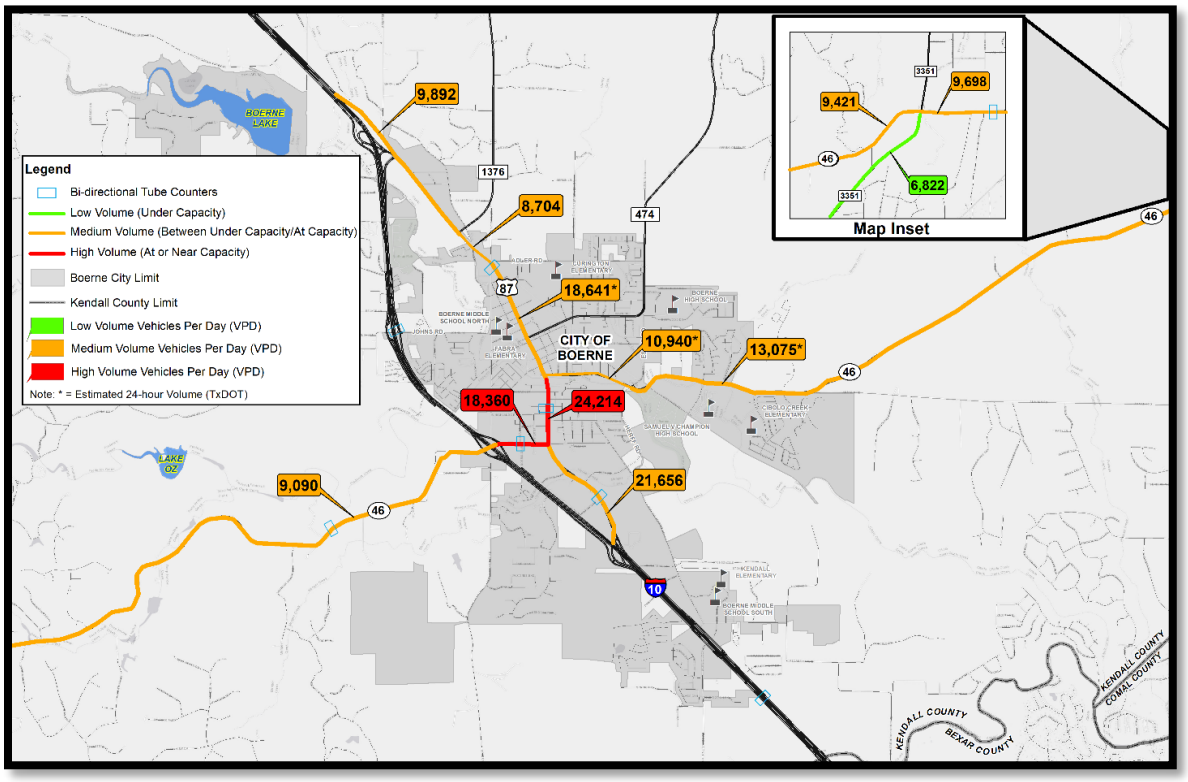

Figure ES-6: Existing Roadway Capacity Conditions (2016)

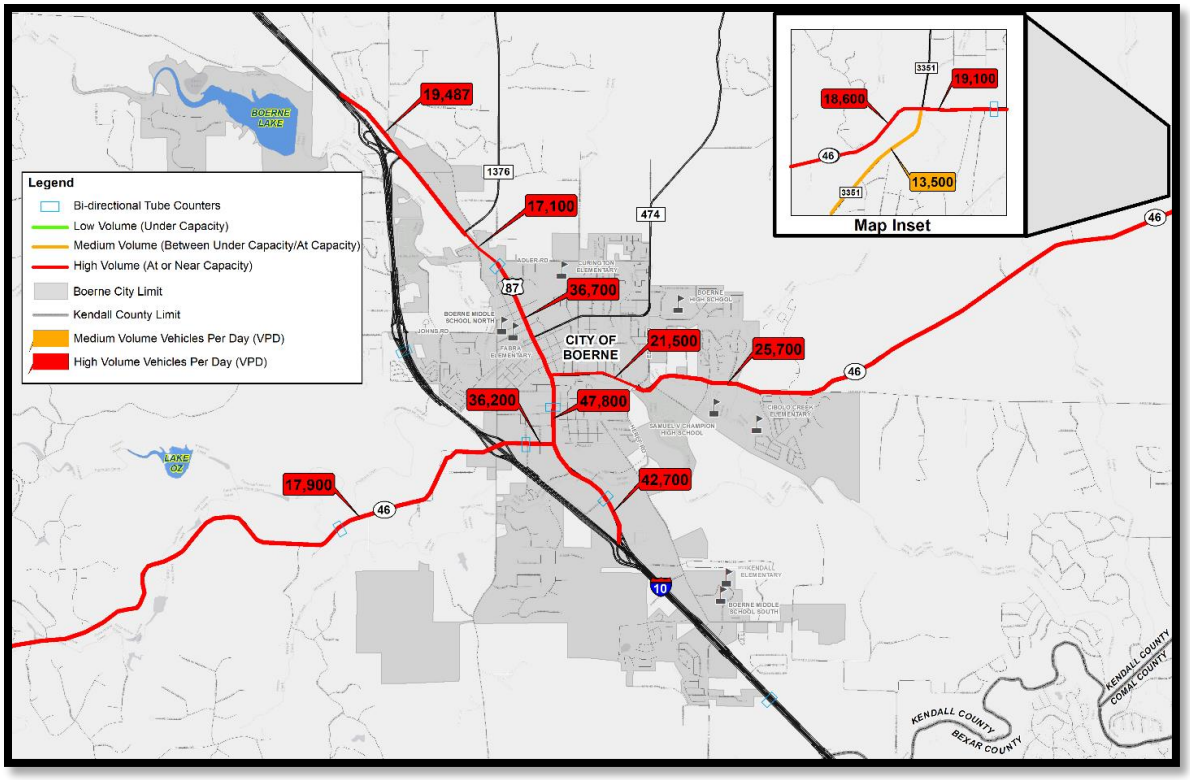

Figure ES-7: Projected Roadway Capacity Conditions (2040)

Data from the Crash Records Information System (CRIS) for 2011 to 2015 were collected for eight corridors and 10 intersections within the Boerne area, including location, date/time, severity, type, injury classification and roadway/environmental factors. Several key findings included:

- SH 46 through downtown Boerne has a crash rate that significantly exceeds the statewide average for similar corridors;
- The SH 46 and BUS 87 (River Rd. and Main St.) intersection in downtown Boerne has the highest number of crashes in the study area, with 96 crashes over a five-year period; and
- Other intersections with an average of 10 crashes per year or more include SH 46 at I-10 and I-10 at Scenic Loop.

To better understand where traffic was traveling to and from within the study area, an Origin and Destination (O&D) analysis was performed using Bluetooth wireless technology. The analysis focused on the major existing corridors, SH 46 and I-10. According to the analysis results, approximately 50 percent of all SH 46 traffic passed through the City of Boerne, continuing to their destinations. Projecting the data to 2040, there were nearly 20,000 vehicles per day (VPD) traveling through downtown Boerne that have destinations elsewhere as shown in **Figure ES-8**.

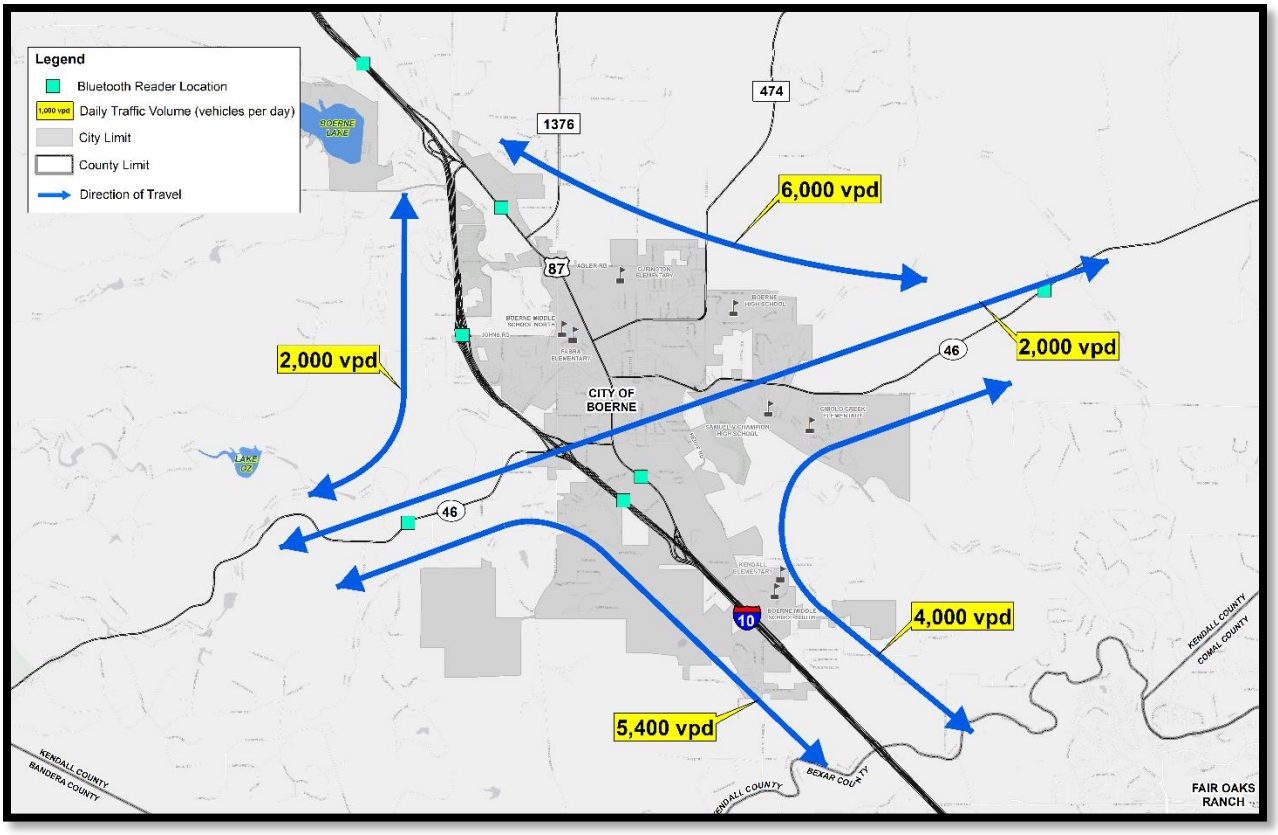

Figure ES-8: Estimated Minimum Traffic Diversions (2040)

Public and Stakeholder Outreach

During development of the KGS, many opportunities for public engagement and input were provided to help guide the study process. The Study Team's goal was to be available for anyone, anytime, anywhere; be transparent; and create an outreach program that was interactive, flexible and customized for this study effort. Public involvement opportunities included three study newsletters, a total of six Technical Working Group (TWG)/Stakeholder Working Group (SWG) meetings, three public open houses, regular communication through the project email at kendallgateway@pozcam.com, one-on-one meetings with elected officials and community members, and three interactive surveys. A comprehensive overview of the robust public outreach effort can be found in **Section 3.0** of the report.

Environmental Considerations

Environmental data were collected at a desktop level throughout the entire study process. Only reliable sources were utilized for the study and generally included data from local, state, and federal agencies and data collected during the public involvement process. Resources gathered within the study area included:

- Community resources such as roadways, utilities, land use, existing schools, parks and public facilities, farmlands, family and heritage program properties, proposed developments, population projections, demographics, race and ethnicity, median household income and poverty status, environmental justice (EJ), language and limited English proficiency, and cultural resources;

- Water resources such as groundwater, geology, aquifers, water wells, surface water, watersheds, rivers, streams, creeks, wetlands, waterbodies, floodplains, and water quality;
- Biological resources such as the identification of wildlife habitat and vegetation using ecoregion data from the Texas Parks and Wildlife Department (TPWD) ecological mapping system of Texas (EMST);
- Protected species;
- Hazardous materials;
- Air quality; and
- Noise environment.

One of the ongoing themes for the study was to gather data at all stages, continually update the data, and consistently request public input. It is important to note while only limited windshield field surveys occurred as part of the study, all environmental constraints are of known, recorded resources from either online databases or from public input. See **Appendix K: Constraints Map** for the constraints gathered from the aforementioned resources.

Concept Development Process

This study was data-driven. The concept development process did not begin until initial data were collected. This information was vital in determining the purpose and need of the study, as well as what types of solutions would effectively address the problems. While the traffic/geometric and environmental data were collected, the Study Team simultaneously began public outreach to gather data from the community.

Combining the results of the traffic/geometric analysis, environmental constraints mapping, and public input, the Study Team started the concept development process. These three major data sets continued to be updated and refined throughout the entire concept development process. **Figure ES-9** below illustrates the general process that was followed.

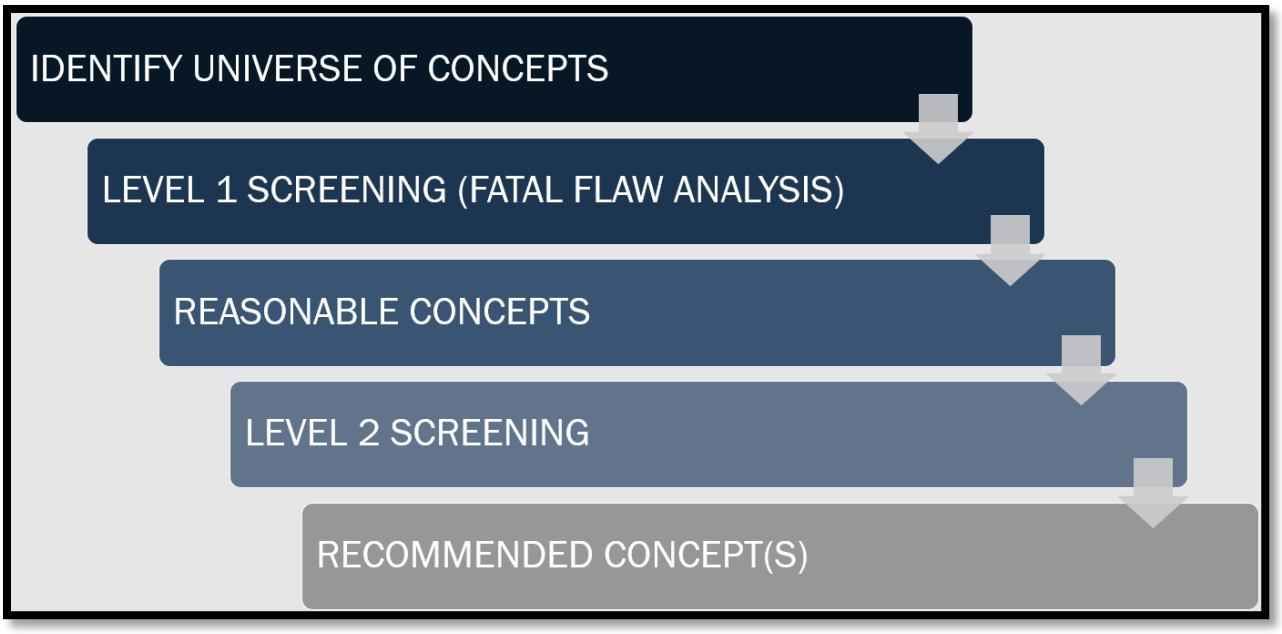

Figure ES-9: Concept Development Process

Typical Section

Before any concepts were drawn on a map, the Study Team established a base footprint for planning purposes. The roadway footprint was envisioned to be wide enough to accommodate the traffic demand through 2040 and beyond should further expansion be needed.

The Study Team determined that a four-lane rural divided highway (two lanes each direction) consisting of 12-foot travel lanes, four-foot inside shoulders, 10-foot outside shoulders and within 300-foot of right of way (ROW) should accommodate the projected 2040 travel demand and allow flexibility for future expansion as needed (**Figure ES-10**). A grass median would separate the two directions of travel. Per preliminary data, it was determined that a 300-foot ROW would be the maximum width necessary for the ultimate buildout. However, this width may not be needed in all or any areas as it was used for early planning purposes only.

The facility was envisioned to be controlled-access to ensure effective long-term operation as a through-route. Access issues and requests could be addressed on a case-by-case basis.

It is important to note that two lanes (one lane each direction) may accommodate traffic in most portions of the proposed concepts for an interim period of time. This could be accomplished by phased construction such as building one side of the divided facility and operating it as a two-way in the interim.

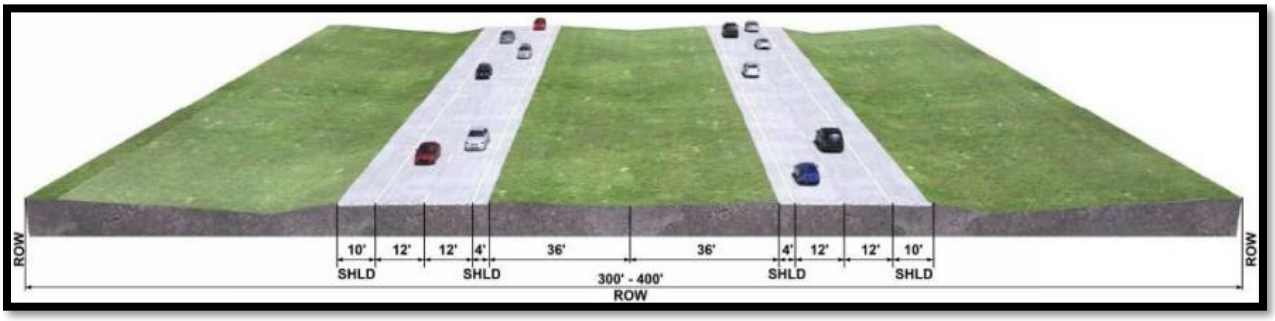

Figure ES-10: Conceptual Four-Lane Divided Highway with Grass Median

Universe of Concepts

This feasibility study started with a blank slate, without any preconceived outcomes. An initial list of engineering and environmental criteria was presented to the working groups (during the first two meetings) and refined according to feedback. A survey was sent out to the public as well. This survey contained the list of engineering and environmental criteria that was developed. The public was asked to rank criteria in order of importance. These public rankings (depicted in **Appendix D6, Section 5**), along with engineering and technical input, became the basis on which the universe of concepts was developed. The universe of concepts was started by drawing 300-foot wide concepts within the study area to address the initial need for a new connection between SH 46 and I-10. Many concepts were drawn within the study area that included over 200 different possible combinations. The concepts incorporated new location corridors as well as utilizing existing facilities as seen in **Figure ES-11**.

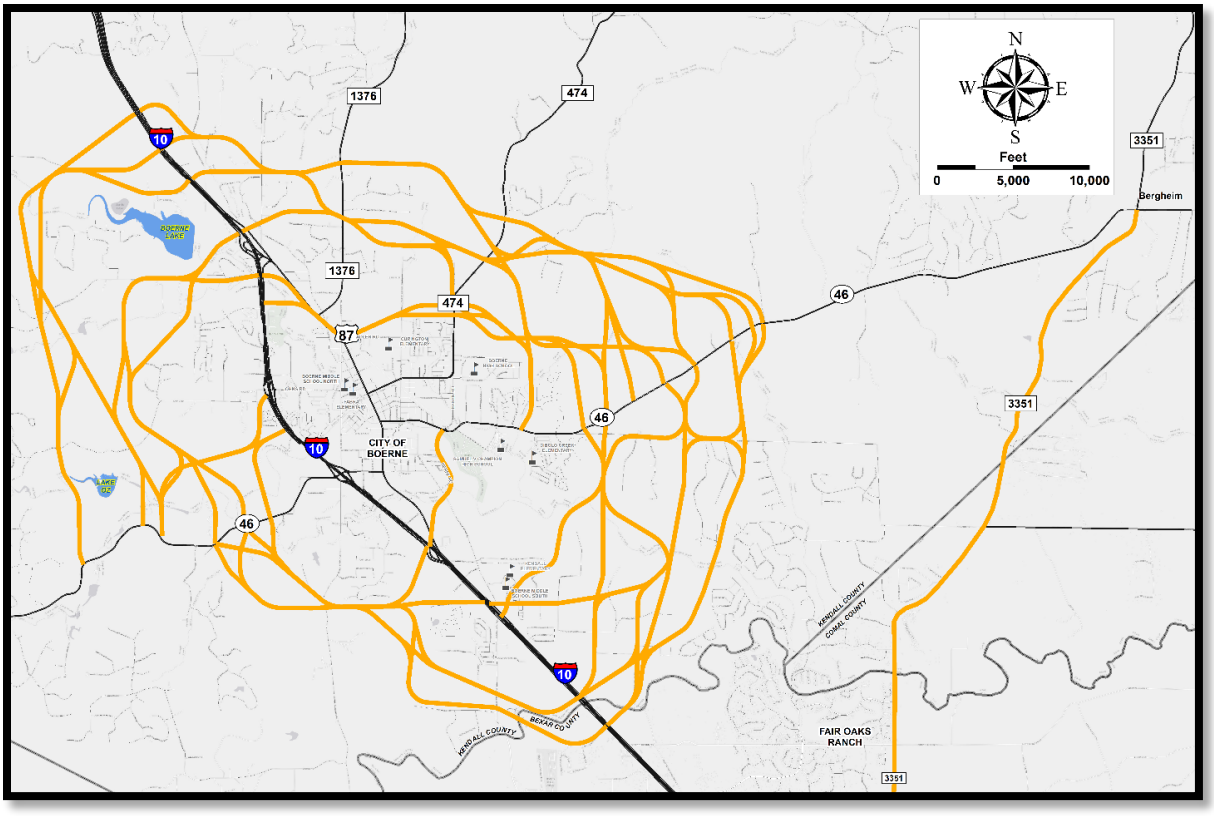

Figure ES-11: Universe of Concepts Map

Reasonable Concepts

The TWG and SWG were combined for the third meeting to help narrow down the universe of concepts in August 2017. The participants were given a summary of the feasibility study to date, the results of the public survey, environmental constraints, and traffic findings around and through the City of Boerne. Using this information, the participants were asked to draw on the universe of concepts map, highlighting routes they preferred, crossing out routes they did not prefer, and drawing new routes, if deemed necessary.

There was no clear preferred concept selected by the combined working groups. Some participants preferred the concepts that were closer to the city center while most preferred concepts that were further out of town. The resounding consensus was that a viable transportation solution was needed to address congestion and growth.

After the working group meeting, the reasonable concepts were presented to the public at the second public open house. A MetroQuest survey was utilized to obtain public input on the feasibility study process, universe of concepts, and the engineering/environmental criteria that were the most important to the community. In addition to obtaining public input, the survey also helped the public understand some of the challenging decisions that arise as part of a feasibility study. From the feedback and comments received, the Study Team made some modifications and developed the concepts as seen in **Figure ES-12**.

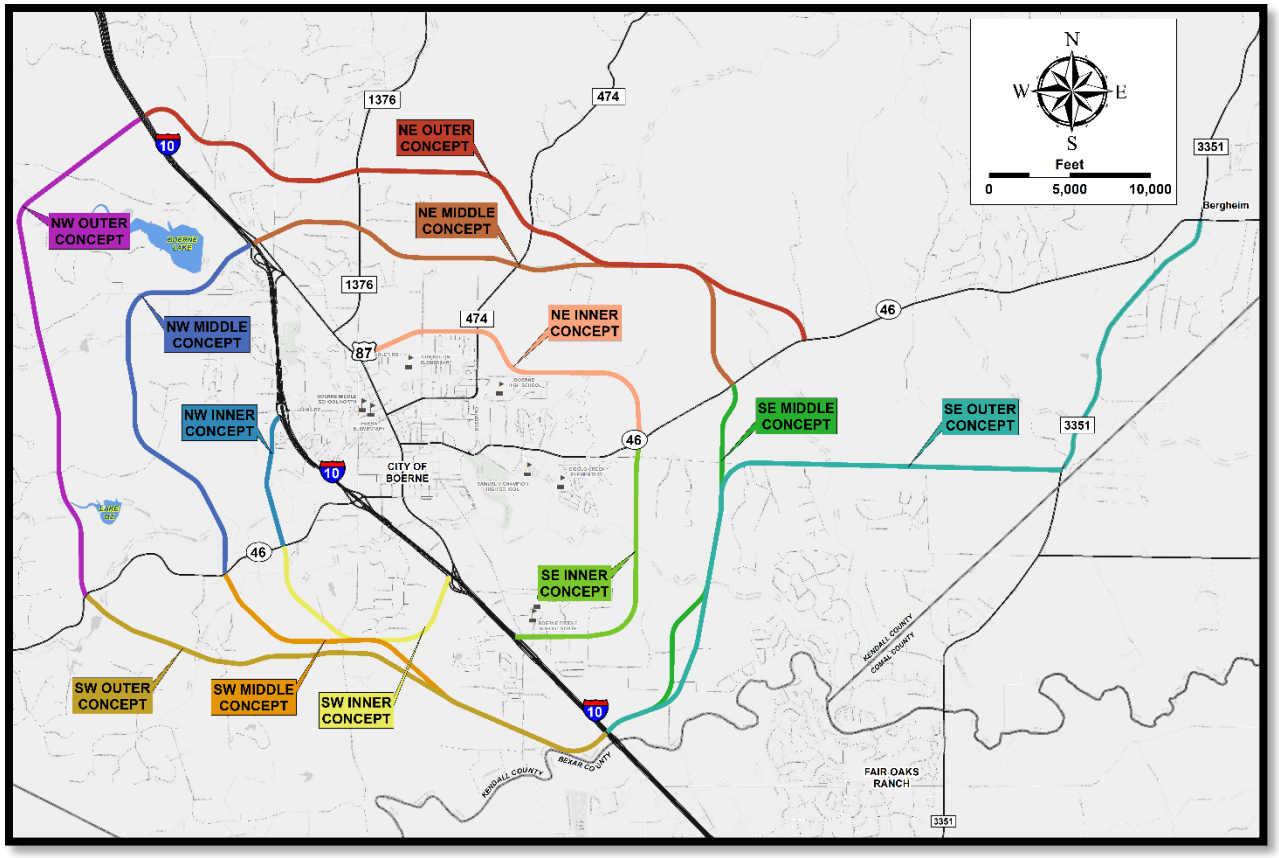

Figure ES-12: Reasonable Concepts Map

Path to Recommended Concepts

In February 2018, the fourth and most impactful working group meeting was held. This meeting began with an overview of public outreach activities, a traffic analysis summary, and a summary of modifications made to the concepts based on public comments received during the second public open house.

The meeting also included a small group workshop. There were seven tables set up in the meeting room, each with one quadrant map illustrating the three reasonable concepts. Participants selected the quadrant they were most interested in for the discussion (northwest, northeast, southeast, or southwest). The maps highlighted the evaluation criteria results for each concept (e.g. how many stream crossings would occur per concept). Each table had a facilitator from the Study Team. Participants were asked to make recommendation decisions within the data-driven framework. The workshop format allowed stakeholders to see the process through the eyes of the Study Team.

Of the seven small groups that participated in this exercise, all recommended at least one concept. The general outcome of the meeting was that all parties acknowledged that a viable transportation solution was needed despite the potential impacts, and that doing nothing was not an option.

After all public input and engineering/environmental considerations were analyzed, the recommended concepts were drafted. The recommended concepts were the four concepts that best represented the public's input, performed the best during the engineering and environmental analysis, and addressed the purpose and need of the project.

Figure ES-13 illustrates the recommended concepts and are color-coded by quadrant (northwest, northeast, southwest and southeast).

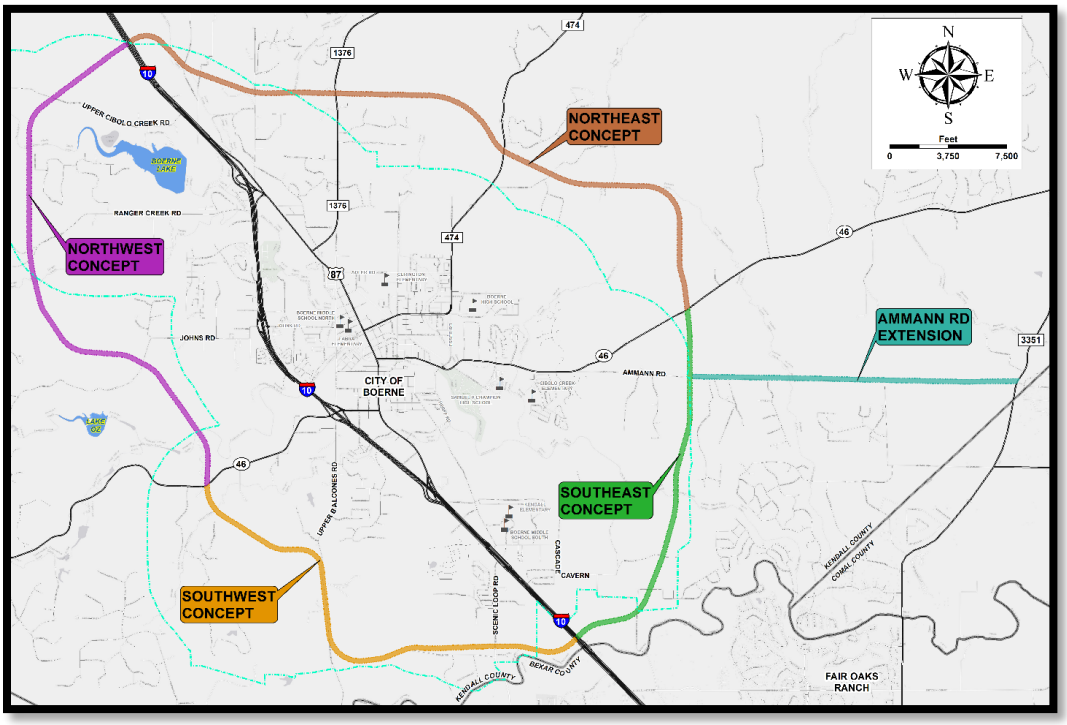

Figure ES-13: Recommended Concepts Map

Table ES-1 highlights the results of the engineering and environmental analysis for each quadrant individually as well as the full loop.

Table ES-1: Recommended Criteria Results

Criteria Results	Northwest	Northeast	Southwest	Southeast	Full Loop
Environmental					
*Known Geologic & Recharge Features (#)	0	0	0	0	0
*Stream Crossings (#)	10	14	10	5	39
*Air Quality (% Trucks Removed)	0%	24%	0%	13%	37%
Direct Commercial Impacts (#)	0	0	0	0	0
Direct Residential Impacts (#)	2	2	5	0	9
Engineering					
*Level of Service (% of Congestion Removed 2040 Within Each Quadrant Independent of Full Loop)	9%	23%	17%	13%	N/A
*Level of Service (% of Congestion Removed 2040)	0%	11%	1%	8%	19%
*Time Reduced (%)	0%	11%	1%	10%	23%
*Drainage (Flood Zone acres)	4	0	8	2	15
Right of Way (acres)	254	309	206	164	933
Parcels Affected (#)	30	50	40	33	153
Length of Roadway (miles)	7.0	8.6	5.9	4.6	26.1
* Public's Top 3 Criteria Results					

The maps below highlight the effectiveness of the recommended concepts. **Figure ES-14** shows the 2040 projected roadway capacity conditions with all proposed existing and committed projects in place, but without the recommended concepts from this feasibility study.

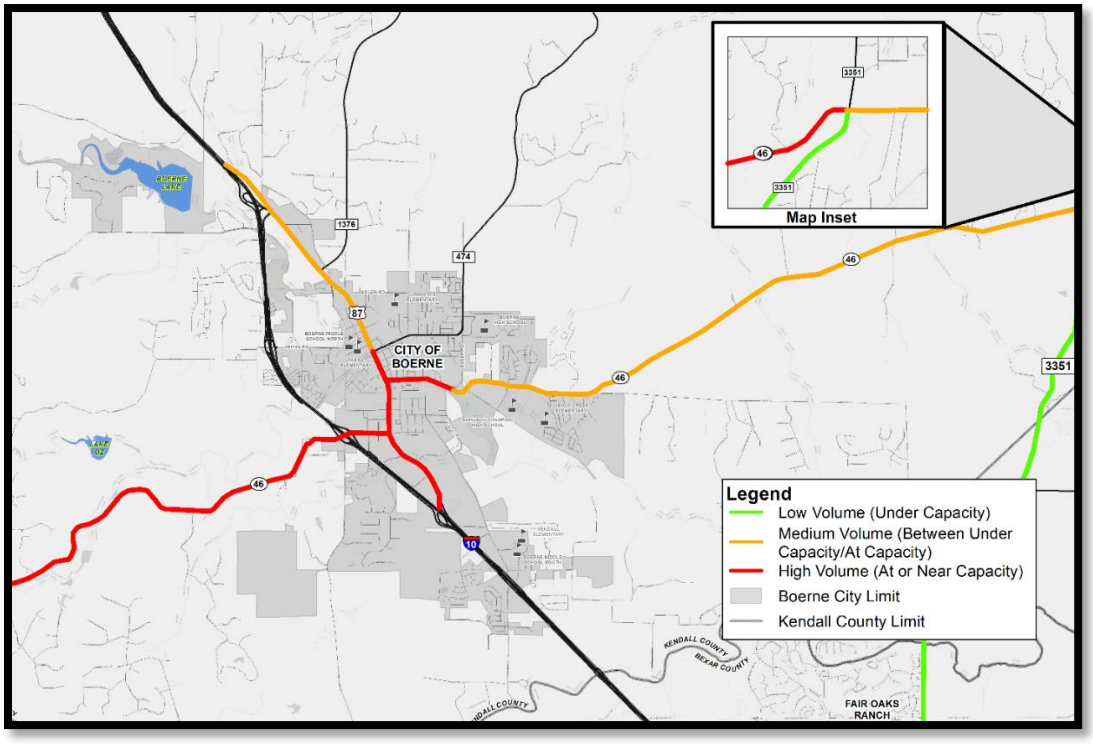

Figure ES-14: Projected Roadway Capacity Conditions Without Recommended Concepts (2040)

Figure ES-15 shows the roadway capacity conditions with the recommended concepts incorporated.

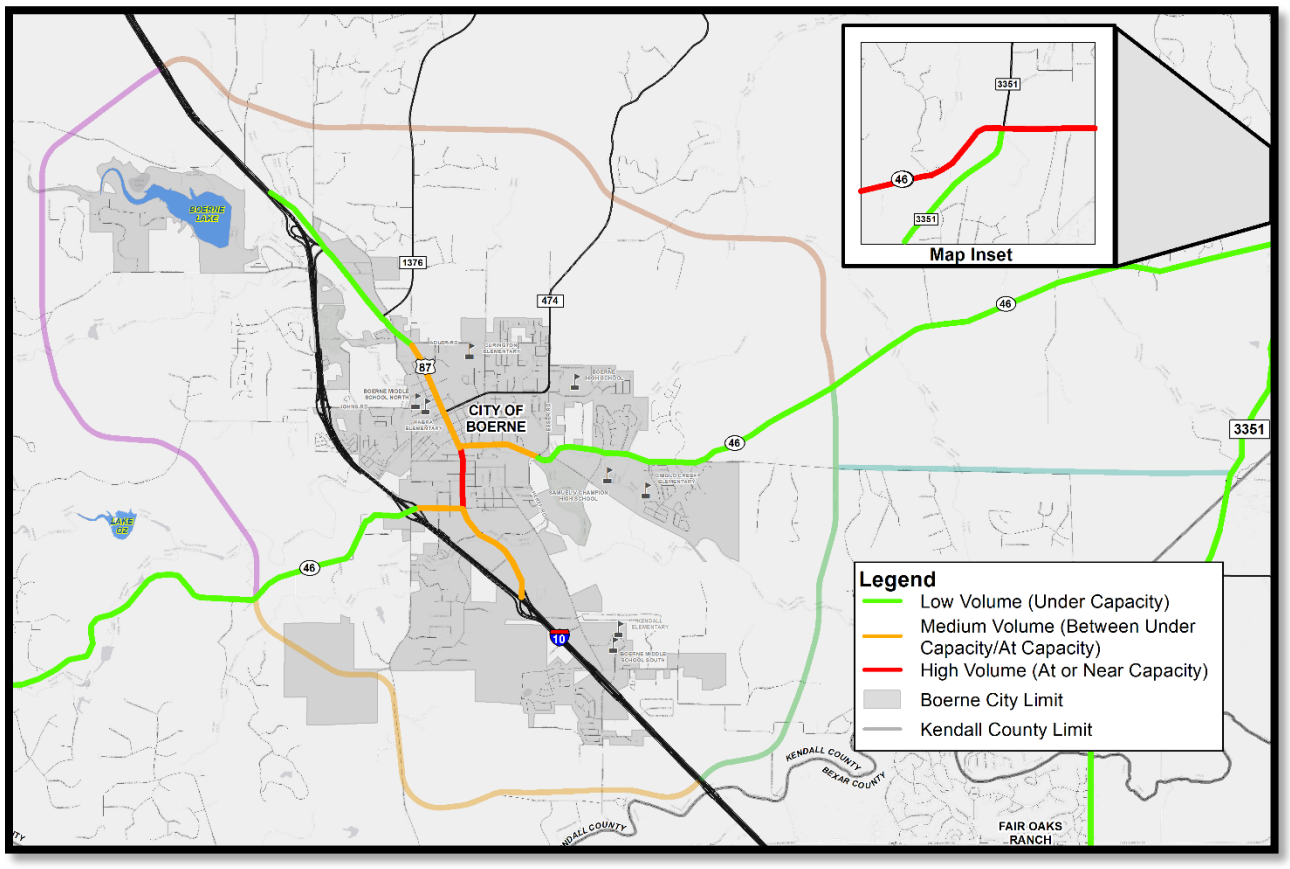

Figure ES-15: Projected Roadway Capacity Conditions with Concepts (2040)

Important results/benefits to highlight included:

- On average, the concepts removed almost 40 percent of the trucks traveling through Boerne in 2040.
- The recommended concepts provided an alternative route for traffic travelling on SH 46 through downtown Boerne with destinations elsewhere.
- The recommended concepts provided reduction of travel time inside the city core, estimated at 23 percent.
- The recommended concepts provided reduction of traffic on the existing effected roadways in the city core, estimated at 19 percent.
- The concepts did not substantially impact any known/identified geologic and recharge features.
- The concepts did not directly impact commercial establishments.
- The concepts impacted only nine residential features.
- The recommended concepts could be implemented independently and phased, beginning with a two-lane facility until travel demand warrants expansion.
- The 300-foot ROW width was selected for planning purposes only and could be narrowed/refined based upon subsequent detailed studies and local input.

- The recommended concepts provided east/west connectivity, additional capacity for the anticipated growth and redundancy within the roadway network, which is particularly critical for emergency services.

Prioritization of the Recommended Concepts

Many variables influenced the prioritization of the quadrant concepts. Which environmental and engineering criteria was the most important can vary greatly between all parties involved. To avoid subjectivity, the Study Team weighed the concepts against one another instead of assigning priority to each of the criteria. The rankings utilized an order of magnitude method that adjusted the percent score based on a comparative level of impact. The lower the score, the higher the priority.

Results (**Table ES-2**) indicated that the concept in the southeast quadrant was the best scoring concept for prioritizing first when all criteria impacts were considered, along with cost and concept efficiency (defined in **Section 6.1.1**).

Table ES-2: Recommended Criteria Rank Results

Criteria Rank Results	Northwest	Northeast	Southwest	Southeast	Recommended First Phase
Environmental					
*Known Geologic & Recharge Features (#)	0%	0%	0%	0%	Tie
*Stream Crossings (#)	26%	36%	26%	13%	Southeast
*Air Quality (% Trucks Removed)	33%	12%	33%	22%	Northeast
Direct Commercial Impacts (#)	0%	0%	0%	0%	Tie
Direct Residential Impacts (#)	22%	22%	56%	0%	Southeast
Engineering					
*Level of Service (% of Congestion Removed 2040 Within Each Quadrant Independent of Full Loop)	28%	21%	24%	26%	Northeast
*Level of Service (% of Congestion Removed 2040)	33%	15%	32%	20%	Northeast
*Time Reduced (%)	33%	17%	32%	18%	Northeast
*Drainage (Flood Zone acres)	30%	0%	56%	13%	Northeast
Right of Way (acres)	27%	33%	22%	18%	Southeast
Parcels Affected (#)	20%	33%	26%	22%	Northwest
Length of Roadway (miles)	27%	33%	23%	18%	Southeast
Cost ($M)	26%	33%	23%	18%	Southeast
Concept Efficiency Factor ($M/%)	41%	20%	19%	20%	Southwest
Rank					
Total Score	3.48	2.74	3.72	2.07	Southeast
Rank	**3**	**2**	**4**	**1**	
* Public's Top 3 Criteria Results					

To address the lack of east-west corridors within the study area, the combination of Southeast and Southwest Concepts (or South Concepts) were further ranked and compared to the Northeast and Northwest Concept combination (north concepts), The combined South or North Concepts would provide the alternate east-west route to SH 46 around downtown Boerne and through the study area. The results are illustrated in **Table ES-3**.

Table ES-3: Northern vs. Southern Criteria Rank Results

Criteria Rank Results	North	South	Recommended First Phase
Environmental			
*Known Geologic & Recharge Features (#)	0%	0%	Tie
*Stream Crossings (#)	62%	38%	South
*Air Quality (% Trucks Removed)	35%	65%	North
Direct Commercial Impacts (#)	0%	0%	Tie
Direct Residential Impacts (#)	44%	56%	North
Engineering			
*Level of Service (% of Congestion Removed 2040 Within Each Quadrant Independent of Full Loop)	48%	52%	North
*Level of Service (% of Congestion Removed 2040)	45%	55%	North
*Time Reduced (%)	50%	50%	Tie
*Drainage (Flood Zone acres)	30%	70%	North
Right of Way (acres)	60%	40%	South
Parcels Affected (#)	52%	48%	South
Length of Roadway (miles)	60%	40%	South
Cost ($M)	59%	41%	South
Concept Efficiency Factor ($M/%)	57%	43%	South
Rank			
Total Score	6.03	5.97	**South**
Rank	**2**	**1**	
* Public's Top 3 Criteria Results			

Considering the findings in **Table ES-2** and **Table ES-3**, the Study Team recommended the Southeast Concept be prioritized first, followed by the Southwest Concept and subsequently the northern concepts.

In addition to the long-range recommended concepts, the Study Team identified some interim improvements that could help with traffic operations and safety in the shorter term. These are summarized in **Section 7.0**.

Conclusion

The KGS was a study done to support future transportation planning efforts by Kendall County and the City of Boerne. The KGS effort was data-driven through an interactive and transparent public involvement process. The KGS identified several overarching needs: identify transportation solutions to address the growing population and travel demands; identify additional and alternate east/west corridors to reduce through-vehicle/truck traffic in downtown Boerne and provide system redundancy, especially for emergencies during catastrophic events; and improve traffic safety conditions in the downtown Boerne center.

Results showed the recommended Kendall Gateway concepts would improve local and regional mobility as the Kendall County/City of Boerne population, development and travel demand continues to grow. The recommended concepts provided alternate east-west corridors to SH 46, connectivity, system redundancy and needed capacity to accommodate the increasing travel demand. The KGS recommended concepts would allow motorists that travel through Kendall County and the City of

Boerne an alternate route, enhancing safety and preserving the cultural and walkability in the downtown center.

Local and non-local motorists would experience improved traffic flow and safety. Local traffic would see a reduction in congestion, delays, and accidents. Non-local, through-traffic, would experience reduced congestion and see a decrease in travel times. Without the proposed concepts, SH 46 and the surrounding street network would continue to experience a decline in the level of service, deteriorating roadway conditions, and increased safety concerns.

As with many transportation improvement projects, the KGS recommended concepts may induce additional traffic to the area. However, the undeveloped tracts in the study area would continue to develop regardless of concept construction. The Kendall Gateway would be one part of a regional solution to help alleviate the congestion that the additional development and growth in the study area would cause.

There were few remaining areas for new location corridors, as illuminated in **Figure ES-16**. Growth projections from local, state, and federal sources indicated that there would be even fewer options for corridors in the years to come; which makes planning now for the future important. While the impetus for the KGS was to support future transportation planning efforts, the City of Boerne and Kendall County could begin early steps, by using the local thoroughfare and master development planning processes to help facilitate these recommendations.

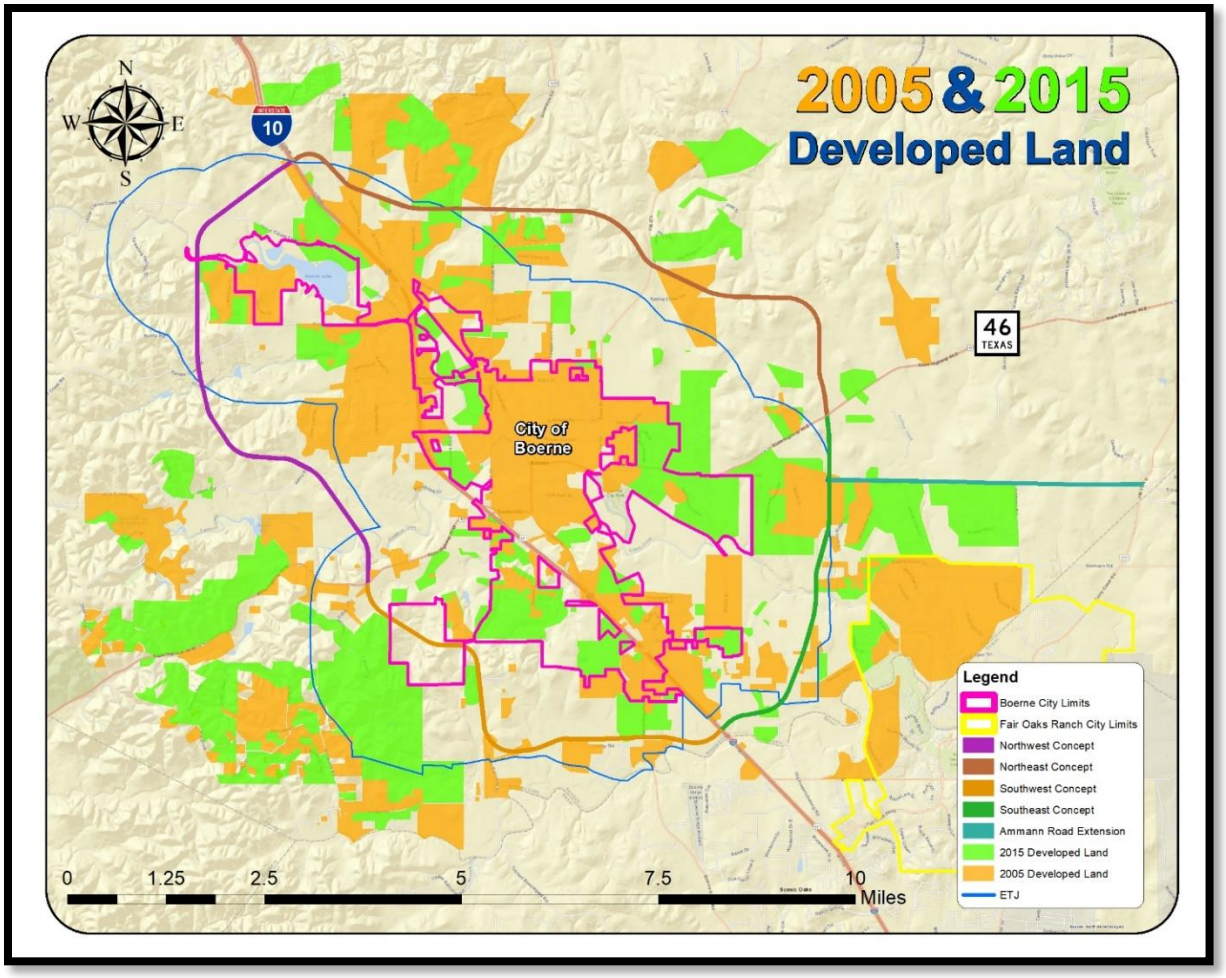

Figure ES-16: Recommended Concepts on Developed Land in Boerne Map per 2005 & 2015 Aerial Analysis

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AACOG	Alamo Area Council of Governments
ACS	American Community Survey
ADT	Average Daily Traffic
AVE	Avenue
BKEDC	Boerne Kendall County Economic Development Corporation
BUS	Business
CEDS	Comprehensive Economic Development Strategy
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CO	Carbon Monoxide
CRIS	Crash Records Information System
CWA	Clean Water Act
DHHS	United States Department of Health and Human Services
DR	Drive
EJ	Environmental Justice
EMST	Ecological Mapping System of Texas
E	East
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ETJ	Extra Territorial Jurisdiction
FAQ	Frequently Asked Questions
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRMs	Flood Insurance Rate Maps
FM	Farm to Market
FPPA	Farmland Protection Policy Act
HOA	Home Owners Association
I-10	Interstate Highway 10
KGS	Kendall Gateway Study
LEP	Limited English Proficiency
LOS	Level of Service
MBTA	Migratory Bird Treaty Act of 1918
MPH	Miles per Hour
MPO	Alamo Area Metropolitan Planning Organization
N	North
NAAQS	National Ambient Air Quality Standards
NHD	National Hydrography Dataset
NO2	Nitrogen Dioxide
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
O3	Ozone
O&D	Origin and Destination
Pb	Lead

PI Plan	Public Involvement Plan
PM	Particulate Matter
POA	Property Owners Association
RCRA	Resource Conservation and Recovery Act
RD	Road
ROW	Right of Way
S	South
SH	State Highway
SO2	Sulfur Dioxide
ST	Street
SWG	Stakeholder Working Group
TCEQ	Texas Commission on Environmental Quality
TDA	Texas Department of Agriculture
TDM	Travel Demand Model
THC	Texas Historical Commission
TPWD	Texas Parks and Wildlife Department
TRRC	Texas Railroad Commission
TWDB	Texas Water Development Board
TWG	Technical Working Group
TWLTL	Two Way Left Turn Lane
TxDOT	Texas Department of Transportation
TXNDD	Texas Natural Diversity Database
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Services
VHT	Vehicle Hours Traveled
VPD	Vehicles Per Day
W	West

1.0 INTRODUCTION

TxDOT San Antonio District entered into a joint resolution on August 25, 2015 with the City of Boerne and Kendall County to lead a transportation planning or feasibility study, named the KGS. The city and county specifically requested that TxDOT "determine potential future transportation corridors needed to accommodate the anticipated growth in the region." The KGS was initiated to identify viable transportation corridors for future growth (**Figure 1**).

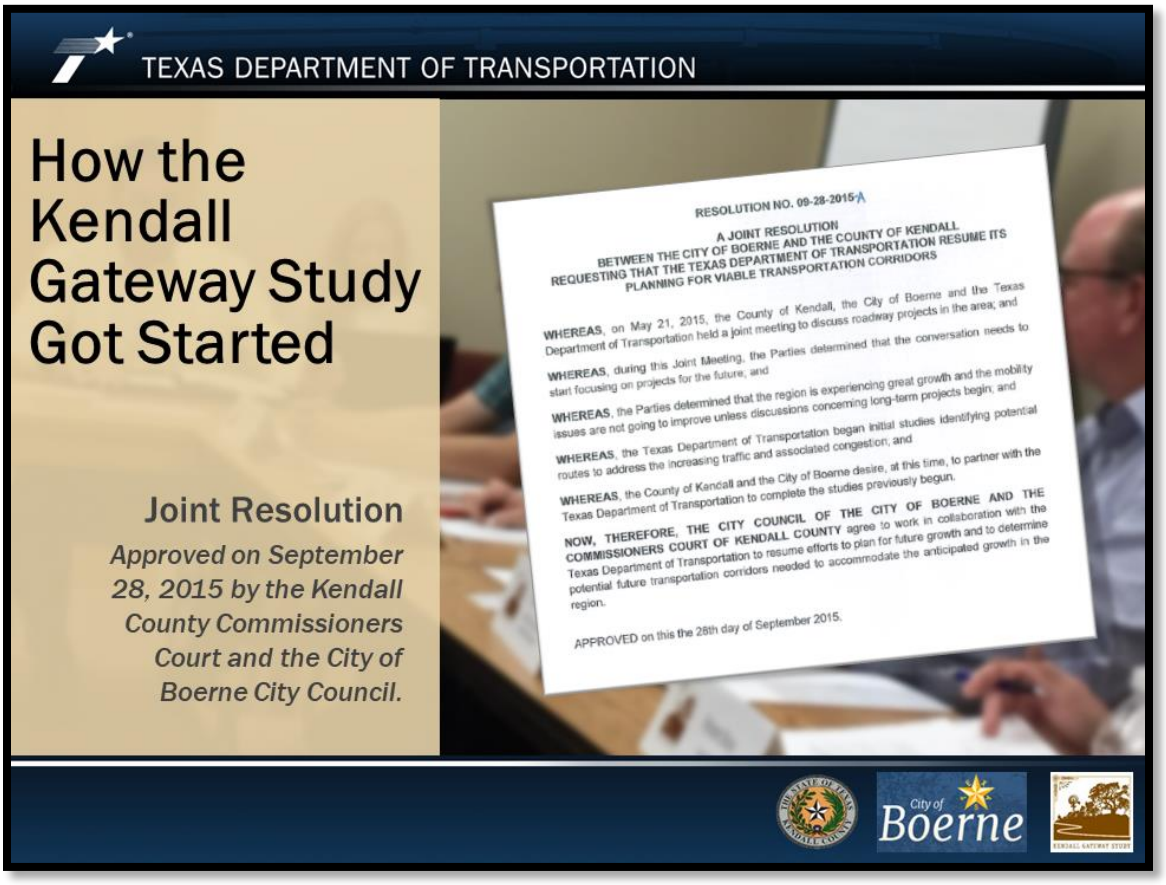

Figure 1: 2015 City of Boerne and Kendall County Joint Initiation

The following sections of this report identify and describe the purpose and need for this planning effort, the study process used, an evaluation of the existing roadway network, the analyses and comparison of potential concepts using specific criteria, and present the recommended concepts.

1.1. GOALS AND OBJECTIVES

Kendall County and the City of Boerne are attractive to families and businesses alike and are rapidly outgrowing the existing transportation network's capacity. Using a data-driven approach, the objective of the KGS was to analyze existing constraints, planned development, and traffic patterns to identify current infrastructure deficiencies. Ultimately, a plan will be produced recommending transportation solutions that benefit the citizens and visitors of the City of Boerne and Kendall County. This plan can be incorporated into future regional, county, and city transportation planning strategies.

1.2. DESCRIPTION OF STUDY AREA

Per the 2010 U.S. Census Bureau, the City of Boerne is a community of approximately 10,471 people located along the I-10 corridor between the cities of San Antonio and Comfort. The study area selected was intended to be of sufficient size to allow for engineering and environmental analysis. The study area is shown in purple in **Figure 2**.

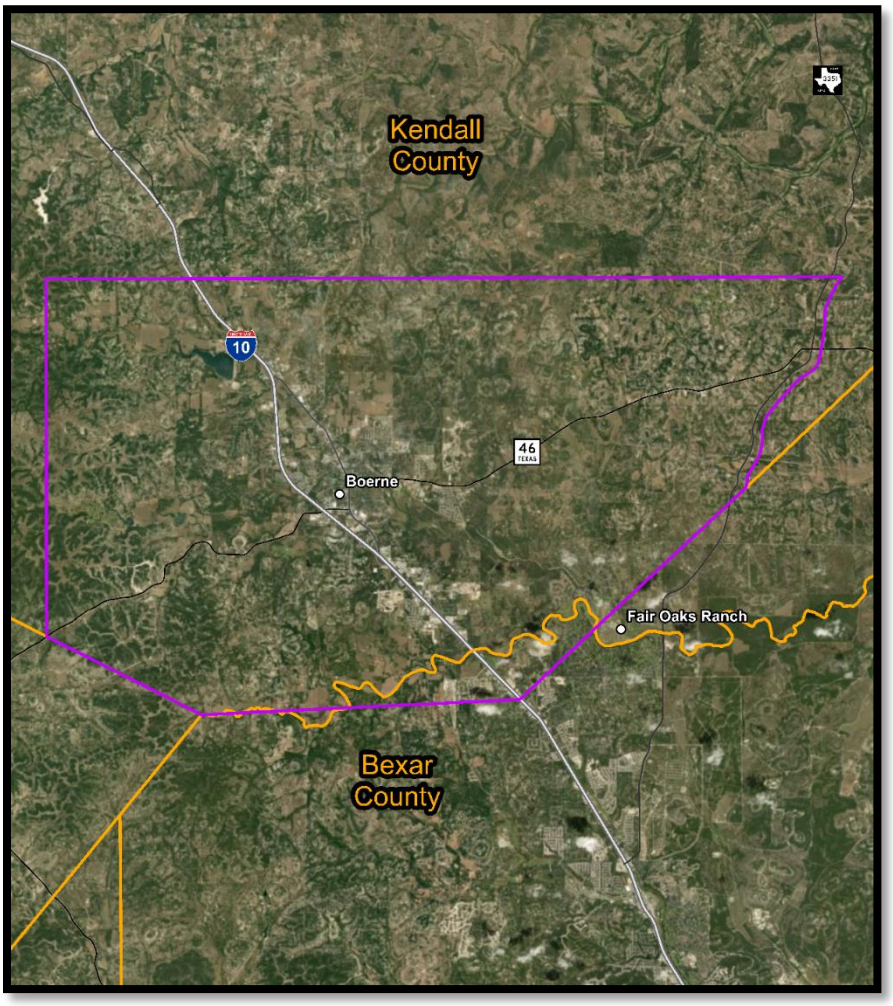

Figure 2: Project Study Area Map

The study area included a majority of the Boerne city limits, Boerne ETJ, and the extended Boerne ETJ, while minimizing areas outside of Kendall County. The study area began at the Kendall, Bandera, and Bexar County intersection and continued clockwise. From this starting point, the study area continued northwest along the Kendall/Bandera County limits to the intersection of RR 475/SH 46 and the Kendall County limits. It then turned due north to Rocky Top Rd. (approximately 2.9 miles west of I-10). From Rocky Top Rd., the study area limit turned due east to 1,000 feet east of FM 3351. The study area paralleled FM 3351 for 1,000 feet to the east until the Kendall/Comal County line. It turned to follow the Kendall/Comal County line straight to I-10. From this point, the study area turned to the west and finished at the starting point at the Kendall, Bandera, and Bexar County intersection.

1.3. PURPOSE AND NEED

The **Purpose and Need** for the KGS was essential in establishing a basis for developing a range of concepts and assisted with the identification, evaluation and selection of a recommended concept.

The **Need** for transportation improvements included three key components as described below:

Need One: Past, present and future population growth and travel demand. There has been substantial population growth in the study area (defined in **Section 2.1**). From 2005 to 2015, the Kendall County population grew from 28,604 to 40,384, respectively. **Figures 3** and **4** illustrate the increase in developments. From 2010 to 2040, the study area is projected to increase another 88 percent, reaching a total population of about 62,821 for the county, according to the Alamo Area Metropolitan Planning Organization's "*Mobility 2040 Metropolitan Transportation Plan*" and the U.S. Census Bureau. Projected 2040 traffic volumes indicate that most, if not all, major roadways in and around Boerne would be at or over capacity by 2040 (described further in **Section 2.0**).

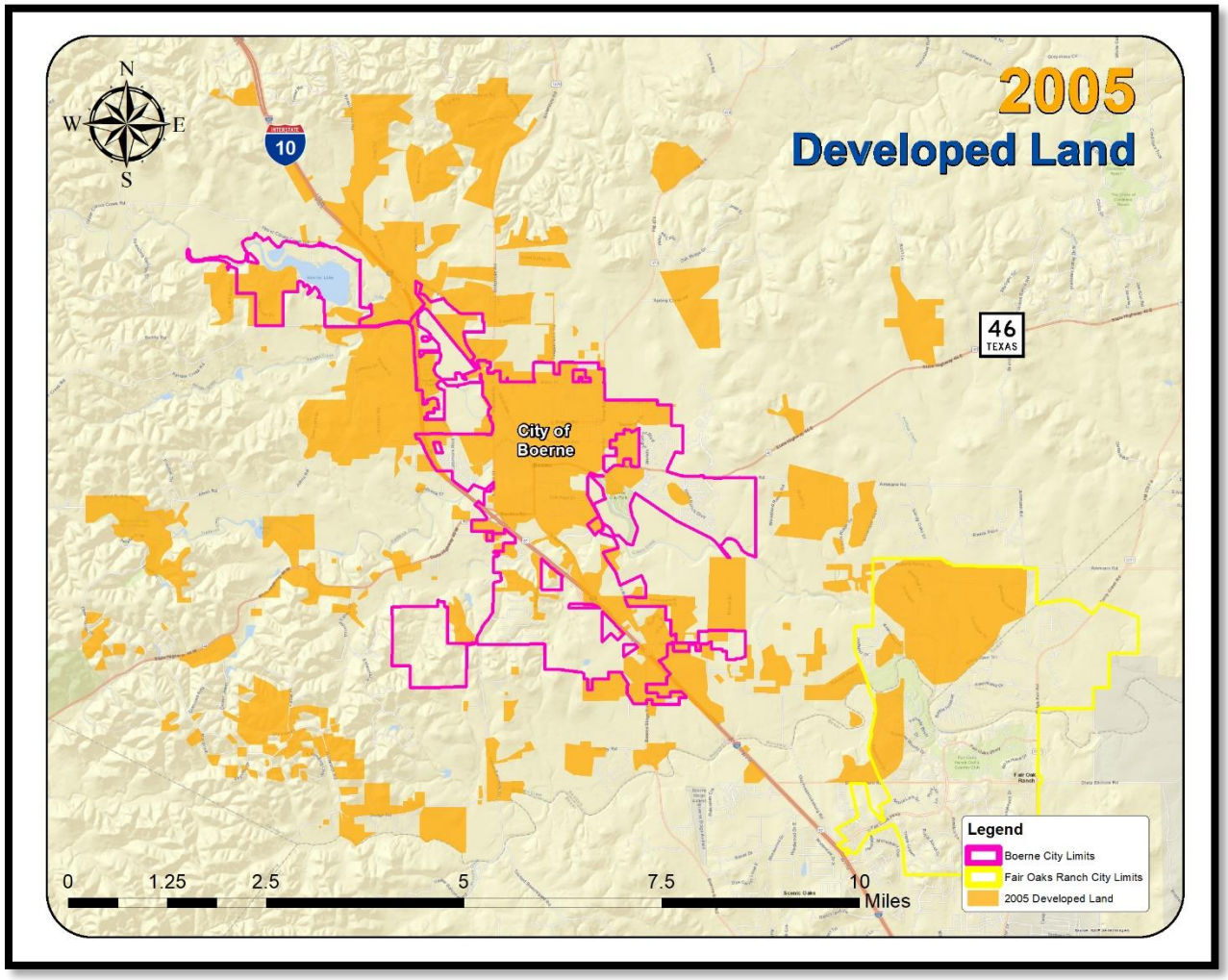

Figure 3: Map of Developed Parcels in Boerne per 2005 Aerial Analysis

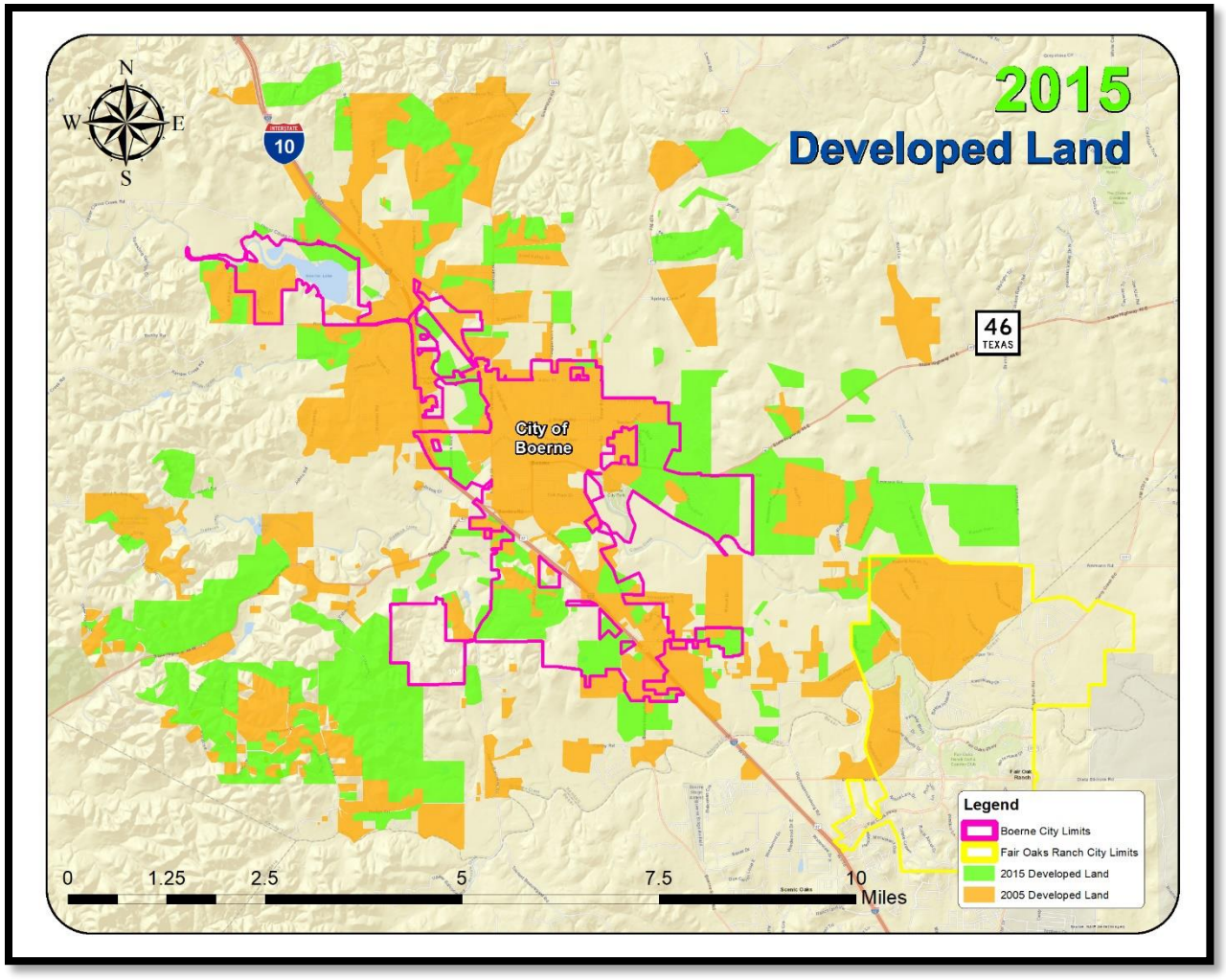

Figure 4: Map of Developed Parcels in Boerne per 2015 Aerial Analysis

Need Two: Additional east/west corridors and connectivity in the study area. SH 46, the only major east/west corridor, cannot accommodate the high volumes of both passenger vehicles and large trucks projected to increase through 2040. SH 46 offsets through downtown Boerne, with no alternate routes for pass-through traffic with destinations elsewhere.

Figure 5 illustrates the traffic projections in 2040 and configuration of SH 46. Importantly, an alternate east/west corridor is needed for system redundancy, especially during emergencies and catastrophic events, such as a flood event from Cibolo Creek in 2016 which significantly hindered emergency services along SH 46.

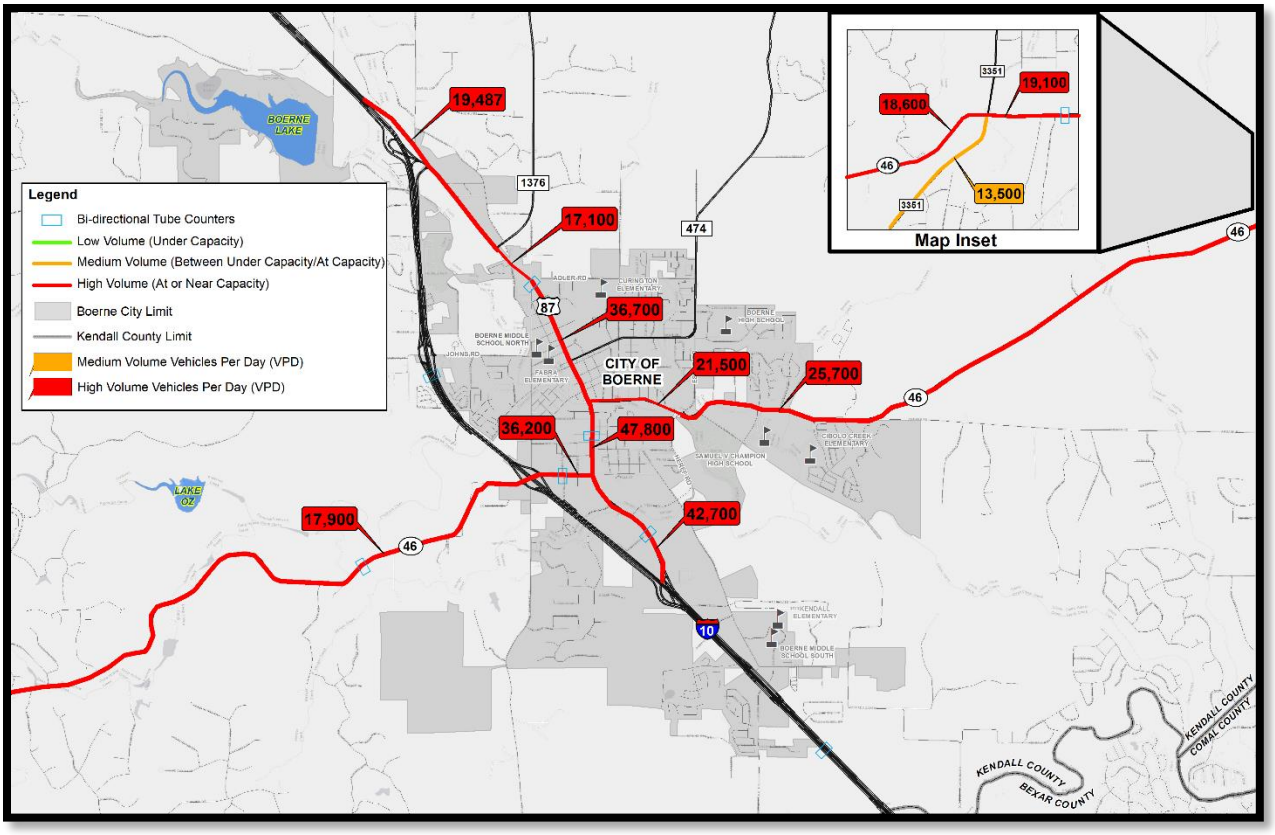

Figure 5: Projected Roadway Capacity Conditions (2040)

Need Three: Safety improvements in downtown Boerne. Vehicular and truck traffic directed through Boerne along the SH 46 route poses circulation problems and conflicts with the downtown center's walkability and pedestrian use. The downtown area, an important tourist destination, lacks the capacity needed to accommodate existing and future growth. Widening SH 46 downtown would result in substantial impacts to the cultural and walkability of the community, including Cibolo Creek and park areas. Without another system link for east/west traffic, through-vehicle and heavy truck traffic travel through the downtown area.

Data obtained from the *2017 Initial Traffic Study Report* (**Appendix A**), revealed a high percentage of truck traffic (roughly 18 percent) on SH 46 coming into town from the east. Substantial numbers of large trucks create conflicts with the local traffic circulation because of limited roadway space and alternative routes for those vehicles.

SH 46 through downtown Boerne has always been a major transportation corridor for traffic heading towards San Antonio and north on I-10. Higher than average truck traffic conflicts with land use, pedestrians crossing the streets, and on-street parking in the downtown area. The downtown infrastructure is also aging and not able to accommodate the combined high volumes of truck traffic, turning movements, street parking, and pedestrian crossings.

The crash analysis from the *2017 Initial Traffic Study Report* revealed several hotspots on the corridor as listed below and further described in **Section 2.2.2**.

- The segments of SH 46 through downtown Boerne, from I-10 to FM 474 have a crash rate that significantly exceeds the state average.
- The intersection of SH 46 and BUS 87 (River Rd. and Main St.) in the center of Boerne has the highest number of crashes in the study area, with 96 crashes over a five-year period from 2011 to 2015, an average of 19 crashes per year.
- Other intersections with an average of 10 crashes per year or more include SH 46 at I-10 and I-10 at Scenic Loop.

Considerable queuing delays occur at intersections along SH 46, including Main St. in downtown. These intersections contribute to an overall delay of traffic in the downtown area and decrease the quality of life for the residents that conduct local trips on the surrounding roadway network.

The **Purpose** of the KGS project was to identify concepts and recommend a solution to address the growing transportation demands within and around the City of Boerne and Kendall County. This study provided solutions for connectivity and regional linkage to the City of Boerne and Kendall County while minimizing impacts and maintaining Boerne's unique natural and cultural resources. The KGS specifically addressed east/west traffic connectivity for travelers along SH 46 and within the downtown area of Boerne.

1.4. LOCAL PLANNING EFFORTS

1.4.1. 2016 CITY OF BOERNE ECONOMIC DEVELOPMENT WORK PLAN

The *2016 City of Boerne Economic Development Work Plan*, the fourth produced, provided a guide for the economic development efforts in the city by identifying goals, strategies, and action items. The plan revisited goals from the previous version to provide an update of progress on the top 10 initiatives and looked at new initiatives for strategic and managed growth today and in the future. Enhancing quality of life, being good stewards of the community's natural resources, and maintaining Boerne's unique identity remained at the forefront of every decision the city made regarding economic development.

The Boerne-Kendall County Economic Development Corporation (BKEDC) strives to seek economic development opportunities targeted at achieving the goals of attracting high quality commercial and retail growth while preserving and improving the quality of life. The BKEDC is evolving with the city's participation toward a more dynamic and results-driven enterprise. The city and BKEDC have developed a new set of shared goals including business retention, expansion, and recruitment.

1.4.2. 2006 CITY OF BOERNE MASTER PLAN UPDATE

The plan provided guidance to the direction, policy, and future actions for the City of Boerne to address current and future needs while promoting the general welfare of citizens. The plan acted as a roadmap to the future that stakeholders and residents envision. The master plan identified a proposed "arterial ring" around the city.

1.4.3. 2012 – 2022 CITY OF BOERNE PARKS, RECREATION, AND OPEN SPACE MASTER PLAN

The plan reflected a range of issues and levels of planning with the broad-scale contextual relationships of the parks in the community and serves as a guide for the future development of the City of Boerne parks and recreation system from the year 2012 – 2022. The planning area contained the city's ETJ, and boundaries of Boerne Independent School District that are not within the city limits or the ETJ. The report contained an outline of the city's future park priorities. The plan identified priorities as well as an implementation and action plan focused along three congruent tracks: outdoor facilities, indoor facilities, and park specific renovations projects. The plan also identified the need to provide a future neighborhood park in the southwest area of the city taking into account the area is currently underserved and development is trending toward that area of the city. The development of the park may be supplemented through developer impact fees or thru subdivision ordinance. No timeline is set for the development of this future park, but it is within the 10-year horizon on this master plan.

1.4.4. 2016 CITY OF BOERNE HISTORIC DESIGN GUIDELINES

Developed by the Boerne Historic Landmark Commission, the guideline outlined the city's approach and requirements for historic and non-historic buildings within designated districts. The goal of the document is to protect the overall character of the districts. The guidelines addressed the historic district, types of projects, architectural features, and site conditions.

1.4.5. 2010 CITY OF BOERNE UPPER CIBOLO CREEK WATERSHED PARTNERSHIP PUBLIC PARTICIPATION PLAN

The document identified steps that the City of Boerne would take to maintain and improve water quality within Upper Cibolo Creek. The plan was developed by the city in cooperation of The Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA) and was largely funded by a federal grant administered through these agencies. This is a non-regulatory plan.

1.4.6. ALAMO AREA COUNCIL OF GOVERNMENTS (AACOG) REGIONAL BICYCLE & PLANNING STUDY, VOLUME FOUR BOERNE BICYCLE AND PEDESTRIAN STUDY

The study provided a focused approach to building a region-wide bicycle and pedestrian system as part of the Alamo Area Metropolitan Planning Organization. The study, dedicated to the City of Boerne (Volume Four), specifically aimed to improve the environment for walking and bicycling throughout Boerne. The study highlighted ways to increase walking and biking activities by making both modes of active transportation more viable and attractive for the city's residents and visitors.

1.4.7. AACOG REGIONAL COMPREHENSIVE ECONOMIC DEVELOPMENT STRATEGY (CEDS)

Every five years, the AACOG works collaboratively with private sector leaders, public officials, private citizens, and economic development stakeholders within the region to develop a CEDS. The CEDS, funded by the Economic Development Administration - U.S. Department of Commerce, serves as a

roadmap that aggregates and synthesizes economic development initiatives throughout the region and provides clarity on how the regional economy would diversify and strengthen over a five-year forward-looking period (2012 to 2017). The CEDS is not intended to supersede local economic development plans and strategies at work in the region, but rather its purpose is to add value to and improve the competitiveness of the region by improving coordination, collaboration, and cooperation among the region's many economic development stakeholders.

1.4.8. 2016 AACOG PUBLIC TRANSPORTATION COORDINATION PLAN

In conjunction with AACOG staff and the members of the Regional Planning and Public Transportation Committee, the *2016 AACOG Public Transportation Coordination Plan* was developed. The plan detailed the following vision: Residents (including the general public and human service clientele) and visitors to the 12-county Alamo Area would be able to move throughout the region safely, reliably, efficiently, and affordably by using a seamless network of public and private facilities and services that are easy to comprehend, responsive to individual travel needs, and easy to access.

1.4.9. PREVIOUS PROJECT HISTORY

In 2005, several route alternatives were identified as relief routes to SH 46. The proposed routes were 13 to 17-mile new location, multi-lane, divided highways connecting SH 46 east of Boerne to I-10 south of Boerne and to SH 46 west of Boerne. A public meeting was held for the project in June 2005 to present the project overview and viable corridor alternatives. Following the public meeting, the project development and design were suspended before a preferred corridor was developed.

1.5. STUDY DEVELOPMENT PROCESS

The following sections of this report discusses the feasibility study process. The phases of the study process are shown in **Figure 6**.

- **Section 2.0 Engineering Considerations in the Study Area**, includes a description of the physical study area and the surrounding environment, including the roadway network. It provides an understanding of issues including related traffic conditions.
- **Section 3.0 Public Involvement**, provides a summary of public engagement activities held to support development of the KGS.
- **Section 4.0 Environmental Considerations in the Study Area**, discusses environmental resource information gathered within the study area (including from desktop analysis, windshield surveys and public input).
- **Section 5.0 Concept Development Process**, provides a definition of the universe of concepts, typical section, facility type, concepts eliminated, as well as reasonable concepts that satisfied the KGS purpose and need. The section also describes the environmental, socioeconomic and engineering criteria developed for use in concept evaluation to arrive at a list of recommended concepts.
- **Section 6.0 Prioritization of Concepts**, provides a review of the quantitative and qualitative factors used to identify project priority. The basis of this serves as the foundation to develop a project implementation plan.

- **Section 7.0 Interim Improvements**, describes projects that are additional to the list of recommended long-range concepts. These projects could be considered in the short-term timeframe to provide interim improvements to overall operations in the area.

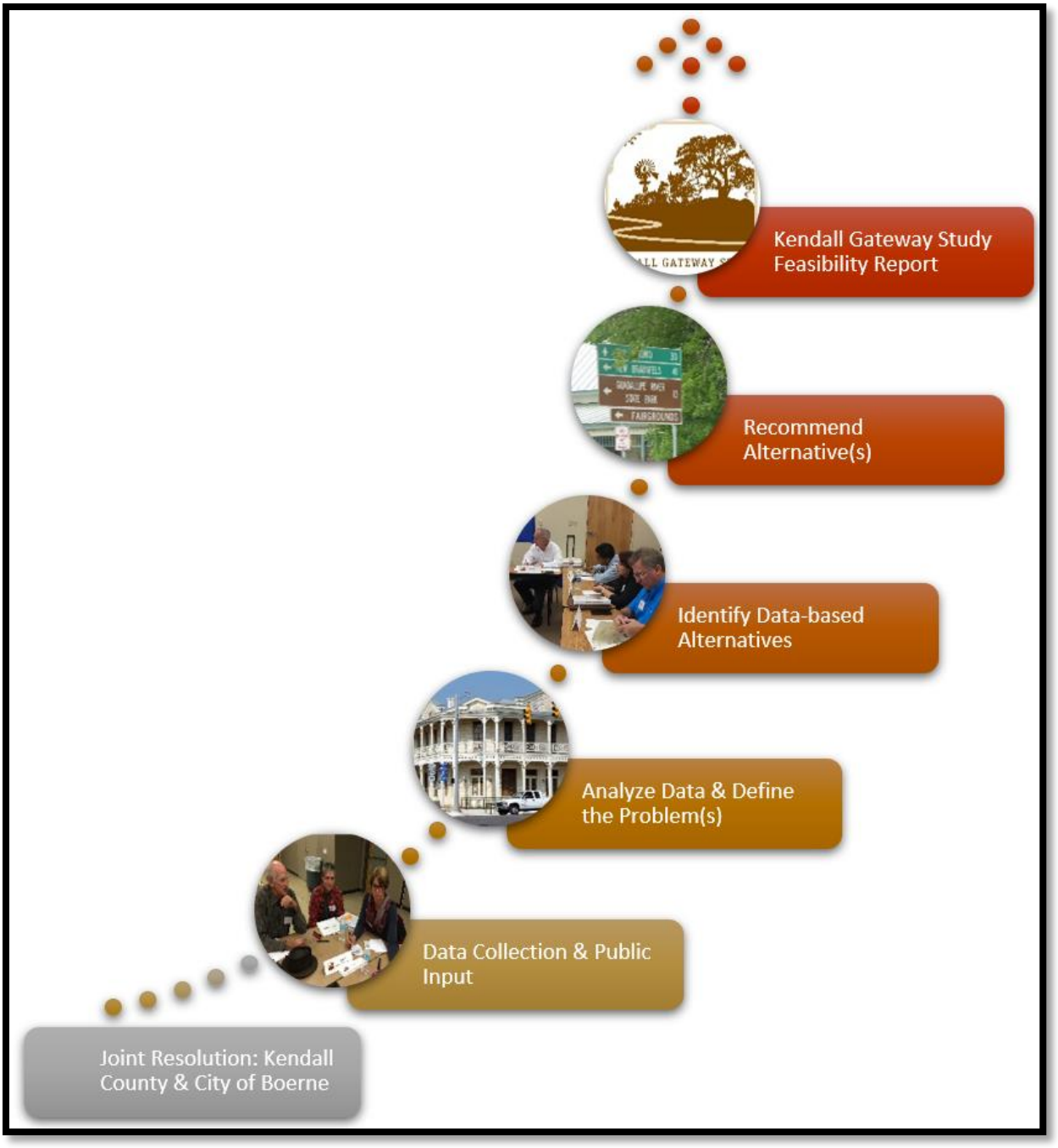

Figure 6: KGS Process

2.0 ENGINEERING CONSIDERATIONS IN THE STUDY AREA

To fully understand the context of the issues along SH 46, it was critical to conduct an evaluation in context to the surrounding environment. This section of the report details a description of the physical study area, including the roadway network, and the related traffic conditions.

2.1. ROADWAY NETWORK

2.1.1. LOCAL STREETS

The Boerne local street network is a typical grid network with only SH 46 providing a continuous east/west traffic route for access to the community's neighborhoods, schools, churches, and businesses.

2.1.2. STATE HIGHWAYS AND FARM-TO-MARKET ROADS

The roadway network in and around Boerne comprises seven major facilities, as shown in **Figure 7**.

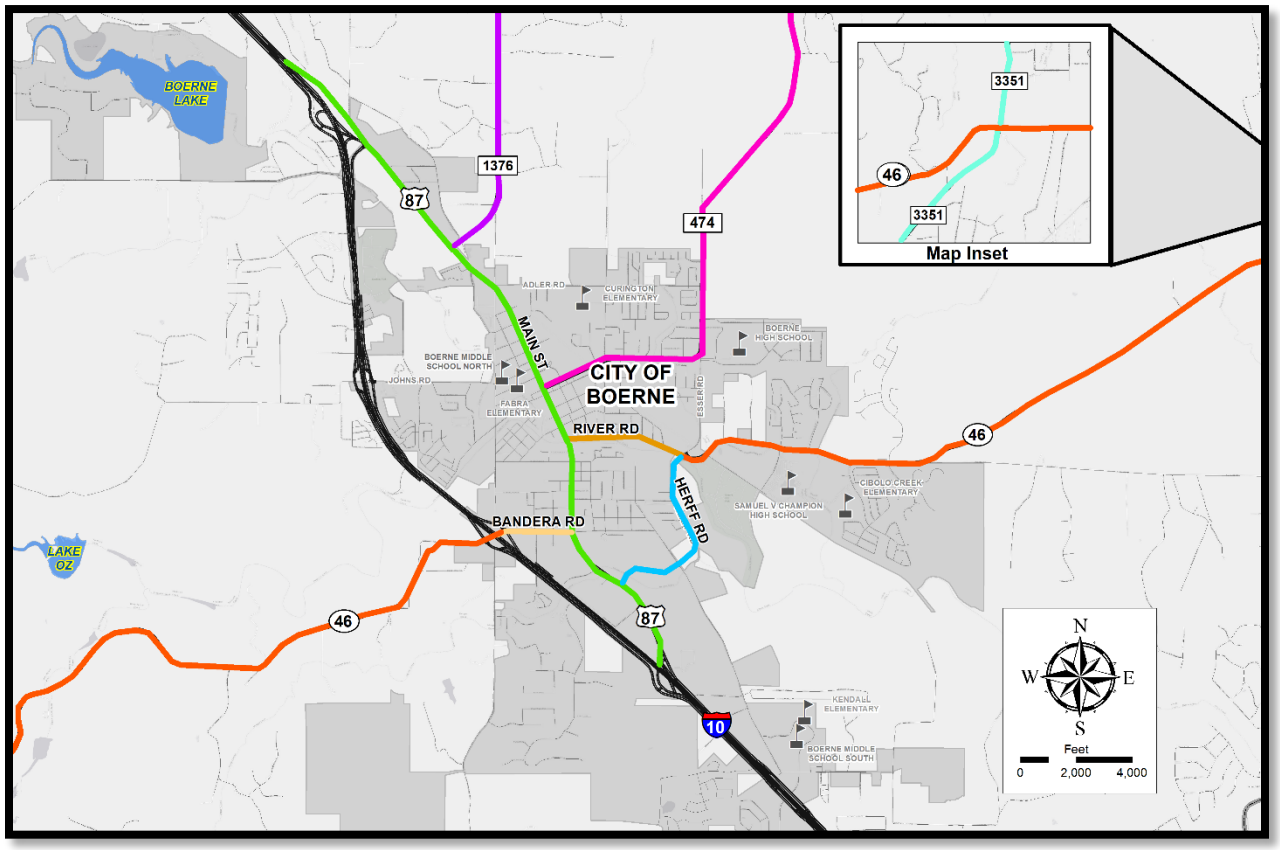

Figure 7: Existing Road Layout

SH 46

SH 46 is the primary east/west arterial through Kendall County with an offset through downtown Boerne, via BUS 87 or "Main St." West of BUS 87 and east of I-10, SH 46 is called Bandera Rd. and is comprised of five lanes (two lanes in each direction with a center turn lane) with a posted speed of 35 miles per hour (mph). Continuing west of I-10, SH 46 is a two-lane rural highway (one lane in each direction) with a speed of 55 mph. East of BUS 87 and west of Herff/Esser Rd. intersection, SH 46 is called River Rd. and has two lanes (one lane in each direction). Continuing east of Herff/Esser Rd., SH 46 transitions to a two-lane rural-type highway with a speed of 65 mph. Through downtown Boerne, SH 46 follows BUS 87 or Main St. between the east and west intersections of River Rd. and Bandera Rd.. The downtown section of SH 46 consists of four lanes (two lanes each direction) with an intermittent center turn lane with a speed of 35 mph.

I-10

I-10 is a four-lane divided interstate highway with a wide median. It intersects with SH 46 and BUS 87. The posted speed limit is 75 mph.

BUS 87

BUS 87 is a north/south arterial through Boerne that connects with I-10 at the northern and southern ends of the city. It is a four-lane road with a center turn lane through the southern half of those limits. North of downtown, there is no center turn lane and it is a four-lane undivided road. North of Sisterdale Rd., the typical section changes again to a two-lane undivided road. The speed limit along BUS 87 varies, 35 mph through downtown and 55 to 50 mph at the southern and northern ends.

FM 1376

FM 1376 is a north/south two-lane undivided major collector. The speed limit transitions from 50 to 60 mph.

FM 474

FM 474 is a north/south major collector. Between US 87 and Esser Rd., FM 474 is a four-lane (two lanes each direction) roadway with a center turn lane. Continuing north, FM 474 transitions to a two-lane road. The speed limit varies from 35 mph in Boerne to 60 mph north of Adler St.

FM 3351

FM 3351 is a north/south minor arterial. FM 3351 is a two-lane undivided road that begins 5.3 miles south of the Kendall/Bexar County limits, continues through Dietz Elkhorn Rd. and Ammann Rd., intersects SH 46 in Bergheim, and connects to FM 473 in Kendalia. To the south of SH 46, the speed limit is 60 mph, then transitions to 45 mph south of Ammann Rd. to I-10. To the north of SH 46, the speed limit is 45 mph, then transitions to 60 mph to FM 473.

Herff Rd.

Herff Rd. is a north/south minor arterial. Herff Rd. is a four-lane divided roadway that begins on South (S.) Main St., continues through Old San Antonio Rd., and connects at the intersection of River Rd. and S. Esser Rd. The speed limit along Herff Rd. is 35 mph.

2.2. TRAFFIC ANALYSIS

Although it was generally understood that a relief route was needed when the feasibility study began, data was needed to verify this assumption. The traffic study area incorporated a large area of southern Kendall County to ensure that the most congested locations were identified.

Before the development of any concepts, the traffic study determined the existing (Year 2016) and forecasted (Year 2040) traffic volumes and local traffic movements. This traffic study was important for two primary reasons:

1. It provided baseline and forecasted traffic information that could be measured against a no-build alternative. This was important because it identified potential traffic impacts to the area if no concept is recommended.
2. It guided the decision of the location of a concept based on the areas of congestion.

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

2.2.1. TRAFFIC DATA

Traffic data were collected at more than 40 locations along I-10, SH 46, FM 3351, BUS 87 (Main St.), and FM 474 (N. Esser Rd.). The type of data collected for this study included 12-hour turning movement counts, 24-hour tube counts, and 72-hour Bluetooth surveys. The traffic data were used to:

- Evaluate the existing roadway characteristics, including lane configuration and intersection geometry;
- Evaluate the existing traffic characteristics, including turning movements and crash data;
- Review previous traffic studies;
- Analyze historical traffic volumes and calculate growth rates to be used in traffic projections;
- Develop traffic projections for the roadways in the study area;
- Analyze crash data for a five-year period (2011 to 2015);
- Perform origin/destination studies using Bluetooth readers for the SH 46 corridor; and
- Recommend potential improvements.

2.2.2. CRASH ANALYSIS

A crash analysis was performed to capture the recent crash history and identify locations with higher than normal crash rates. Data from the CRIS for 2011 to 2015 were obtained for the eight traffic study corridors and 10 traffic study intersections in the City of Boerne area. The data included specific information for all recorded crashes including location, date and time, crash severity, crash type, crash injury classification, as well as various roadway and environmental conditions at the time of the crash.

The results of the crash analysis can be found in **Section 5** of the *Initial Traffic Study Report* in **Appendix A.** The crash analysis revealed several hotspots on the SH 46 corridor:

- The segments of SH 46 through downtown Boerne, from I-10 to FM 474 had a crash rate that substantially exceeds the state average, described in **Appendix A**, **Section 5**;
- The intersection of SH 46 and BUS 87 in downtown Boerne had the most substantial number of crashes in the study area, with 96 crashes over a five-year period from 2011 to 2015, an average of 19 crashes per year; and
- Other intersections with an average of 10 crashes per year or more included SH 46 at I-10 and I-10 at Scenic Loop.

Apart from SH 46 at BUS 87, the intersections studied have fairly standard geometry. The higher than average crash rates were most likely due to congestion on the road network. The combination of the volume of cars, lack of lanes and close proximity/frequency of intersections resulted in less safe conditions. The mix of traffic types was also a contributing factor. SH 46 through downtown Boerne mixes local and tourist traffic with pass-through traffic. The pass-through traffic avoids multiple stops while the local traffic makes frequent stops. With downtown Boerne also being a tourist destination, this mixed use of traffic types causes conflicts in driver expectations.

The location with the most substantial crash numbers was SH 46 at BUS 87. See **Figure 8** for an aerial overview of this intersection.

Figure 8: Existing Intersection of SH 46 and BUS 87

This is a “T” intersection with an acute angle in the south east corner. Although this intersection had the sixth highest peak volume traffic in the study, it only has three roadway segments as compared to the others which have four.

All of these intersections had limited room for expansion without impacting the downtown center; however, would benefit from reduced volumes. A relief route would help reduce the pass-through volume of traffic through these intersections so that any future intersection improvements could focus on the more multi-model localized vehicle, pedestrian, and bicycle traffic.

2.2.3. TRAFFIC PROJECTIONS

The purpose of the KGS was to determine solutions that could improve current and projected future congestion problems. Some areas may be performing well today; however, would be congested in the future as travel demand continues to increase.

The TxDOT Statewide Planning map provided data for future traffic volumes and 24-hour truck percentage. The most recent projected volumes and truck percentages were for 2035. Data were gathered for the existing corridors within the study area. Based on the 2015 and the 2035 traffic volumes provided by TxDOT, a traffic growth rate was calculated for the following corridors as depicted in **Table 1**.

Table 1: TxDOT Traffic Growth Rate and Volumes

Location	TxDOT 2015 AADT	TxDOT 2035 Projected AADT	TxDOT 2035 Truck Percentage (%)	TxDOT Growth Rate (%)
SH 46 east of FM 3351	6,440	11,980	20.6	3.152
SH 46 west of I-10	8,186	15,190	4.9	3.151
SH 46 (Bandera Rd.) east of I-10	16,290	30,300	4.8	3.152
SH 46 east of Los Indios Ranch Rd.	5,785	10,760	21.5	3.152
I-10 east of Jennifer Dr.	21,439	39,880	12.8	3.152
I-10 north of Bandera Rd.	30,370	56,490	13.5	3.152
I-10 east of Scenic Loop	52,353	97,380	9.7	3.152
US 87 south of Bess St.	22,706	42,230	2.1	3.151
US 87 north of School St.	6,219	11,570	4.0	3.153
US 87 north of Cross Point Rd.	17,137	31,880	2.4	3.152
US 87 south of Commerce Ave.	6,797	12,640	3.7	3.151
FM 3351 south of SH 46	3,357	4,500	7.9	1.476

Source: TxDOT Statewide Planning Map

Based on the calculated TxDOT growth rates, an average growth for the study limit area was projected to be 3 percent. There was a direct correlation with the projected population growth in 2040 and the projected traffic volume within the study area. The City of Boerne's local government estimated an annual population growth of approximately 2.7 percent. This data were collected from the City of Boerne website based on their Nielsen database. The projected 2040 volumes for the study area are summarized in **Table 2**.

Table 2: Projected Traffic Volume Summary

Location	2016 Volume	Projected 2040 Volume
SH 46 east of FM 3351	9,698	19,100
SH 46 west of FM 3351	9,090	17,900
SH 46 (Bandera Rd.) east of I-10	18,360	36,200
SH 46 east of Los Indios Ranch Rd.	9,421	18,600
I-10 east of Jennifer Dr.	32,516	64,200
I-10 north of Bandera	40,118	79,200
I-10 east of Scenic Loop	55,536	109,600
US 87 south of Bess St.	24,214	47,800
US 87 north of School St.	8,704	17,200
US 87 north of Cross Point Rd.	21,656	42,700
US 87 south of Commerce Ave.	9,892	19,500
FM 3351 south of SH 46	6,822	13,500

Source: TxDOT Statewide Planning Map

2.2.4. O&D ANALYSIS

To better understand where traffic was traveled to and from within the study area, an O&D analysis was performed. The analysis focused on the major existing corridors, SH 46 and I-10. The method utilized for the O&D study was Bluetooth readers which use a wireless technology to measure travel times and match Bluetooth signatures. A detailed breakdown of the O&D analysis can be viewed in the traffic study in **Appendix A**.

As a result of the O&D analysis, the following was identified:

- For the traffic traveling into the City of Boerne from the east along SH 46, roughly 10 percent of the traffic drove through town to head west on SH 46; less than 10 percent drove through town to head south on I-10; approximately 30 percent of traffic would cut through town to head north on I-10; and almost 50 percent of traffic stayed in town or returned to the east along SH 46.
- For traffic traveling into the City of Boerne from the west along SH 46, less than 10 percent of vehicles drove through town to go north on I-10; less than 10 percent of vehicles drove through

town to go east on SH 46; roughly 30 percent of vehicles drove through town to go south on I-10; and, about 50 percent of vehicles stayed in town or returned to the west along SH 46.

- For traffic traveling into the City of Boerne from the north along I-10, less than 5 percent of vehicles drove through town to go west on SH 46; about 20 percent of vehicles drove through town to go east on SH 46; about 75 percent of vehicles are heading south on I-10; and less than 5 percent of vehicles visited and stayed in town or returned to the north along I-10.
- For traffic traveling into the City of Boerne from the south along I-10, less than 5 percent of vehicles drove through town to go west on SH 46; less than 5 percent of vehicles drove through town to go east on SH 46; about 50 percent of vehicles are heading north on I-10; and, roughly 45 percent of vehicles stayed in town or returned to the south along I-10.

2.2.5. TRAFFIC STUDY FINDINGS

The findings from the traffic study were important because they assisted in the decision-making process by determining the most congested areas and what is the cause of the congestion. The following findings from the traffic study validated the description of traffic described by TxDOT, the City of Boerne, and Kendall County. The existing roadway segments in downtown Boerne are over capacity (**Figure 9**). Most of the congestion occurred in the center of downtown along Main St. between River Rd. and Bandera Rd. and along West (W.) Bandera Rd. Based on the number of existing lanes, intersection proximity and current volumes, the major arterials into Boerne are near or at capacity. This included SH 46 to the east and west of downtown and Main St. north and south of downtown.

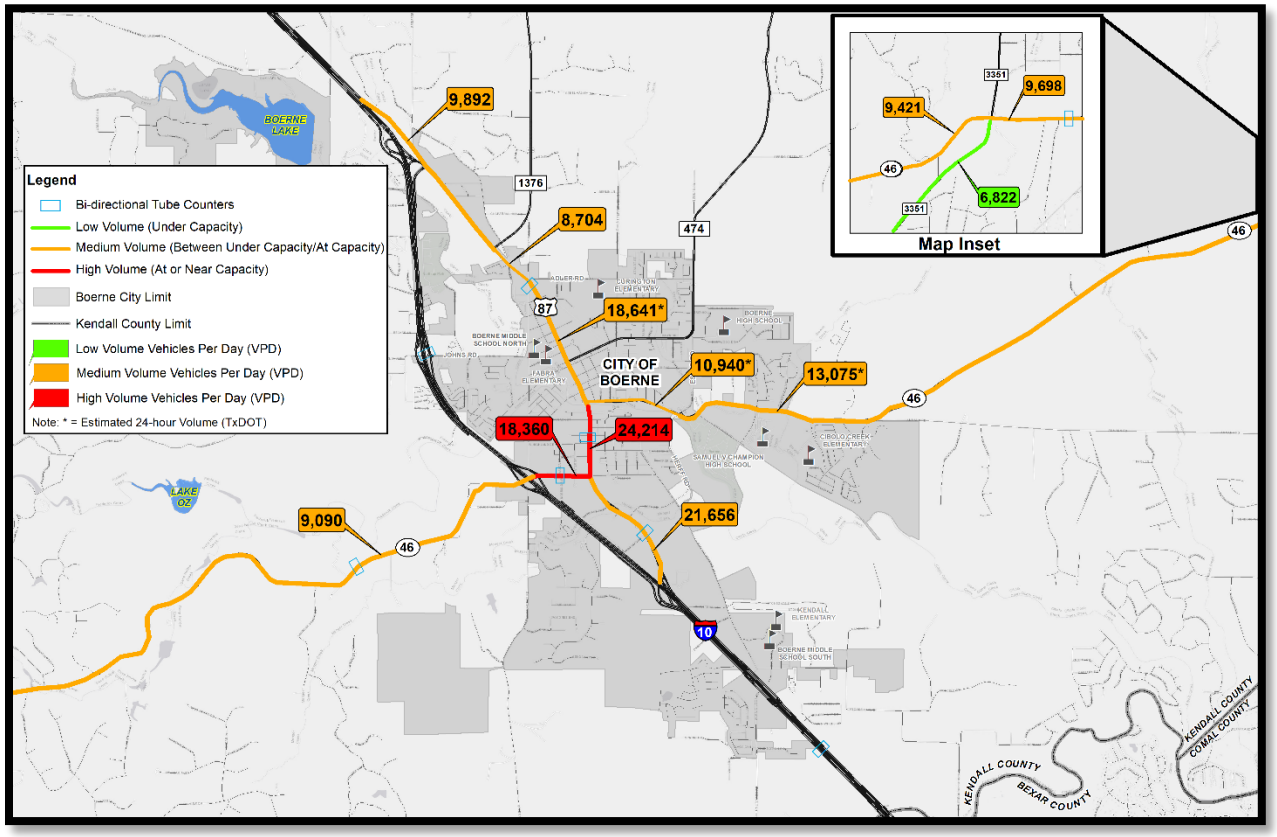

Figure 9: Existing Roadway Capacity Conditions (2016)

Most, if not all, of the major roadways in and around downtown Boerne would be at or over capacity in 2040 as shown in **Figure 10**.

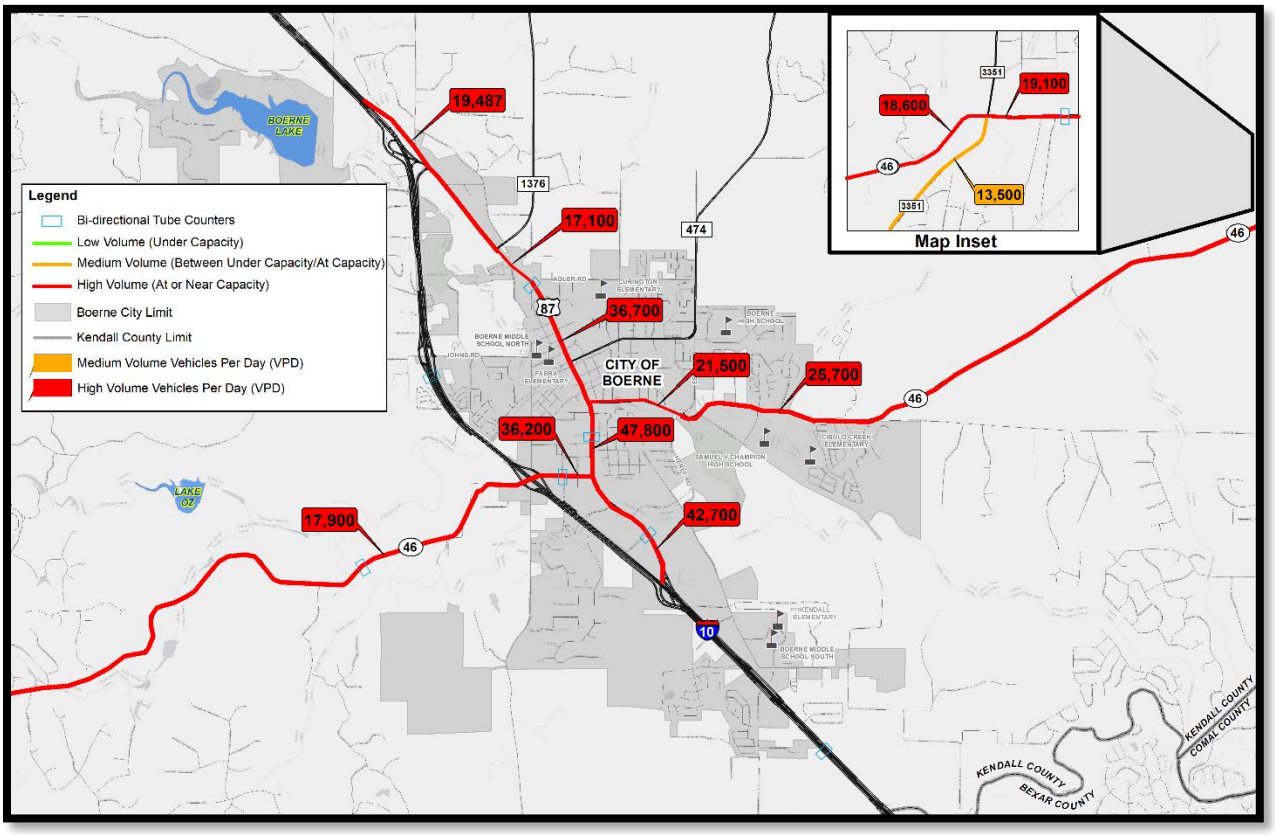

Figure 10: Projected Roadway Capacity Conditions (2040)

Through-traffic was a large portion of volume going through downtown. Through-traffic was defined as vehicles that enter and exit Boerne in less than an hour. According to the O&D analysis, approximately half of the traffic entering Boerne from the east was through-traffic.

Projecting the data to 2040, there are nearly 20,000 VPD that would be travelling through Boerne that have destinations elsewhere (**Figure 11**). SH 46 was the main east/west thoroughfare used for vehicles traveling to I-10. From the Herff Rd. and Esser Rd. intersection on the east side of Boerne and I-10 on the west, SH 46 was the only east/west option into and out of Boerne.

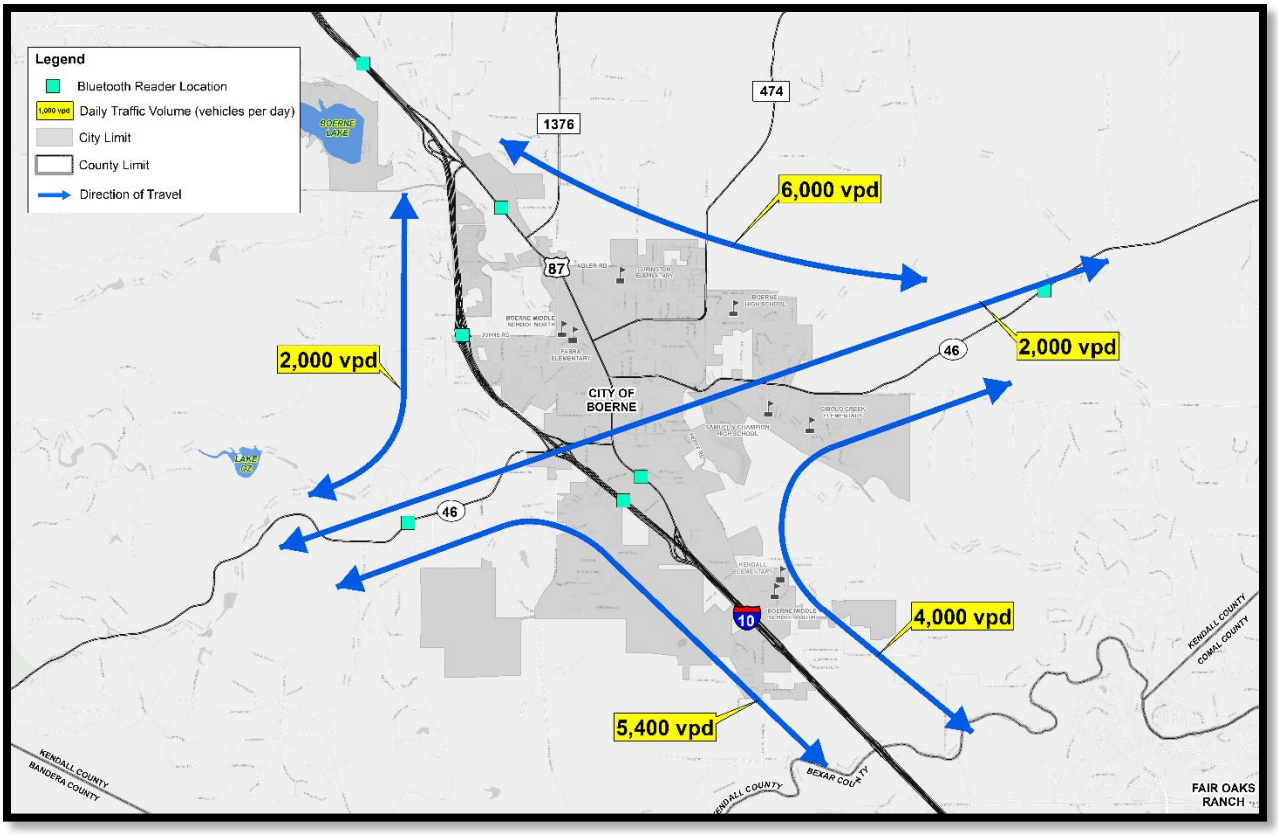

Figure 11: Estimated Minimum Traffic Diversions (2040)

3.0 PUBLIC INVOLVEMENT

To support the development of the KGS, the Study Team implemented a public engagement process that informed stakeholders and the public and provided opportunities to document comments and input on the feasibility study (**Figure 12**).

The Study Team:

- Provided several opportunities for stakeholder, public, and agency participation and input;
- Implemented various outreach methods to stakeholders and the public to increase public involvement and input; and
- Used visually informative and bilingual materials to help communicate concepts and retain public interest.

Public outreach and involvement opportunities for this study included TWG and SWG meetings, public open houses, interactive surveys, study newsletters, and media outreach and coverage, as summarized below and described in further detail in the *Public Involvement Summary Report* provided in **Appendix D**.

Figure 12: Public Outreach

3.1. PUBLIC INVOLVEMENT PLAN

At the onset of the KGS, the Study Team prepared the Public Involvement (PI) Plan to facilitate and document the feasibility study's structured interaction with stakeholders, the public, and other agencies.

The PI Plan:

- Identified how TxDOT, in cooperation with the City of Boerne and Kendall County, would provide opportunities for input in accordance with applicable laws, regulations, and policies;
- Provided a general overview of the KGS and goals;
- Described the roles and responsibilities of the various federal, state, and local resource agencies;
- Identified public involvement goals to ensure two-way communication was fostered throughout the course of the study;
- Identified various coordination and communication tools to communicate the study's purpose and need and provide consistent and thorough information to stakeholders, the public, and agencies;
- Described the various types of meetings planned throughout the study, including TWG and SWG meetings, one-on-one meetings, and public open houses; and
- Provided a study timeline, including roles and responsibilities of each member of the Study Team.

3.2. STAKEHOLDER DATABASE

Throughout the course of the KGS, the Study Team developed and maintained a "living" database of names and contact information that was used to disseminate the study information and public meeting notices. This database initially included members of the public that attended prior public meetings (e.g. individuals who attended meetings for the previous study conducted in 2005), elected and public officials in the study area, regulatory agencies, community organizations, and other key stakeholders. As the study progressed, this database was continually updated to include individuals who signed up or participated in the public open houses or other meetings, requested to receive study updates, and completed interactive surveys for the study.

At the completion of the KGS, the stakeholder database consisted of contact information for approximately 1,650 individuals, including approximately 1,165 email addresses and 1,215 mailing addresses.

3.3. STUDY NEWSLETTERS

Three newsletters were developed at major milestone points of the study and were distributed to individuals on the stakeholder database and handed out at the public open houses. The three newsletters were distributed in January 2017, April 2017, and February 2018 (**Appendix D**).

The first newsletter introduced the KGS and included an anticipated study timeline and Frequently Asked Questions (FAQs), such as: "*What is a feasibility study?", "Who is heading the KGS?", "Why is*

this study being done?", among other FAQs. This newsletter was handed out during the first open house on January 17, 2017.

The second newsletter (April 2017) highlighted the January 17, 2017 open house, next steps for the study, as well as ways to contact the Study Team.

The third and final newsletter (February 2018) highlighted the November 8, 2017 open house, described constraints mapping conducted for the study, provided an overview of the responses received during the third interactive survey, and included FAQs.

3.4. TWG AND SWG MEETINGS

The Study Team organized and coordinated with two working groups throughout the KGS– the TWG and the SWG. The TWG was composed of local and state technical staff and key technical stakeholders. This group was tasked with providing technical input and expertise throughout the study process. The Study Team conducted a total of four meetings with the TWG; two of the four meetings were combined with the SWG. The TWG consisted of 22 individuals, including representatives from the following organizations:

- Alamo Area Council of Governments
- Alamo Area Metropolitan Planning Organization
- Boerne Independent School District*
- City of Boerne
- City of Fair Oaks Ranch
- Comal County*
- Kendall County
- Boerne-Kendall County Economic Development Corporation
- Kendall West Utility LP
- Matkin-Hoover Engineering & Surveying
- TxDOT

The SWG was composed of representatives of local and regional businesses, environmental organizations, advocacy groups, homeowners' and property owners' associations (HOAs, POAs), and agencies. This group was tasked with providing input and local knowledge of Kendall County and the City of Boerne throughout the study process. The Study Team conducted a total of four meetings with the SWG; two of the four meetings were combined with the TWG. The SWG consisted of 62 individuals, including representatives from the following organizations:

- Ammann Ranch Estates POA
- Ammann Road property owners
- Boerne Area Historical Preservation Society
- Boerne Business Alliance*
- Boerne Chamber of Commerce
- Boerne Convention & Visitors' Bureau*
- Boerne Independent School District*
- Boerne Moontime Rotary
- Boerne Stage Airfield
- Boerne Sunrise Rotary*
- Cascade Caverns
- Cibolo Conservancy
- Cibolo Nature Center
- City of Boerne
- Cordillera Ranch POA

- Cow Creek Groundwater Conservation District
- Edwards Aquifer Authority
- Estancia at Thunder Hill HOA*
- Fair Oaks Ranch HOA
- Geneva School of Boerne*
- Greater Edwards Aquifer Alliance*
- Kendall County
- Kendall County Historical Commission
- Kendall Pointe Subdivision
- Kendall Ranch Estates
- Kronkosky Charitable Foundation*
- Pfeiffer Ranch property owners
- Ranger Creek HOA
- River Mountain Ranch HOA
- River Trail POA*
- Rotary Club of Boerne*
- Saddlehorn HOA*
- Sierra Club – Alamo Group*
- Spring Creek HOA
- Texas Parks and Wildlife Department
- Trails of Herff Ranch HOA*
- Transporatic.com*
- U.S. Army Corps of Engineers*
- U.S. Department of Agriculture*
- U.S. EPA*
- U.S. Fish and Wildlife Service*
- Villas at Hampton Place HOA*
- Woods of Frederick Creek H

Of note, any of the organizations or agencies listed above with an asterisk represents groups that were invited to a TWG or SWG meeting; however, did not attend.

Both the TWG and the SWG were instrumental in assisting with the development of the local vision, transportation goals and objectives, purpose and need, screening criteria, screening process, and concept development and evaluation. Detailed meeting summaries are available for public review at the TxDOT San Antonio District Office.

3.5. PUBLIC OPEN HOUSES

Three public open houses were held for the KGS on January 17, 2017, November 8, 2017, and May 23, 2018. The first two open houses were held from 5:30 p.m. to 7:30 p.m., while the third was held from 6:00 p.m. to 8:00 p.m. All of these meetings were held at Boerne Middle School South located at 10 Cascade Cavern, Boerne, Texas 78015.

The public, stakeholders, public and elected officials, TWG/SWG members, and various agencies were notified prior to all the open houses. Each open house was advertised at least two weeks prior to the meeting via various outreach methods. News releases were sent to local and area print, television, radio, and online media, including Spanish-language newspapers and television stations within the study area, as available.

The purpose of the first open house was to introduce the feasibility study to the public and gather public input regarding the transportation-related vision and goals to relieve congestion on SH 46 and other major arterials in Boerne and Kendall County. Approximately 255 people signed in at the

registration table, including 219 community members, seven elected officials, three members of the media, and 26 Study Team members. A total of 37 comments were received during the public comment period that concluded on February 1, 2017.

The second open house presented the preliminary results of the traffic study, public input received to-date, and reasonable concepts. Approximately 198 people signed in at the registration table, including 156 community members, six elected officials, one member of the media, and 35 Study Team members. A total of 53 comments were received during the public comment period that concluded on December 4, 2017.

The third and final open house presented and requested input on the recommended concepts. Approximately 335 people signed in at the registration table, including 300 community members, six elected officials, and 29 Study Team members. A total of 372 comments were received during the public comment period that concluded on June 7, 2018.

Following the open houses, a *Documentation of Open House Report* was prepared for each meeting, which included a comment response matrix, notices, sign-in sheets, comments received, exhibits, handouts, photographs, and a description of any study modifications as a result of comments received; these reports are available for public review at the TxDOT San Antonio District Office and attached in **Appendices D3, D7,** and **D10**.

3.6. INTERACTIVE SURVEYS

The Study Team conducted three interactive surveys throughout various stages of the KGS. The first two surveys were similar, but targeted different audiences. The first survey was conducted in June 2017 and was available to TWG and SWG members; 25 individuals responded to this survey. During this survey, TWG/SWG members were asked: "What are the three most important environmental criteria in the KGS?" Respondents answered as follows: (1) geologic and recharge features, (2) streams, and (3) residential displacements. Similarly, the survey asked for respondents' top three important transportation criteria; respondent answered as follows: (1) level-of-service, (2) conformance with regional transportation plans, and (3) travel time.

Following completion of survey number one, a similar survey was conducted from July to August 2017 with the public. Over 475 individuals completed this survey. Respondents answered that the top three environmental criteria are (1) streams, (2) geologic and recharge features, and (3) air quality; while the top three transportation criteria are (1) level-of-service, (2) travel time, and (3) drainage. Unveiled at the second public open house, the third and final survey was available from November 8, 2017 to December 4, 2017. A total of 1,124 individuals participated in the survey. Key takeaways from this survey included:

- Plan long-term
- Control growth and development in the study area
- Widen existing corridors
- Avoid private property
- Avoid or minimize impacts to environmental resources
- Reduce heavy truck traffic through Boerne and preserve downtown
- Reduce or alleviate local school traffic

3.7. PUBLIC INVOLVEMENT SUMMARY

During development of the KGS, numerous opportunities for public engagement and input were provided to help guide the study process. Public involvement opportunities included three study newsletters, a total of six TWG/SWG meetings, three public open houses, regular communication through the project email at kendallgateway@pozcam.com, one-on-one meetings with elected officials and community members, and three interactive surveys. The following infographic (**Figure 13**) summarizes the public involvement activities conducted for the KGS.

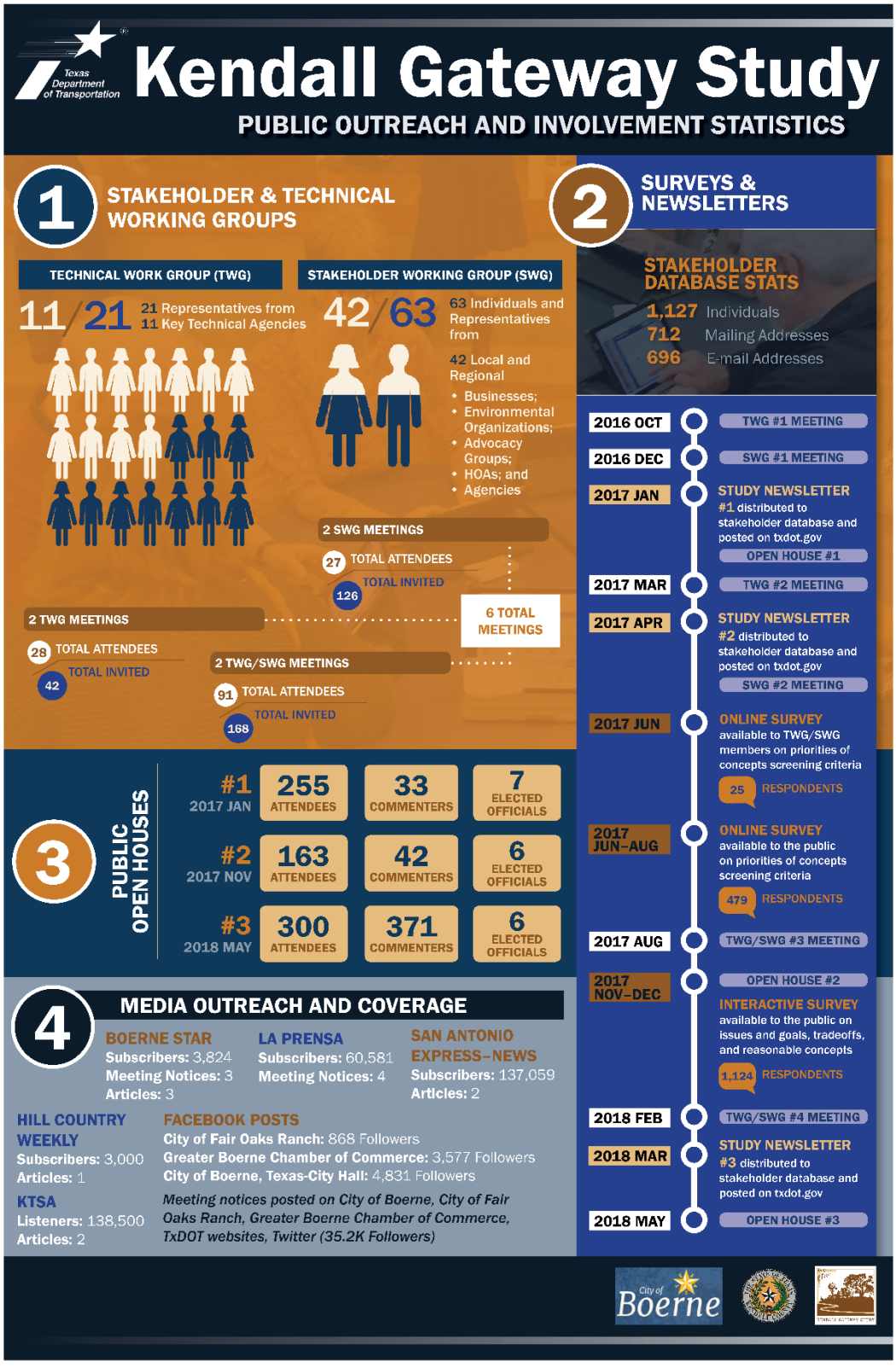

Figure 13: Infographic Summarizing the Public Involvement Efforts

4.0 ENVIRONMENTAL CONSIDERATIONS IN THE STUDY AREA

This section of the report represents the environmental data collected throughout the study process from readily available sources. Only reliable sources were utilized for the study and generally included geospatial data from local, state, and federal agencies and data collected during the public involvement process. As previously stated, one of the ongoing themes for the study was to gather data at all stages, continually update the data, and consistently request public input. An example of this is the proposed development data that the Study Team received from the City of Boerne and Kendall County. From the inception of the study to the last public meeting, data were consistently updated to reflect the latest available information on proposed developments throughout the study area.

The environmental data presented below and throughout the report has not been field verified, but does provide a well-rounded base of information that helped make informed decisions throughout the study process. Limited windshield surveys were conducted from existing public ROW to verify some of the existing resources such as vegetation types and water features. As the next stage of project development is identified, this report could be utilized to start a collaborative and an integrated approach to engage the public in the transportation decision-making process that (1) considers environmental, community, and economic goals, and (2) uses the information, analysis, and products developed during planning to inform the environmental review process.

The following sections discuss the resource data that were gathered within the study area (from desktop analysis and public input) and includes information ranging from existing community resources such as land use types to known cultural features such as cemeteries.

4.1. COMMUNITY RESOURCES

Community resources were evaluated to determine the potential effects a transportation project may have on a community and its quality of life. Community resources identified in the study area included: current transportation infrastructure, utilities, existing land use, structures, schools, parks, public facilities, farmlands, and Family Land Heritage Program properties. Based on information provided by the City of Boerne and Kendall County planners, planned/platted proposed developments are also included. Demographic data from the U.S. Census Bureau and from American Community Survey (ACS) provided a glimpse into the communities within the study area and a baseline understanding of the demographics of the community.

4.1.1. EXISTING FACILITIES

4.1.1.1. EXISTING ROADWAYS

The existing roadway facilities in the study area were analyzed to understand the capacity and condition of the roadways. The primary existing roadway corridors in the center of the study area are the combination of BUS 87, US 87, and I-10 running north and south through Boerne, SH 46 running east and west through Boerne, and FM 3351 running north and south on the eastern bounds of the study area. Each of these major roads were viewed during the limited windshield surveys. **Section 2.1** includes detailed descriptions and **Appendix E** includes study area photographs.

4.1.1.2. UTILITIES

Based on a review of available data from the Texas Railroad Commission (TRRC), **Table 3** lists the operator and length of oil and gas pipelines within the study area. See **Appendix F (Exhibit 5)** for the location of these pipelines and high mast power lines within the study area. The high mast tower locations were identified through desktop aerial photograph analysis.

Table 3: Major Pipelines Operators within the Study Area

Operator Name	Pipeline Linear Miles
Enterprise Products Operation, LLC	9.1
Energy Transfer Company	1.0
Total	**10.1**

Source: High Mast Utilities: BGE (2017), Pipelines: TRRC (2017)

4.1.2. EXISTING LAND USE

The study area encompassed approximately 73,405 acres (111 square miles) in southern Kendall County, and contained portions of the City of Boerne, associated ETJs, Fair Oaks Ranch, and City of San Antonio ETJ as well as unincorporated land in Kendall County and a small portion of Bexar County. The land use within the study area was primarily large tract single family homesteads and commercial businesses located along the I-10 corridor. Growth and new development in the study area was dominated by single family residential subdivisions east of the City of Boerne along the SH 46 corridor. Commercial business growth was along the I-10 corridor in the southeastern portion of the study area. Due to the large number of existing structures in the study area, the Study Team did not quantify the total number of structures within the full study area. Instead, existing structures were identified within and from 500 feet the recommended concepts from aerial photograph interpretation. Based on the review, 1,564 structures were identified (see **Appendix G**).

4.1.2.1. EXISTING SCHOOLS, PARKS, AND PUBLIC FACILITIES

Based on a review of available data and aerial photograph interpretation, there were 32 existing schools, parks, or other public facilities (such as hospitals, libraries, or government offices) located within the study area (**Table 4**).

Table 4: Existing Schools, Parks, and Public Facilities within the Study Area

Name	Facility Type
Methodist Boerne Emergency Center	Hospital
Northside Community Park	Public Park
Northrup Park	Public Park
Main Plaza	Public Park
Patrick Heath Public Library	Public Library
Civic Center	Public Facility

Table 4: Existing Schools, Parks, and Public Facilities within the Study Area

Name	Facility Type
Currey Creek Trail	Public Trail
Roeder Park	Public Park
Old Number 9	Public Trail
Veterans Plaza	Public Park
River Road Park	Public Park
Optimist Park	Public Park
Cibolo Nature Center	Nature Preserve
Agricultural Heritage Museum	Museum
Northside Neighborhood Park	Public Park
Boerne City Lake Park	Public Park
City Park	Public Park
Cibolo Creek Trail	Public Trail
Herff Farm	History Center
Cibolo Creek Elementary School	School
Samuel V. Champion High School	School
Currington Elementary School	School
Boerne High School	School
Fabra Elementary School	School
Boerne Middle School North	School
Boerne Middle School South	School
Kendall Elementary School	School
Geneva School of Boerne	School
Meadowland Charter School	School
Boerne Police Department	Law Enforcement Facility
Kendall County Sheriff's Department	Law Enforcement Facility
Kendall County Courthouse	Courthouse

Sources: City of Boerne (2017)

4.1.2.2. FARMLANDS

The Farmland Protection Policy Act (FPPA), as detailed in Subtitle I of Title XV of the Agricultural and Food Act of 1981, provides protection to the following: (1) prime farmland; (2) unique farmland; and (3) farmland of local or statewide importance. The FPPA defines prime farmland as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (not urban built-up land or water). Unique farmland is land other than prime farmland that is used for production of specific high value food, feed, and fiber crops; it has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of specific crops. Farmland of local or statewide importance is determined by the appropriate state or local government agency or agencies.

According to the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) website accessed March 2018, the study area was located within 32 soil map units listed in **Table 5.** Two of the map units within the study area contain major components that met the hydric soils criteria as described by the National Technical Committee for Hydric Soils.

Table 5: Soil Units within the Study Area

Name	Map Unit Symbol	Acreage	Percent of Study Area
Brackett-Real association	5	15,204	21
Doss-Brackett association	9	13,111	18
Krum silty clay	12, 13	7,869	11
Brackett association	4	7,084	10
Denton silty clay	6, 7	6,224	9
Eckrant-Comfort association	10	6,014	8
Doss silty clay	8	5,880	8
Anhalt clay	1	2,402	3
Eckrant-Rock outcrop association	11	2,368	3
Oakalla silty clay loam	16, Ok	1,842	2
Nuvalde silty clay	14, 15	1,495	2
Boerne fine sandy loam	3	619	1
Eckrant cobbly clay	TaB	610	1
Anhalt clay	Ca	591	1
Crawford and Bexar stony soils	Cb	520	1
Tarpley clay	18	369	1

Table 5: Soil Units within the Study Area

Name	Map Unit Symbol	Acreage	Percent of Study Area
Lewisville silty clay	LvB, LvA	351	Less than 1
Water	W	320	Less than 1
Tarpley-Comfort association	19	146	Less than 1
Patrick soils	PaB	92	Less than 1
Kerrville gravelly clay loam	BKX, BRE	86	Less than 1
Eckrant cobbly clay	TaC	63	Less than 1
Barbarosa silty clay loam	2	47	Less than 1
Sunev loam	VaB	33	Less than 1
Dams	DAM	18	Less than 1
Krum clay	Kr, KrB	16	Less than 1
Whitewright-Austin complex	BsC	12	Less than 1
Brackett-Eckrant association	BtE	8	Less than 1
Orif-Boerne association	17	7	Less than 1
Pits and Quarries	Pt	3	Less than 1
Brackett-Rock outcrop-Real complex	BtG	1	Less than 1
Real-Comfort-Doss complex	RcD	1	Less than 1
Orif soils	Or	Less than 1	Less than 1
Pratley silty clay	DL	Less than 1	Less than 1
Krum-Pratley association	KRX	Less than 1	Less than 1
Total		**73,405**	**100**

Source: USDA, NRCS (2005)

Approximately 23 percent of the study area was comprised of land designated as prime farmland. In addition to prime farmland, approximately 1 percent of the study area was comprised of land designated as farmland of statewide importance. These designated farmlands are listed in **Table 6** and shown in **Appendix F (Exhibit 6)**.

Table 6: Farmland Types within the Study Area

Land Type	Acreage	Percent of Study Area
Non-Prime Farmland	55,630	76
Prime Farmland	7,890	11
Prime Farmland (if irrigated)	9,233	12
Farmland of Statewide (if irrigated)	619	1
Farmland of Statewide	33	Less than 1
Total	**73,405**	**100**

Source: USDA, NRCS (2017)

4.1.2.3. FAMILY LAND HERITAGE PROGRAM PROPERTIES

The Texas Department of Agricultural (TDA) Family Land Heritage Program is a recognition program that honors families who have owned and operated a continuous agricultural operation for 100 years or more. Although TDA did not provide a map of the operations included in the program, the annual registry provided names and a general location description of each property. The annual registry was used to identify agricultural operations located within the study area. This list is based on family ownership; therefore, names on the TDA list were compared to the Kendall County Central Appraisal District property owner database. In addition to the desktop review, property owners provided written comments and drew Family Land Heritage Program properties on maps displayed at the three open houses. These comments were also considered in determining preliminary boundaries of these properties. The preliminary review identified six properties within the study area with this designation. See approximate locations of these properties in **Appendix F (Exhibit 7)**.

4.1.2.4. PROPOSED DEVELOPMENTS

To better plan for future traffic patterns and land use, local plans were reviewed to determine the locations of proposed developments within the study area. In addition to the local plans, meetings with the City of Boerne and Kendall County assisted in the identification of proposed development sites within the study area listed in **Table 7** (see **Appendix F [Exhibit 8]**). By including these proposed developments, the Study Team could plan for land use changes that could affect the location of concepts. The exact acreage of proposed developments was not known for all locations within the study area.

Table 7: Proposed Developments within the Study Area

Name	Acreage
Post Oak Subdivision	1,141
Schmeltzer Property, For Sale	109
Pleasant Valley Business Park	74
Storage Units Rear	44

Table 7: Proposed Developments within the Study Area

Name	Acreage
Schmidt Property, For Sale	32
Storage and Mini-Storage	28
Bill Millers	-
Bush's Chicken	-
Durango Subdivision	-
Esperanza	-
Franklin Park	-
Fuzzy's Taco Shop	-
Infinity of Boerne	-
Mark Motors	-
Menger Springs	-
Mini Texans Christian Learning	-
Ranches at Creekside	-
Regent Park	-
Saddlehorn Subdivision	-
Southglen	-
Vantage at Boerne	-
Westward Environmental	-
Woods of Frederick Creek Apartments	-
YMCA	-

Sources: Kendall County and City of Boerne Platted/Planned Projects (2018)

4.1.3. POPULATION PROJECTION

As with most of central Texas, the populations of Kendall County and the City of Boerne have increased by 17 percent and 25 percent, respectively, from 2010 to 2015. Within the next 20 years, the City of Boerne's population is expected to grow by 25 percent *(http://www.bkcedc.com/area-demographics/)*, a trend that many cities and counties are projected to experience. As seen in **Figure 14** below, population data from the Alamo Area Metropolitan Planning Organization (MPO) supports this growth trend.

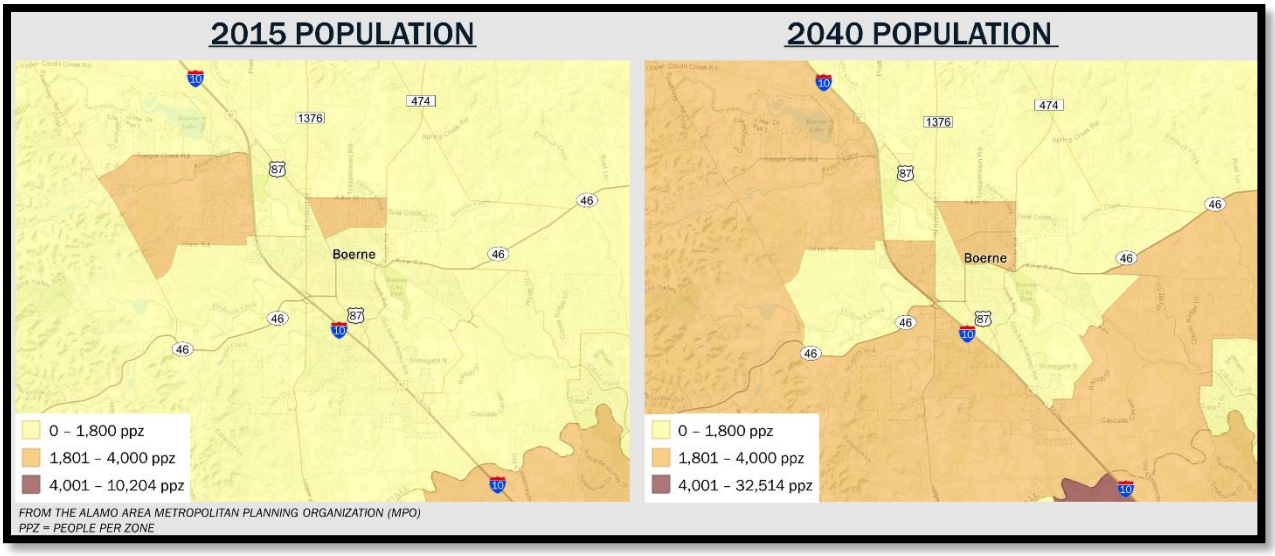

Figure 14: MPO Population 2040 Population Projections within the Study Area

4.1.4. DEMOGRAPHICS

As part of the community resource evaluation, the social and economic conditions within the study area were evaluated. This analysis focused on population, race, ethnicity, and income characteristics. The socioeconomic information was collected from the U.S. Census Bureau 2010 decennial census and the 2012-2016 ACS. It should be noted that the data contained in the ACS are only estimates and do not represent actual counts. As noted below, there were numerous census tracts and block groups within the study area. Census tracts usually cover a contiguous area and generally have a population size between 1,200 and 8,000 people. Block groups are a division of the census tract and generally contain between 600 and 3,000 people.

According to the U.S. Census Bureau, eight census tracts intersected the boundaries of the study area (see **Appendix F [Exhibit 9]**). Within these eight census tracts, there were 19 block groups that intersected the study area. The following bullets list the 16 block groups and the associated census tracts. **Figure 15** illustrates the boundaries of the block groups and associated census tracts.

- Census Tract 9703.01, Block Group 1
- Census Tract 9703.01, Block Group 2
- Census Tract 9703.02, Block Group 1
- Census Tract 9703.02, Block Group 2
- Census Tract 9703.02, Block Group 3
- Census Tract 9704.01, Block Group 1
- Census Tract 9704.01, Block Group 2
- Census Tract 9704.01, Block Group 3
- Census Tract 9704.02, Block Group 1
- Census Tract 9704.02, Block Group 2
- Census Tract 9704.02, Block Group 3
- Census Tract 9704.02, Block Group 4
- Census Tract 9705, Block Group 1
- Census Tract 9705, Block Group 2
- Census Tract 9705, Block Group 3
- Census Tract 9705, Block Group 4
- Census Tract 1821.01, Block Group 2
- Census Tract 1821.02, Block Group 2
- Census Tract 1821.3, Block Group 1

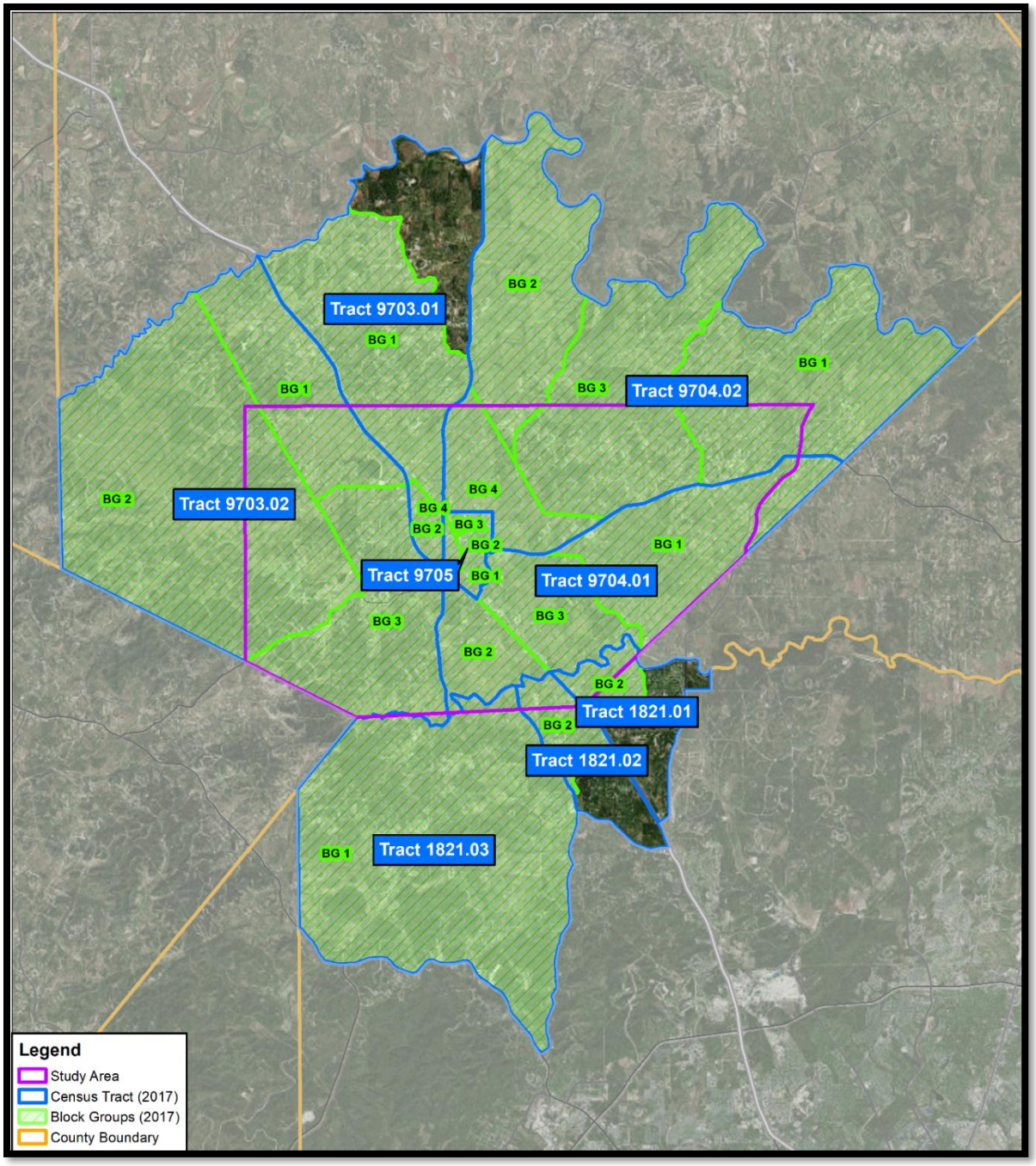

Figure 15: Census Geographies within the Study Area

4.1.4.1. RACE AND ETHNICITY

The percentage of minority residents in Kendall County was approximately 25.5 percent and City of Boerne percentage was slightly higher at 28.1 percent. As shown in **Appendix F (Exhibit 10)**, the percentage of minority populations are presented at the block group level. Of the 19 block groups, 14 block groups contain a zero to 25 percent minority population. Four block groups contained a 25 to 50 percent minority population and one of the block groups contained a minority population between 50 and 100 percent (**Table 8**).

Table 8: Percentage of Population in Study Area by Race and Ethnicity

Census Tract	Block Group	Total Population	Not Hispanic or Latino							Hispanic or Latino	Total Minority (All Not White, Non-Hispanic)
			White	Black or African American	American Indian or Alaskan Native	Asian	Native Hawaiian or Pacific Islander	Other Races	Two or More Races		
1821.01	-	8,342	5,858	88	-	277	-	-	163	1,956	2,484
	2	2,200	1,735	-	-	13	-	-	95	357	465
1821.02	-	8,076	4,765	254	-	312	30	-	87	2,628	3,311
	2	1,829	1,512	24	-	-	20	-	29	244	317
1821.03	-	2,598	1,603	69	42	-	-	-	37	847	995
	1	2,598	1,603	69	42	-	-	-	37	847	995
9703.01	-	5,490	4,433	22	-	-	-	-	90	945	1,057
	1	2,154	1,826	1	-	-	-	-	53	274	328
	2	2,345	1,946	21	-	-	-	-	37	341	399
9703.02	-	4,110	3,455	8	-	19	-	-	20	608	655
	1	724	626	-	-	6	-	-	7	85	98
	2	698	667	-	-	8	-	-	-	31	39
	3	2,688	2,170	8	-	5	-	-	13	492	518
9704.01	-	8,812	6,939	153	19	23	11	-	254	1,413	1,873
	1	2,940	2,244	43	-	-	-	-	102	551	696
	2	2,159	1,779	7	-	9	11	-	38	315	380
	3	3,713	2,916	103	19	14	-	-	114	547	797

Table 8: Percentage of Population in Study Area by Race and Ethnicity

Census Tract	Block Group	Total Population	Not Hispanic or Latino							Hispanic or Latino	Total Minority (All Not White, Non-Hispanic)
			White	Black or African American	American Indian or Alaskan Native	Asian	Native Hawaiian or Pacific Islander	Other Races	Two or More Races		
9704.02	-	7,120	5,829	14	-	74	-	-	18	1,185	1,291
	1	2,820	2,463	-	-	46	-	-	-	311	357
	2	821	685	-	-	-	-	-	-	136	136
	3	1,397	1,318	-	-	-	-	-	18	61	79
	4	2,082	1,363	14	-	28	-	-	-	677	719
9705	-	6,561	4,146	72	-	18	-	-	74	2,251	2,415
	1	1,991	751	-	-	-	-	-	-	1,240	1,240
	2	1,837	1,104	63	-	8	-	-	-	662	733
	3	1,978	1,854	8	-	10	-	-	38	68	124
	4	755	437	1	-	-	-	-	36	281	318
Kendall County		39,010	29,055	269	19	301	11	-	623	8,732	9,955
Bexar County		1,858,699	536,935	132,227	3,391	48,891	652	2,457	289,006	1,105,240	1,581,864

Source: U.S. Census. 2010. Summary File 1, "Race, Combinations of Two Races, and Not Hispanic or Latino" (QT-P4).

4.1.4.2. MEDIAN HOUSEHOLD INCOME AND POVERTY STATUS

Table 9 shows income data from the 2012-2016 ACS. This data were gathered for median household income at the block group level within the study area, the lowest level for which income information was collected. The ACS measures income over a period of five years (2011-2015); the numbers shown in the table represent an average of those sampled over that period. Median household income data is also shown for both Kendall and Bexar Counties since the study area is within each.

Table 9: Median Household Income within the Study Area

Census Tract	Block Group	Median Household Income (2016)
9703.01	1	$66,823
	2	$48,782
9703.02	1	$80,938
	2	$99,352
	3	$65,852
9704.01	1	$84,389
	2	$107,653
	3	$99,464
9704.02	1	$135,369
	2	$87,763
	3	$144,615
	4	$72,188
9705	1	$66,890
	2	$42,207
	3	$67,188
	4	$36,303
1821.01	2	$117,106
1821.02	2	$107,670
1821.03	1	$118,000
Kendall County	N/A	$76,350
Bexar County	N/A	$52,353

Source: U.S. Census, ACS, 2012-2016 "Median Household Income in 2016 Inflation-Adjusted Dollars" (B19013)

The United States Department of Health and Human Services' (DHHS) poverty guideline for a family of four in 2018 was $25,100. A four-person family earning below this amount is considered to be below the poverty line. The poverty guideline was compared to the median household income of the study area block groups from 2012-2016. No household exhibited a median household income below the poverty level.

Poverty rates for the census tracts (the smallest level of geography for which this data was most recently available) within the study area were collected. The average poverty rate in the study area was 6.2 percent. The highest poverty rate in the study area was 7 percent in Census Tract 9704.02, which was slightly higher than Kendall County, as shown in **Table 10** (see **Appendix F [Exhibit 10]**).

Table 10: Percentage Poverty by Census Tract within the Study Area

Census Tract	Population for Whom Poverty Status is Determined	Persons Below Poverty	Percentage of Population Below Poverty
Census Tract 9703.01	5,490	313	6
Census Tract 9703.02	4,064	204	5
Census Tract 9704.01	8,715	233	3
Census Tract 9704.02	7,022	505	7
Census Tract 9705	6,355	344	5
Census Tract 1821.01	8,342	196	2
Census Tract 1821.02	8,037	696	9
Census Tract 1821.03	2,588	110	4
Kendall County	38,501	2,363	6
Bexar County	1,824,707	313,406	17

Source: U.S. Census, ACS, 2012-2016 "Poverty Status in the Past 12 Months" (S1701)

4.1.5. ENVIRONMENTAL JUSTICE

Executive Order (EO) 12898, "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations," requires each federal agency to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." Although this EO only applies to federal agencies, TxDOT's environmental process generally mirrors that of the federal government. The federal guidance is a useful tool in assessing certain socioeconomic impacts, including EJ. The Federal Highway Administration (FHWA) has identified three fundamental principles of EJ (FHWA, 2012). The three fundamental principles are:

- To avoid, minimize, or mitigate disproportionately high and adverse human health or environmental effects, including social and economic effects, on minority populations, and low-income populations;
- To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process; and
- To prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority populations and low-income populations.

Disproportionately high and adverse human health or environmental effects are defined as adverse effects that:

- Are predominately borne by a minority population and/or a low-income; or
- Would be suffered by the minority population and/or low-income population and are appreciably more sever or greater in magnitude than the adverse effects that would be suffered by the nonminority population and/or non-low-income populations.

Minority means a person who is:

- Black (having origins from any of the black racial groups of Africa);
- Hispanic/Latino (of Mexican, Puerto Rican, Cuban, Central, or South American, or other Spanish culture or origin, regardless of race);
- Asian-American (having origins from any place of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); or
- American Indian and Alaskan Native (having origins from any of the original people of North America and now maintaining cultural identification through tribal affiliation or community recognition).

Minority population means any readily identifiable group of minority persons who live in geographic proximity, and, if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who would be similarly affected by a proposed program, policy, or activity. Minority populations were identified based on the federal Council on Environmental Quality's (CEQ's) guidance document Environmental Justice: Guidance Under the National Environmental Policy Act (CEQ, 1997). Based on this guidance:

"Minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis."

4.1.6. LANGUAGE AND LIMITED ENGLISH PROFECIENCY (LEP)

To determine the dominant languages spoken in the study area, the 2008-2012 ACS five-year estimates at the block group level were used. This data is depicted in **Table 11**. The majority of residents spoke only English at home, with Spanish the second most commonly spoken language.

EO 13166: "Improving Access to Services for Persons with Limited English Proficiency (LEP)," requires federal agencies to examine the services they provide, identify any need for services to those with LEP,

and develop and implement a system to provide those services so that LEP persons can have meaningful access to them. As in the case of EJ, this EO applies to federal action.

ACS 2008-2012 estimates showed that 3.3 percent of residents in the study area were considered LEP, speaking English less than very well, with the highest concentration of LEP residents in census tract 17.74, block group two.

Table 11: Language Spoken at Home and LEP Population within the Study Area

Census Tract	Block Group	Population 5 years and older	English only	Spanish	Other Indo-European	Asian and Pacific Islander	Other	Speak English Less Than Very Well
9703.01	1	2,144	2,028	24	116	0	0	55
	2	2,274	2,187	193	0	0	0	48
9703.02	1	724	682	24	18	0	0	5
	2	698	652	16	22	8	0	16
	3	2,587	2,316	261	10	0	0	7
9704.01	1	2,805	2,571	169	65	0	0	59
	2	2,040	1,892	131	28	8	0	22
	3	3,465	3,179	216	56	14	0	71
9704.02	1	2,809	2,485	288	31	39	0	73
	2	821	810	11	0	0	0	0
	3	1,397	1,370	27	0	0	0	0
	4	1,917	1,616	294	47	13	0	67
9705	1	1,855	934	921	0	0	0	283
	2	1,605	1,441	160	0	4	0	128
	3	1,872	1,762	81	29	0	0	9
	4	702	492	210	0	0	0	123
1821.01	2	2,118	1,907	156	31	24	0	38
1821.02	2	1,664	1,389	246	29	0	0	30
1821.03	1	2,456	1,920	531	5	0	0	125
1821.01	2	2,118	1,907	156	31	24	0	38
1821.02	2	1,664	1,389	246	29	0	0	30

Table 11: Language Spoken at Home and LEP Population within the Study Area

Census Tract	Block Group	Population 5 years and older	English only	Spanish	Other Indo-European	Asian and Pacific Islander	Other	Speak English Less Than Very Well
1821.03	1	2,456	1,920	531	5	0	0	125
Kendall County	-	37,008	31,888	4,449	564	97	0	1,559
Bexar County	-	1,723,161	1,025,295	632,787	24,325	31,581	9,173	211,279

Source: U.S. Census, ACS, 2012-2016 "Median Household Income in 2016 Inflation-Adjusted Dollars" (B19013).

4.2. CULTURAL RESOURCES

Cultural resources are structures, buildings, sites, districts (a collection of related structures, buildings, and/or archeological site), cemeteries, and objects. Archeological sites may include prehistoric camps and villages; prehistoric and historic cemeteries; isolated burials; shipwrecks; and historic farmsteads. Archeological resources are sites and locales containing interpretable material traces of past human activity in the form of artifacts, ruins, structural remnants, or other human-made feature remains either on the surface or buried below ground. Archeological resources include materials and artifacts ranging in age from more than 10,000 years old to 50 years old.

The National Historic Preservation Act of 1966, as amended, established the National Register of Historic Places (NRHP) and the required review process known as Section 106 review. Section 106 requires federal agencies to take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation an opportunity to comment on the effects of the undertaking. Undertakings requiring compliance with Section 106 include projects and programs that are funded, permitted, licensed, or authorized by a federal agency, both on and off federal lands such as Section 404 of the Clean Water Act (CWA). Historic properties are sites, buildings, districts, structures, or objects listed in or eligible for listing in the NRHP. The NHRP is used as the standard for defining those historic places worthy of preservation and protection.

As shown in **Table 12**, there were four Texas Historical Commission (THC) recorded cemeteries, 29 historical markers, four national register properties, one courthouse, and one completed neighborhood survey within the study area (see **Appendix F [Exhibit 11]**).

Table 12: THC Recorded Historic Resources and Cemeteries within the Study Area

Resource Name	Resource Type
Bergheim	Cemetery
Deafs	Cemetery
Boerne	Cemetery

Table 12: THC Recorded Historic Resources and Cemeteries within the Study Area

Resource Name	Resource Type
Unknown (west of Upper Balcones Rd.)	Cemetery
Herff-Rozelle Farm	National Register Property
Kendall County Courthouse	Courthouse
Lee, Robert E.	Historical Marker
Beseler House	Historical Marker
Cascade Cavern	Historical Marker
Boerne Schoolhouses	Historical Marker
Fabra Smokehouse	Historical Marker
German Music in Boerne	Historical Marker
Graham, Henry J.	Historical Marker
Kutzer, Albert Paul	Historical Marker
James House	Historical Marker
Phillip, Julius A. and Anna	Historical Marker
Kendall County	Historical Marker
Kendall County Courthouse	Historical Marker
Kuhlmann-King House	Historical Marker
Saint Helena's Episcopal Church	Historical Marker
Saint Peter's Catholic Church	Historical Marker
Engel Store	Historical Marker
Theis House	Historical Marker
Vogt-Clegg Log House	Historical Marker
Ye Kendall Inn	Historical Marker
Staffel Family and the Staffel Store	Historical Marker
Weyrich Building	Historical Marker
Pinta Trail in Kendall County	Historical Marker
Boerne Cemetery	Historical Marker
Kendall, George Wilkins	Historical Marker

Table 12: THC Recorded Historic Resources and Cemeteries within the Study Area

Resource Name	Resource Type
Dienger, Joseph	Historical Marker
Kendall Masonic Lodge No. 897	Historical Marker
W. G. Hughes	Historical Marker
Boerne Chapter No. 200, O.E.S.	Historical Marker
Dr. Ferdinand Ludwig Von Herff	Historical Marker
Neighborhood Survey	Neighborhood Surveys
Dienger, Joseph, Building	National Register Property
Kendall Inn	National Register Property
Kendall County Courthouse and Jail	National Register Property

Source: U.S. Census, ACS, 2012-2016 "Median Household Income in 2016 Inflation-Adjusted Dollars" (B19013).

In addition to the THC database, the TxDOT NHRP and Eligible Bridges of Texas mapper were utilized. Historic bridges include bridges that are listed or eligible to be listed on the NRHP. Criteria for a bridge to be deemed a historic bridge includes a bridge that: is rare in type, unusual from an engineering perspective, or historically significant because of location or association with an important event or person. Although no listed eligible or potentially eligible bridges were identified with in the study area using the TxDOT NRHP bridge data, THC information indicated that there is one bridge on the I-10 corridor at Balcones Creek that is of historic age.

Finally, as part of the public involvement process, attendees of the public outreach events were asked to provide data on unrecorded cemeteries that were not included in the data obtained from the THC. According to the public and additional archival research, an additional six cemeteries may have been located within the study area. These include: Behr Ranch Cemetery, Gerfers Cemetery, Herbst-Patton Cemetery, Magers Cemetery, Meckel Cemetery, and the Phillip Cemetery.

Other considerations included historic trails such as the Pinta Trail (**Figure 16**), which was a natural pathway through the hill country that was used by Native Americans and linked Spanish settlements. The trail went through the center of Kendall County, east of Boerne.

Figure 16: Photograph of the Pinta Trail Historical Marker in the Study Area

4.3. WATER RESOURCES

Identified water resources within the study area included ground water (aquifers and water wells) and surface water (watersheds, streams, creeks, waterbodies, wetlands, and impaired waters). Of note, water quality was identified as one of the primary concerns by the public during the public involvement process. Cibolo Creek (shown below in **Figure 17**) and Boerne Lake are two natural resource destinations for City of Boerne residents and visitors.

Figure 17: Photograph of Cibolo Creek, just south of River Rd.

4.3.1. GROUNDWATER

Groundwater is underground water stored in the pore spaces of soils and rocks. The primary storage of ground water is aquifers. Of the identified groundwater resources, there were: five geologic units, 1,014 water wells, and one aquifer, as described in further detail below.

4.3.1.1. GEOLOGY

The study area primarily included five geologic units: Edwards Limestone, Fort Terrett Member, Lower Glen Rose Formation, Upper Glen Rose Formation, and Fluviatile terrace deposits (see **Appendix F [Exhibit 12]**). **Table 13** provides the total acreage and the percentage of each geologic unit within the study area, while **Table 14** provides the geologic description of each unit.

Table 13: Geological Units within the Study Area

Name	Acreage*	Percent of Study Area
Upper Glen Rose Formation	50,476	68.6
Lower Glen Rose Formation	15,119	20.6
Fort Terret Member	4,020	5.5
Fluviatile Terrace Deposits	2,020	2.8
Edwards Limestone	1,800	2.5

Source: United States Geological Survey (USGS) (2005)
*All acreages are approximate

Although ground surveys were not part of the KGS, many known geologic features, such as caves and sinkholes, occured within the study area. Two examples of these occured in the center of the study area and included Cascade Caverns and the Cascade Caverns sink. According to the THC historical marker for the cavern presents an interesting mix of geological, archeological, and historical features. The cavern is home to a number of unusual animals including cliff and leopard frogs, Mexican brown bats, and the Cascade Caverns salamander. According to the marker, archeological evidence uncovered near the cave indicated the presence of two sites. Commercial development of the cave, previously known as Hester's Cave began in the 1930s.

Table 14: Geological Units within the Study Area

Name	Geologic Description
Edwards Limestone	This Cretaceous rock unit of the Fredericksburg Group consists of fine to coarse grain, medium gray to grayish brown limestone/dolostone/chert with fossils, with a total thickness of 300 to 500 feet.
Fort Terrett Member	This Cretaceous age rock unit of the Fredericksburg Group consists of limestone and dolomite. Colors range from light to dark gray and a medium brownish gray.
Lower Glen Rose Formation	This Cretaceous age rock unit of the Trinity Group consists of limestone, dolomite, and marl as alternating resistant and

Table 14: Geological Units within the Study Area

Name	Geologic Description
	recessive beds forming stairstep topography. The Lower Glen Rose has massive beds containing fossils.
Upper Glen Rose Formation	This unit is the same the Lower Glen Rose Formation, but lacks the massive bedding and the fossiliferous beds.
Fluviatile Terrace Deposits	The Quaternary age rock unit is predominantly gravel, limestone, dolomite, and chert. This formation can be found above flood level along entrenched streams.

Source: USGS (2005)

4.3.1.2. AQUIFERS

The majority of the study area lied over the Trinity Aquifer, which is among the most extensively used aquifers in Texas (see **Appendix F [Exhibit 13]**). According to information from the Texas Water Development Board (TWDB), the Trinity Aquifer underlies much of the central and northeastern portions of the state. Water is pumped from the aquifer for many uses including irrigation and livestock, but the largest use is for municipalities. A small portion of the study area, within Bexar County was over the regulated portions of the Edwards Aquifer. According to the TCEQ, the study area within Bexar County is in both the Contributing Zone and Recharge Zone of the Edwards Aquifer. These zones are regulated by the TCEQ.

4.3.1.3. WATER WELLS

Water wells allow people to access fresh drinking water from underground sources, such as aquifers. As shown in **Table 15**, databases from the TWDB, as well as TCEQ were utilized to identify 1,014 recorded water wells in the study area (see **Appendix F [Exhibit 14]**).

Table 15: Recorded Water Wells within the Study Area

Database	Number of Wells
Submitted Driller's Reports Database	745
Groundwater Database	198
Brackish Resources Aquifer Characterization System	10
Public Water System	61
Total	**1,014**

Note: Counts above could reflect wells that appear in multiple databases.
Source: TWDB & TCEQ (2017)

4.3.2. SURFACE WATER

Surface water includes watersheds, rivers, streams, creeks, waterbodies, and wetlands. Databases were used to identify surface water resources within the study area. The identified surface water resources included: eight watersheds, 19 named streams/creeks with numerous unnamed tributaries,

16 acres of mapped National Wetland Inventory (NWI) wetlands, and one listed impaired stream. The following sections detail these findings.

4.3.2.1. WATERSHEDS

Watersheds are classified into four different levels of hydrologic units in the United States. The geographically largest hydrologic units are regions, and the smallest are cataloging units. The eight cataloging units located within the study area are the Balcones Creek-Cibolo Creek, Frederick Creek-Cibolo Creek, Pleasant Valley Creek-Cibolo Creek, Goss Creek-Guadalupe River, Honey Creek-Guadalupe River, Pipe Creek-Red Bluff Creek, Wasp Creek-Guadalupe River, and Headwaters Leon Creek watersheds. **Table 16** lists the acreage and percentage of each watershed within the study area.

Table 16: Watersheds within the Study Area

Name	Acreage	Percent of Study Area
Balcones Creek-Cibolo Creek	26,524	36
Frederick Creek-Cibolo Creek	21,991	30
Pleasant Valley Creek-Cibolo Creek	11,549	16
Goss Creek-Guadalupe River	6,976	10
Honey Creek-Guadalupe River	2,591	4
Pipe Creek-Red Bluff Creek	1,987	3
Wasp Creek-Guadalupe River	1,782	3
Headwaters Leon Creek	2	Less than 1
Total	**73,409**	**100**

Source: USGS (2017)

4.3.2.2. RIVERS, STREAMS, CREEKS, WETLANDS, AND WATERBODIES

The river, stream, and creek systems that occurred in the study area include Swede Creek, Spring Creek, Sabinas Creek, Rundale Creek, Rock Creek, Ranger Creek, Postoak Creek, Pleasant Valley Creek, Panther Creek, Menger Creek, Madrona Creek, Frederick Creek, Easter Creek, Deep Hollow Creek, Currey Creek, Cibolo Creek, Browns Creek, Black Creek, and Balcones Creek (see **Appendix F [Exhibit 15]**). These systems generally flowed from the northwest to southeast within the study area. Also shown in **Appendix F (Exhibit 15)**, the NWI mapped wetlands represent freshwater forested/shrub wetlands. **Table 17** provides a summary of the total quantity of each water feature type that occurs within the study area.

Section 404 of the CWA regulates waters defined as "jurisdictional" based on regulatory guidance provided by the United States Army Corps of Engineers (USACE). A mapped surface water does not necessarily constitute jurisdiction as defined by Section 404 of the CWA. KGS did not include field surveys, which would be required to determine if desktop identified waters and potentially others are regulated by the USACE.

Table 17: Surface Waters Mapped within the Study Area

Feature Type	Quantity within Study Area
NHD Rivers/Streams/Creeks	279 miles
NHD Waterbody	530 acres
NWI Wetlands	16 acres

Source: USFWS NWI (2017); USGS NHD (2017)

4.3.2.3. FLOODPLAINS

A floodplain is a low-lying area adjacent to a river or stream that is subject to flooding. The Federal Emergency Management Agency (FEMA) publishes Flood Insurance Rate Maps (FIRMs) that delineate the base floodplain elevations and floodways for the major rivers and streams. The FEMA FIRMs were reviewed within the study area. There were 4,776 acres of FEMA floodplains mapped within the study area as depicted in **Table 18** (see **Appendix F [Exhibit 15]**).

Table 18: FEMA Floodplains within the Study Area

Watershed	Acreage
Designated Floodway	332
100-year Floodplain (studied base flood elevation)	1,053
100-year Floodplain (unstudied base flood elevation)	3,391
Total	**4,776**

Source: FEMA (2017)

4.3.2.4. WATER QUALITY

The goal of the EPA CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (33 U.S.C §1251(a)). The law requires that states rank waterbodies on a list and develop Total Maximum Daily Loads, a calculation of the maximum amount of a pollutant that could be present in a waterbody and still meet water quality standards. The TCEQ produces *The Texas Integrated Report of Surface Water Quality*, as specified by the CWA Sections 305(b) and 303(d). This TCEQ report assesses surface water quality in Texas and designates impaired waters.

A search of TCEQ databases revealed one impaired water, Cibolo Creek, was within the study area (see **Appendix F (Exhibit 16)**.

4.4. BIOLOGICAL RESOURCES

4.4.1. ECOREGIONS

Ecoregions denote areas of general similarity in ecosystems and in the type and quality of environmental resources. The study area lied entirely within the Level IV Balcones Canyonlands ecoregion as mapped by the EPA (see **Appendix F (Exhibit 17)**). The Balcones Canyonlands ecoregion forms the southeastern boundary of the Edwards Plateau. The Balcones Canyonlands are highly

dissected through the erosion and solution of springs, streams, and rivers working both above and below ground. This ecoregion supports a number of endemic plants and woodlands dominated by black cherry, Texas mountain-laurel, madrone, Lacey oak, bigtooth maple, and Carolina basswood.

4.4.2. TPWD ECOLOGICAL MAPPING SYSTEMS OF TEXAS

The EMST classification is a cooperative effort between the TPWD and private, state, and federal partners to produce a land classification map for Texas. The EMST was produced by first classifying land cover, and then using ancillary data (e.g. hydrology, environmental data, highways, and cities) to model final mapped vegetation types. TPWD and partner personnel also collected ground data on land cover, composition, ecological system, and mapped vegetation type using a legend developed via an expert committee.

A total of seven major land cover types occured within the study area, according to EMST data available on TPWD's website (see **Appendix F [Exhibit 18]**). **Table 19** provides the approximate acreage of each of the seven land cover types present within the study area and the approximate percentage of the study area the land cover type occupies. As indicated in the table, four of the 16 types of classification account for 99 percent of the total land cover types in the study area. These four cover types were Edwards Plateau Savannah, Woodland, and Shrubland (82 percent), Urban (7 percent), Riparian, (7 percent), and Disturbed Prairie (3 percent). The remaining three land cover types each account for 1 (or less) percent of the study area.

Table 19: TPWD EMST MOU Classification within the Study Area

Name	Acreage*	Percent of Study Area
Edwards Plateau Savannah, Woodland, and Shrubland	60,274	82
Urban	5,264	7
Riparian	5,147	7
Disturbed Prairie	2,132	3
Agriculture	827	1
Open Water	272	Less than 1
Breaks, Cliffs Barrens	Less than 1	Less than 1

Source: TPWD (2017)
***All acreages are approximate**

4.4.3. PROTECTED SPECIES

4.4.3.1. FEDERALLY PROTECTED SPECIES

The Endangered Species Act (ESA) provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The lead federal agencies for implementing the ESA are the United States Fish and Wildlife Services (USFWS) and the U.S.

National Oceanic and Atmospheric Administration Fisheries Service. The USFWS maintains the list of endangered species. Species include birds, insects, fish, reptiles, mammals, crustaceans, and plants.

Table 20 includes USFWS-listed threatened, endangered, and candidate species that were known or expected to be on or near the study area. The list may also include species that occur outside of the study area, but that could potentially be directly or indirectly affected by activities in the study area. Additionally, the online USFWS Critical Habitat Mapper was reviewed to identify known critical habitat for any of the endangered, threatened, or candidate species listed by the USFWS within the study area. The potential for a species to occur within the study area was also based on desktop aerial photography analysis by a biologist. Although no known critical habitat was mapped within the study area, there is the potential for all USFWS-listed species to occur within the study area.

Table 20: USFWS Federal List of Threatened, Endangered, & Candidate Species

Name	Listing Status	Potential to Occur within the Study Area (Yes/No)
Golden-cheeked Warbler *(Dendroica chrysoparia)*	Endangered	Yes
Least Tern *(Sterna antillarum)*	Endangered	Yes
Piping Plover *(Charadrius melodus)*	Threatened	Yes
Red Knot *(Calidris canutus rufa)*	Threatened	Yes
Whooping Crane *(Grus Americana)*	Endangered	Yes
San Marcos Salamander *(Eurycea nana)*	Threatened	Yes
Texas Blind Salamander *(Typhlomolge rathbuni)*	Endangered	Yes
Fountain Darter *(Etheostoma fonticola)*	Endangered	Yes
Golden Orb *(Quadrula aurea)*	Candidate	Yes
Texas Fatmucket *(Lampsilis bracteate)*	Candidate	Yes
Texas Fawnsfoot *(Truncilla macrodon)*	Candidate	Yes
Texas Pimpleback *(Quadrula petrina)*	Candidate	Yes
Beetle *(Rhadine exilis)*	Endangered	Yes
Beetle *(Rhadine infernalis)*	Endangered	Yes
Comal Springs Dryopid Beetle *(Stygoparnus comalensis)*	Endangered	Yes
Comal Springs Riffle Beetle *(Heterelmis comalensis)*	Endangered	Yes
Helotes Mold Beetle *(Batrisodes venyivi)*	Endangered	Yes
Braken Bat Cave Meshweaver *(Cicurina venii)*	Endangered	Yes
Cokendolpher Cave Harvestman *(Texella cokendolpheri)*	Endangered	Yes

Table 20: USFWS Federal List of Threatened, Endangered, & Candidate Species

Name	Listing Status	Potential to Occur within the Study Area (Yes/No)
Government Canyon Bat Cave Meshweaver *(Cicurina vespera)*	Endangered	Yes
Government Canyon Bat Cave Spider *(Neoleptoneta microps)*	Endangered	Yes
Madla's Cave Meshweaver *(Cicurina madla)*	Endangered	Yes
Robber Baron Cave Meshweaver *(Cicurina baronia)*	Endangered	Yes
Peck's Cave Amphipod *(Stygobromus pecki)*	Endangered	Yes
Bracted Twistflower *(Streptanthus bracteatus)*	Candidate	Yes
Texas Wild-rice *(Zizania texana)*	Endangered	Yes
Tobusch Fishhook Cactus *(Sclerocactus brevihamatus ssp. Tobuschii)*	Threatened	Yes

Source: U.S. Fish & Wildlife Service IPaC Resource List (generated May 23, 2018)

Additionally, migratory birds protected under the Migratory Bird Treaty Act of 1918 (MBTA) were reviewed. The study area was located within the Central Flyway for migratory birds. Fall and spring migrants use the region for temporary stops during travel between the northern and southern hemispheres. Some species may breed and nest within the study area during spring, summer, and early fall. Other species may potentially be year-round residents. In addition to protection under the MBTA, bald and golden eagles are also protected under the Bald and Golden Eagle Act of 1940.

4.4.3.2. STATE PROTECTED SPECIES

The Texas legislature has authorized regulations pertaining to the management, regulation, and protection of native plants and animals listed as state threatened or endangered. TPWD regulations prohibit the taking, possession, transportation, or sale of any of the animal species designated by state law as endangered or threatened without the issuance of a permit. TPWD's Texas Natural Diversity Database (TxNDD), and TPWD's county list of rare species were reviewed to identify potential occurrences or habitat for threatened and endangered species within Kendall County and Bexar County.

Table 21 includes TPWD listed threatened, endangered, and rare species for Kendall and Bexar Counties. Of note, the annotated county list also includes federally-listed species; therefore, there is overlap with **Table 20**. In additional to information from the TxNDD, the potential for a species to occur within the study area was also based on desktop aerial photography analysis by a biologist. As noted in the table below, all TPWD-listed rare species have the potential to occur with the study area.

Table 21: TPWD Annotated County List of Rare Species for Kendall and Bexar Counties

Name	Listing Status	Potential to Occurrence within the Study Area (Yes/No)
Blanco River Springs Salamander (*Eurycea pterophila*)	-	Yes
Cascade Caverns Salamander *(Eurycea latitans complex)*	Threatened	Yes
Comal Blind Salamander *(Eurycea tridentifera)*	Threatened	Yes
Texas Salamander (*Eurycea neotenes*)	-	Yes
Bracken Bat Cave Meshweaver *(Cicurina venii)*	Endangered	Yes
Cokendolpher Cave Harvestman (*Texella cokendolpheri)*	Endangered	Yes
Government Canyon Bat Cave meshweaver (*Cicurina vespera)*	Endangered	Yes
Government Canyon Bat Cave spider (*Neoleptoneta microps)*	Endangered	Yes
Madla Cave meshweaver (*Cicurina madla)*	Endangered	Yes
Robber Baron Cave Meshweaver (*Cicurina baronia)*	Endangered	Yes
American Peregrine Falcon (*Falco peregrinus anatum)*	DL	Yes
Arctic Peregrine Falcon (*Falco peregrinus tundrius)*	DL	Yes
Bald Eagle (*Haliaeetus leucocephalus)*	DL	Yes
Black-capped Vireo (*Vireo atricapilla)*	DL	Yes
Golden-cheeked Warbler (*Setophaga chrysoparia)*	Endangered	Yes
Interior Least Tern (*Sternula antillarum athalassos)*	Endangered	Yes
Peregrine Falcon (*Falco peregrinus)*	DL	Yes
Red Knot (*Calidris canutus rufa)*	Threatened	Yes
White-faced Ibis (*Plegadis chichi*)	Threatened	Yes
Whooping Crane (*Grus Americana*)	Endangered	Yes
Wood Stork (*Mycteria Americana)*	Threatened	Yes
Zone-tailed Hawk (*Buteo albonotatus)*	Threatened	Yes
Toothless blindcat (*Trogloglanis pattersoni)*	Threatened	Yes
Widemouth blindcat (*Satan eurystomus*)	Threatened	Yes
A ground beetle (*Rhadine exilis)*	Endangered	Yes
A ground beetle (*Rhadine infernalis)*	Endangered	Yes

Table 21: TPWD Annotated County List of Rare Species for Kendall and Bexar Counties

Name	Listing Status	Potential to Occurrence within the Study Area (Yes/No)
Helotes Mold Beetle (*Batrisodes venyivi)*	Endangered	Yes
Black Bear (*Ursus americanus)*	Threatened	Yes
Gray Wolf (*Canis lupus)*	Endangered	Yes
Red Wolf (*Canis rufus)*	Endangered	Yes
False Spike Mussel (*Fusconaia mitchelli)*	Threatened	Yes
Golden Orb (*Quadrula aurea)*	Threatened	Yes
Texas Fatmucket (*Lampsilis bracteate)*	Threatened	Yes
Texas Pimpleback (*Quadrula petrina)*	Threatened	Yes
Cagle's Map Turtle (*Graptemys caglei)*	Threatened	Yes
Texas Horned Lizard (*Phrynosoma cornutum)*	Threatened	Yes
Texas Indigo Snake (*Drymarchon melanurus erebennus)*	Threatened	Yes
Texas Tortoise (*Gopherus berlandieri)*	Threatened	Yes
Timber Rattlesnake (*Crotalus horridus)*	Threatened	Yes
Bracted Twistflower (*Streptanthus bracteatus)*	Candidate	Yes

Source: Texas Parks & Wildlife Department, Wildlife Division, Diversity and Habitat Assessment Programs, Kendall County and Bexar County List of Texas Rare Species. (last revised July 25, 2016; accessed May 23, 2018)

4.5. HAZARDOUS MATERIALS

The term "hazardous materials" refers to a broad category of hazardous wastes, hazardous substances, and toxic chemicals that could negatively impact human health or the environment. Examples of hazardous material sites and issues include industrial sites, petroleum storage tanks, oil and gas wells, landfills, pipelines, structures with asbestos containing materials, structures with lead containing materials, and contaminated soil and groundwater associated with any of the above listed concerns.

Potentially applicable regulations include the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). CERCLA, commonly known as Superfund, was enacted by Congress on December 11, 1980. This act establishes prohibitions and requirements concerning closed and abandoned hazardous waste sites, provides for liability of persons responsible for releases of hazardous waste at these sites, and established a trust fund to provide for cleanup when no responsible party could be identified.

The RCRA was enacted by Congress in 1976 to address the huge volumes of municipal and industrial solid waste generated nationwide and provides broad guidelines for the establishment of a national waste management program.

Seven TCEQ online databases were reviewed, as listed below. According to these databases, two sites were registered as municipal solid waste site/landfill (City of Boerne Landfill and the Trash Pickup Service Transfer Station) and 20 petroleum storage tanks were identified within the study area (see Appendix F [Exhibit 19]).

- Municipal Solid Waste Sites/Landfills
- Superfund Sites
- Municipal Designations (Point)
- Municipal Designations (Boundaries)
- Radioactive Waste Sites
- Petroleum Storage Tanks
- EPA Toxic Release Inventory

4.6. AIR QUALITY

The Clean Air Act requires EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants that are common in outdoor air, are considered harmful to public health and the environment, and that come from numerous and diverse sources. The statute established two types of national air quality standards: primary standards and secondary standards for each of the six pollutants of the NAAQS for each of the six criteria pollutants. These pollutants are:

- Carbon Monoxide (CO)
- Lead (Pb)
- Particulate Matter (PM)
- Ozone (O3)
- Nitrogen Dioxide (NO2)
- Sulfur Dioxide (SO2)

Kendall County is currently in attainment for all measured pollutants. At this stage of planning, an air quality analysis has not been completed.

4.7. NOISE ENVIRONMENT

TxDOT enacted a policy to comply with the NEPA and FHWA requirements regarding traffic noise by providing procedures for noise studies and noise abatement measures to help protect the public's health, welfare, and livability; to supply noise abatement criteria; and to establish requirements for information to be given to local officials for use in the planning and design of highways. At this stage of planning, no traffic noise analyses have been completed per the FHWA and TxDOT Traffic Noise guidelines. Should a proposed project be implemented, traffic noise and abatement measures would be addressed at that time.

5.0 CONCEPT DEVELOPMENT PROCESS

Although there was a previous study conducted in 2005 to glean information and some general observations from, the Study Team determined that current data and corresponding analyses as well as public and stakeholder input would guide the solutions derived from this feasibility study. This data includes:

- Traffic/Geometric
- Environmental
- Public input

The concept development process began after initial data were collected. This information was vital in determining the purpose and need of the study, as well as what types of solutions would effectively address the traffic problems in Boerne and Kendall County. While the traffic/geometric and environmental data were collected, the Study Team began preparing for local outreach to gather information from the public.

Combining the results from the traffic/geometric analysis, environmental constraints map, and public input the Study Team started the concept development process. These three major data sets continued to be updated and refined throughout the process illustrated below (**Figure 18**).

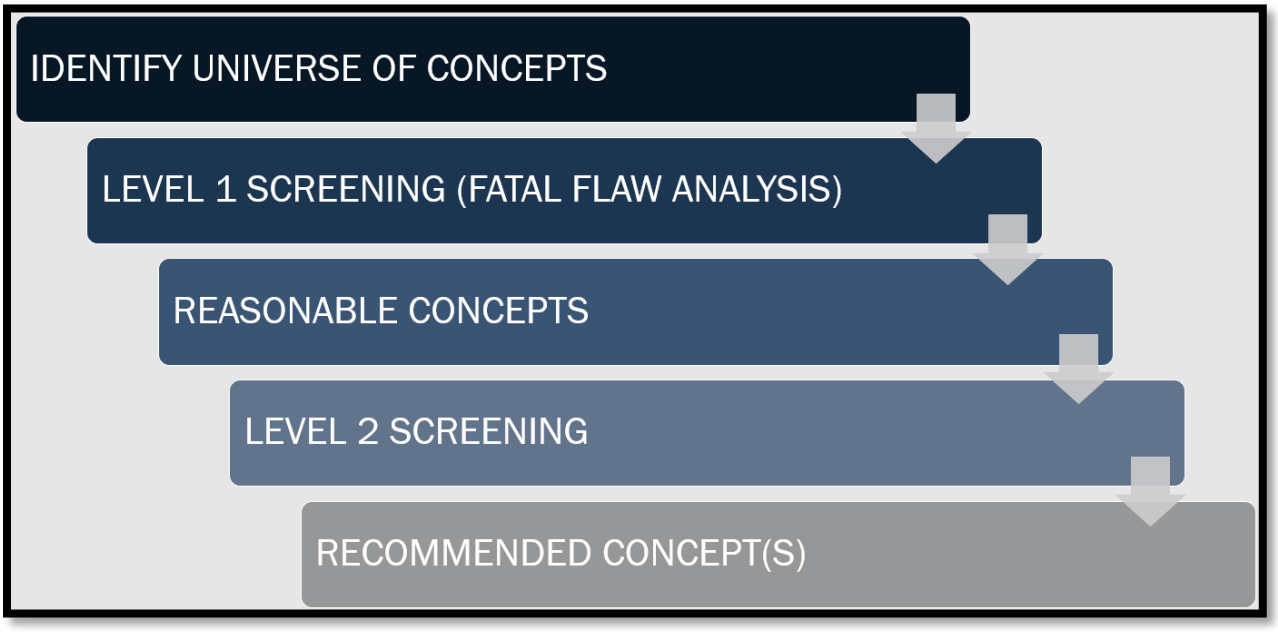

Figure 18: Concept Development Process

Based on all of the initial data received, the purpose and need was established (see **Section 1.3**). All of the concepts that the Study Team developed needed to satisfy the purpose and meet the needs. For example, The Study Team focused on developing added capacity concepts in areas that would not negatively transform downtown Boerne but would provide more east/west connectivity through the study area.

5.1. UNIVERSE OF CONCEPTS

This concept development process started with a blank map. The universe of concepts was developed by drawing corridors within the study area that provided a connection between SH 46 and I-10. Ultimately, there were over 200 different possible combinations of corridor concepts within the study area that comprised the universe of concepts. These concepts incorporated new location corridors as well as utilizing existing facilities.

5.1.1. TYPICAL SECTION AND FACILITY TYPE

Before any concepts were drawn on a map, the Study Team needed to select a base footprint width for both the ROW and the roadway facility.

The Study Team determined that a four-lane rural divided highway within a 300-foot ROW width would accommodate the travel demand through 2040. Each direction of travel would consist of four 12-foot lanes with four-foot inside shoulders and 10-foot outside shoulders and be separated by a grass median (**Figure 19**). Phased construction of two lanes may accommodate traffic in most portions of the proposed concepts for an interim period. Four lanes would ensure a higher level of service and potentially accommodate greater than anticipated growth.

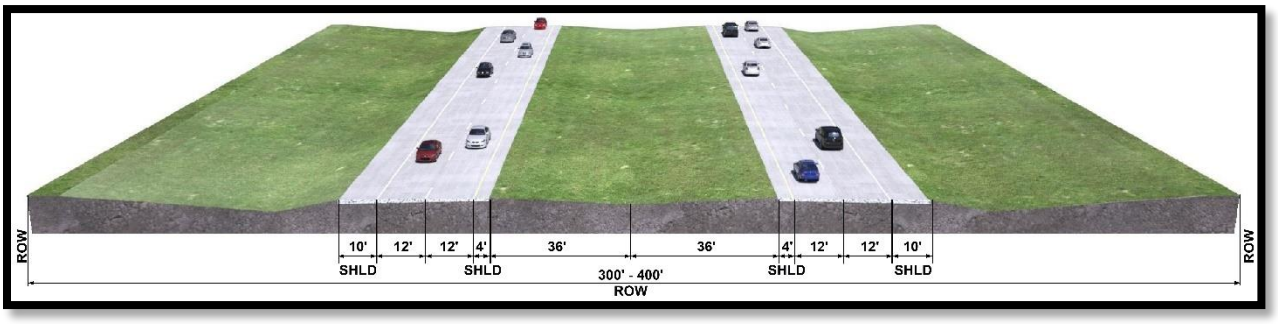

Figure 19: Conceptual Four-Lane Divided Highway with Grass Median

Additionally, 76-foot wide grass ditches were included on each side to accommodate drainage, turn lanes and to maintain a natural separation from surrounding land. This base footprint would also allow for flexibility within the proposed ROW to account for varying terrain and potential grade separations at major intersections.

This base footprint could be phased in with a single direction being constructed and serving two directions until demand warrants more lanes. The other direction could then be constructed while the existing lanes remain in service (**Figure 20**).

Figure 20: Ultimate Four-Lane Example

It is important to note that the base footprint and roadway type selected was for planning purposes only and represented a conservative width for future flexibility. The footprint could be narrowed/refined based upon local needs, public input or as demonstrated by subsequent studies. For example, the proposed footprint could potentially be reduced while maintaining the same capacity by replacing the safety median with a barrier and reducing ditch widths (**Figure 21**).

Figure 21: Interim Two-Lane Example

Because this is a feasibility-level study, the Study Team chose to use the more conservative footprint of 300-feet to develop concepts and measure them against each other consistently (**Figure 22**). This would also help accommodate future growth without the need to revisit this level of study and assist in the development of a ROW preservation plan (**Appendix J**).

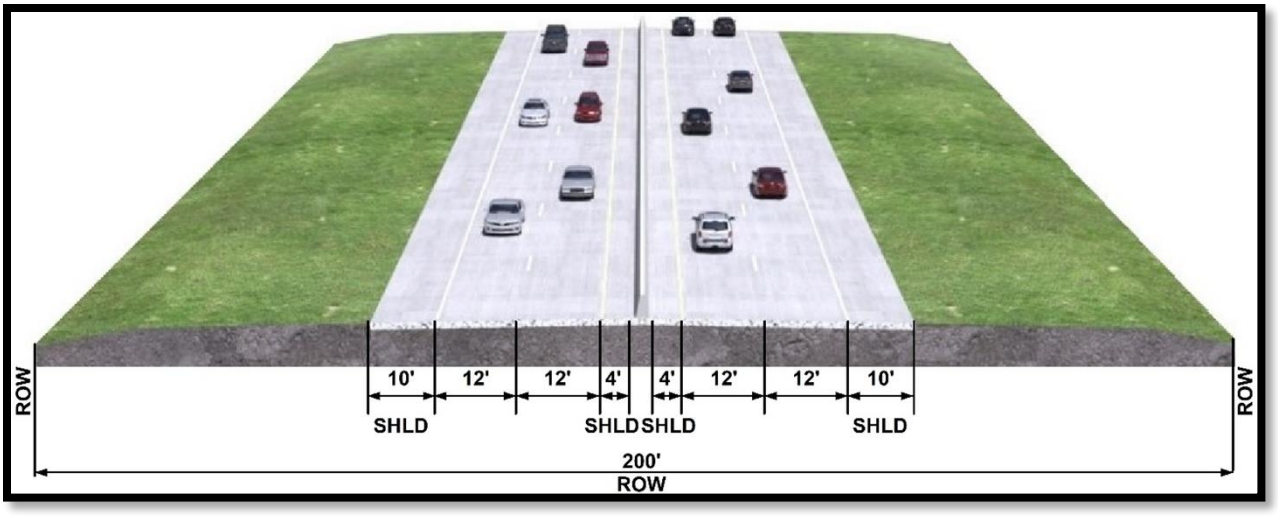

Figure 22: Possible Four-Lane Divided Highway with Barrier

Rural highway design standards were utilized, with a 60-mph design speed. The design speed is high enough to encourage utilization, but low enough to allow geometric flexibility with horizontal alignment challenges. This design speed establishes the minimum curve radii that could be placed along the potential concepts. The geometric design parameters adhere to TxDOT's *Roadway Design Manual* and are summarized in **Table 22** below.

Table 22: Design Parameters

Description	Proposed Concept	
	Desired	Minimum
Roadway Classification	Arterial	
Design Speed (mph)	60	
Minimum Radius (ft)	2195	1330
Superelevation (%)	e(max) = 6	
Lane Width (ft)	12	
Outside Shoulder Width (ft)	10	8
Inside Shoulder Width (ft)	4	4
Median Width (ft)	76	48
Right-of-Way Width (ft)	300	

Source: Study Team and the TxDOT *Roadway Design Manual* (Revised April 2018)

5.1.2. OTHER CONCEPTS CONSIDERED AND ELIMINATED

Simultaneous to the development of the typical section above, other innovative solutions were considered; however, they did not meet the purpose of and need for the proposed project.

Signal Timing

There are approximately ten signalized intersections along SH 46 and Main St. through the City of Boerne. Sometimes congestion can be reduced by optimizing the timing of these signals to increase throughout.

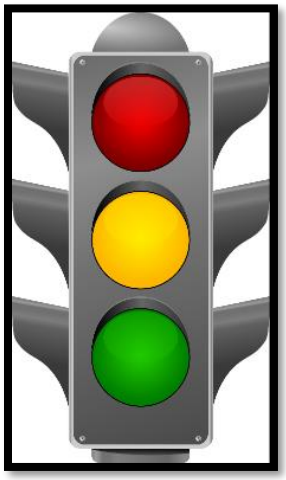

Figure 23: Signal Timing

According to the 2040 volume projections, almost every facility would be over capacity; therefore, it was concluded that signal optimization would have a minor impact. Signal timing would also not provide more east/west redundancy (**Figure 23**).

Innovative Intersections

Similar to signal timing improvements, some intersections could benefit from innovative geometric reconfigurations. These are commonly referred to as innovative intersections. Examples include:

- Roundabouts (**Figure 24**);
- Single-Point Urban Interchanges;
- Diverging Diamond Interchanges;
- Displaced Left Turn;
- Median U-Turn (or Super St.); and
- Quadrant Roadway.

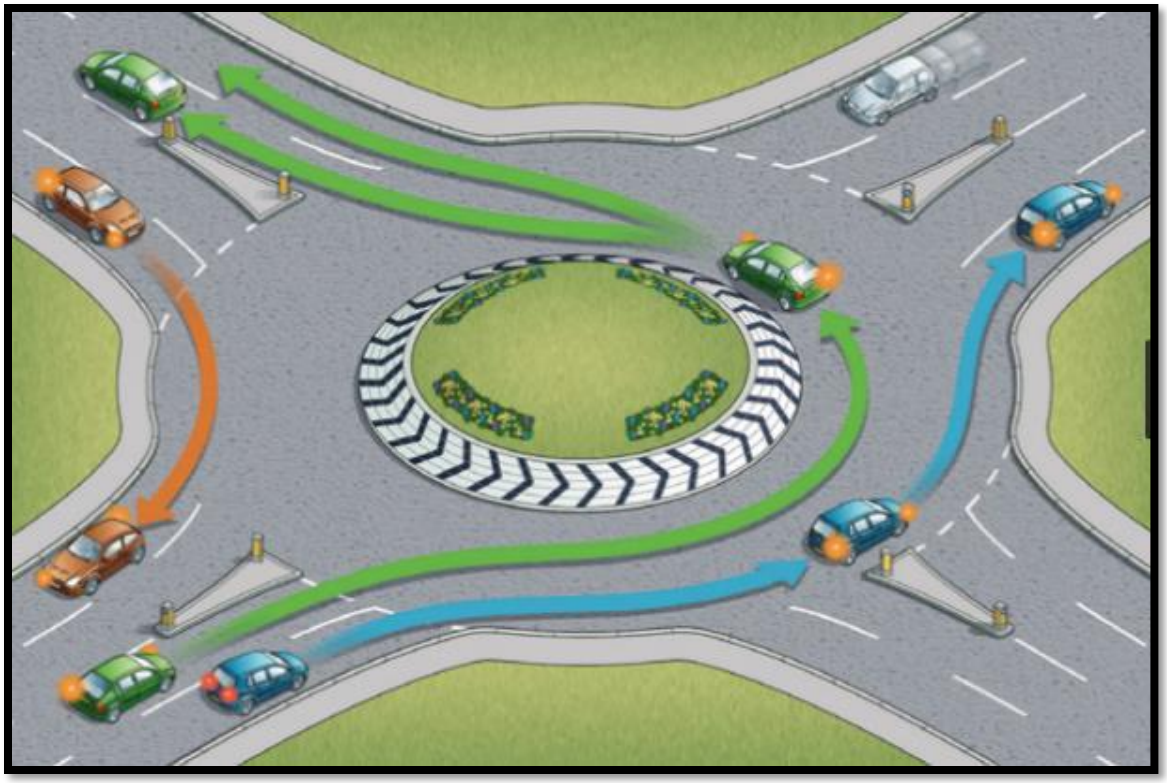

Figure 24: Innovative Intersection Example

When considering the 2040 traffic volume projections it was found that almost every facility would be over capacity, it was concluded that innovative intersections on existing facilities would have only minor positive impacts. They also would not provide more east/west redundancy.

Mass Transit

Mass transit could be accomplished by a few different options:

- Bus routes
- Trolley
- Light rail

All of these options could reduce congestion by providing an option to the public instead of single occupancy vehicle use. This could help reduce the number of vehicles by consolidating a large number of people into one vehicle.

Mass transit systems (**Figure 25**) are generally successful at getting people to leave their cars behind in dense urban environments. Boerne does not have the density to support a transit system large enough to alleviate the projected capacity deficiencies.

Figure 25: Mass Transit – Light Rail Option

Conclusion of "Other Concepts Considered"

All of these concepts could decrease congestion and increase the level of service; however did not satisfy all the needs of this study. However, some could be considered as potential interim or complementary options to the recommended concepts.

5.1.3. MATRIX CRITERIA DEVELOPMENT

During this phase of the study, an initial list of criteria was developed to determine how the universe of concepts were going to be evaluated and screened, via the fatal flaw analysis, to a more reasonable subset of concepts. The list of criteria was developed from commonly utilized criteria for roadway feasibility projects and input from the public. The criteria were divided into known environmental/social economic factors and traffic/engineering performance measures. Of note, no weight was given to any of the criteria (**Figure 26**).

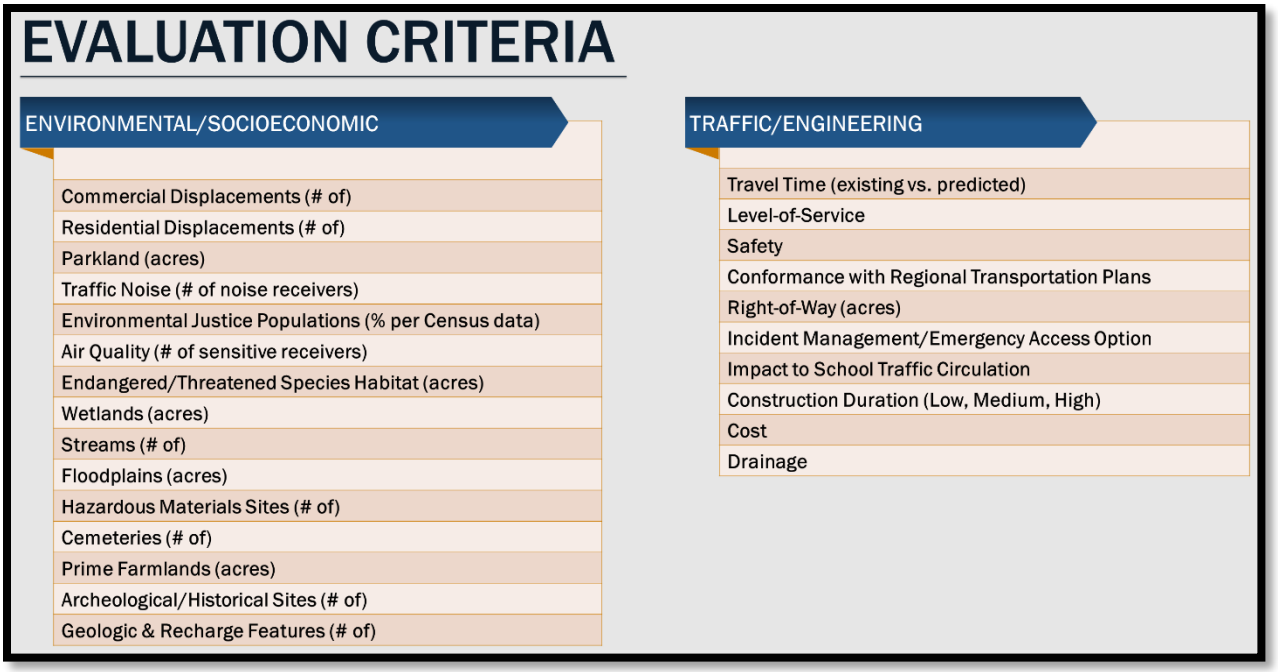

Figure 26: Environmental and Engineering Evaluation Criteria

5.1.4. PUBLIC INVOLVEMENT

The initial list of criteria was presented to the working groups and refined according to feedback. A survey was mailed and emailed to a list of known stakeholders (see **Section 3.6**). This survey contained the list of criteria that was developed. The public was asked to rank criteria in order of importance. These public rankings, along with engineering and technical input, became the basis on which the universe of concepts was developed.

5.1.5. ENVIRONMENTAL RESOURCES

During the universe of concepts phase of the study, the Study Team continued to gather and refine environmental resource data. This information was compiled onto an environmental constraints map. Due to the size of the study area, the constraints map was broken into four separate quadrants (**Figure 27** below). This allowed the Study Team and the public to better visualize the constraints. No field surveys were completed during this phase. All environmental resource data came from either the public or from online resources. Because of the integrated approach between environmental and engineering, the environmental process is included throughout the entirety of this section of the document, such as the evaluation criteria description.

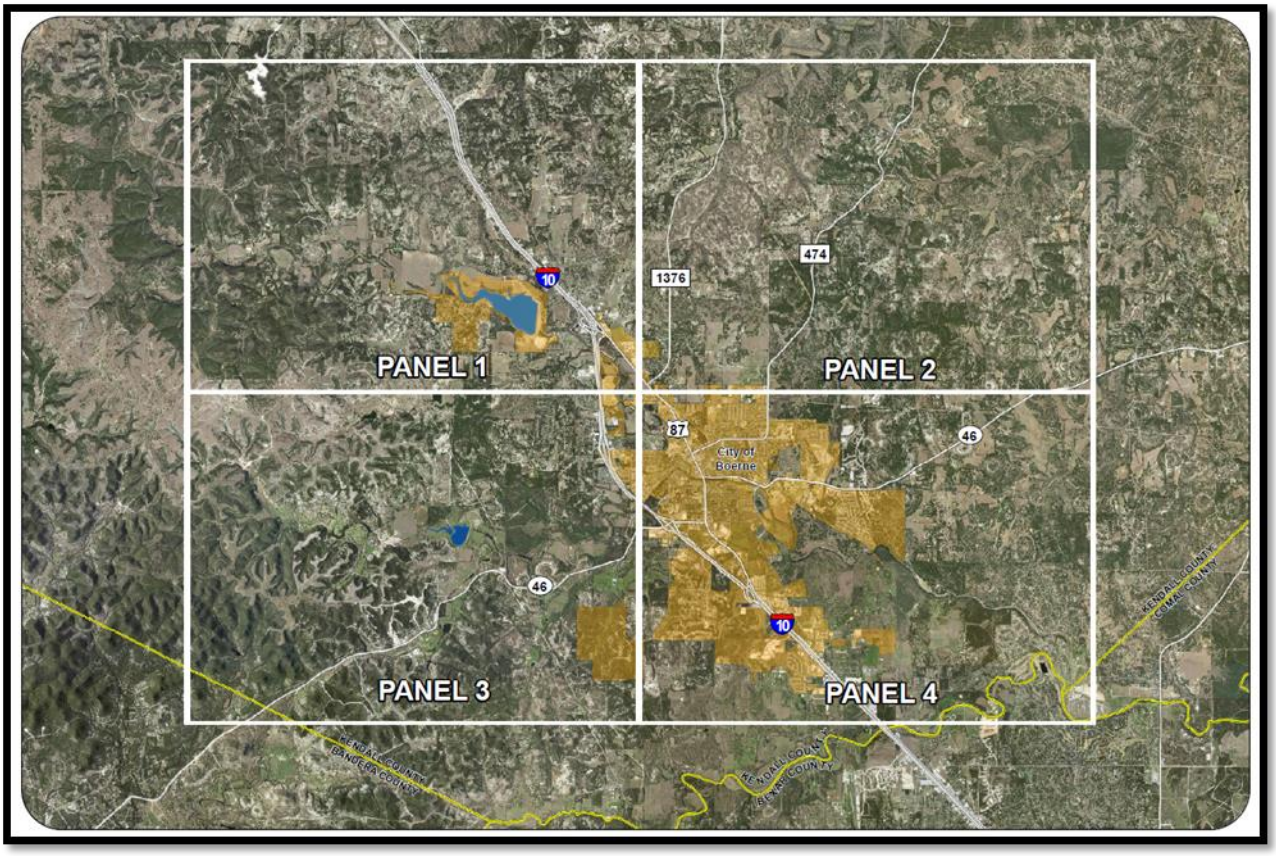

Figure 27: Study Area Quadrangles

5.1.6. RESULTS

The following components were now available to develop the universe of concepts:

- **Environmental Constraints Map:** developed through publicly available data, working groups and a public meeting;
- **Purpose and Need**: developed from public outreach, traffic data, and geometric analysis of existing and future conditions;
- **Typical Section**: developed from traffic data and analysis to accommodate 2040 traffic volume projections and increase safety; and
- **Criteria List**: developed from practice standards, refined through the working groups and a public survey.

The Study Team used these initial components to draw interchangeable concepts on the environmental constraints maps with the goal of avoiding and minimizing impacts. As previously mentioned, all of the concepts drawn needed to maintain a design speed of 60 mph. The result included several conceptual concepts that could be combined with others to create continuous corridors. The concepts included widening existing roads as well as new location routes. Some concepts impacted environmentally sensitive areas while others impacted commercial and residential structures (**Figure 28**).

The city center of the project was considered the intersection of River Rd. and Main St. in Boerne. This was also the center of congestion and the location of the highest crash rate. The general rule of thumb for the corridor placement was that the concept be between one and five miles from the city center. If it was too close to the center, the concept would only serve as another local collector. Also, the density of development near the city center prohibited a 300-foot wide corridor.

If the concept was too far from the city center, it would not attract the through-traffic away from downtown. Also, the rugged hill country terrain increased around five miles from the city center. The only option that was considered outside of this five-mile radius was the widening of FM 3351.

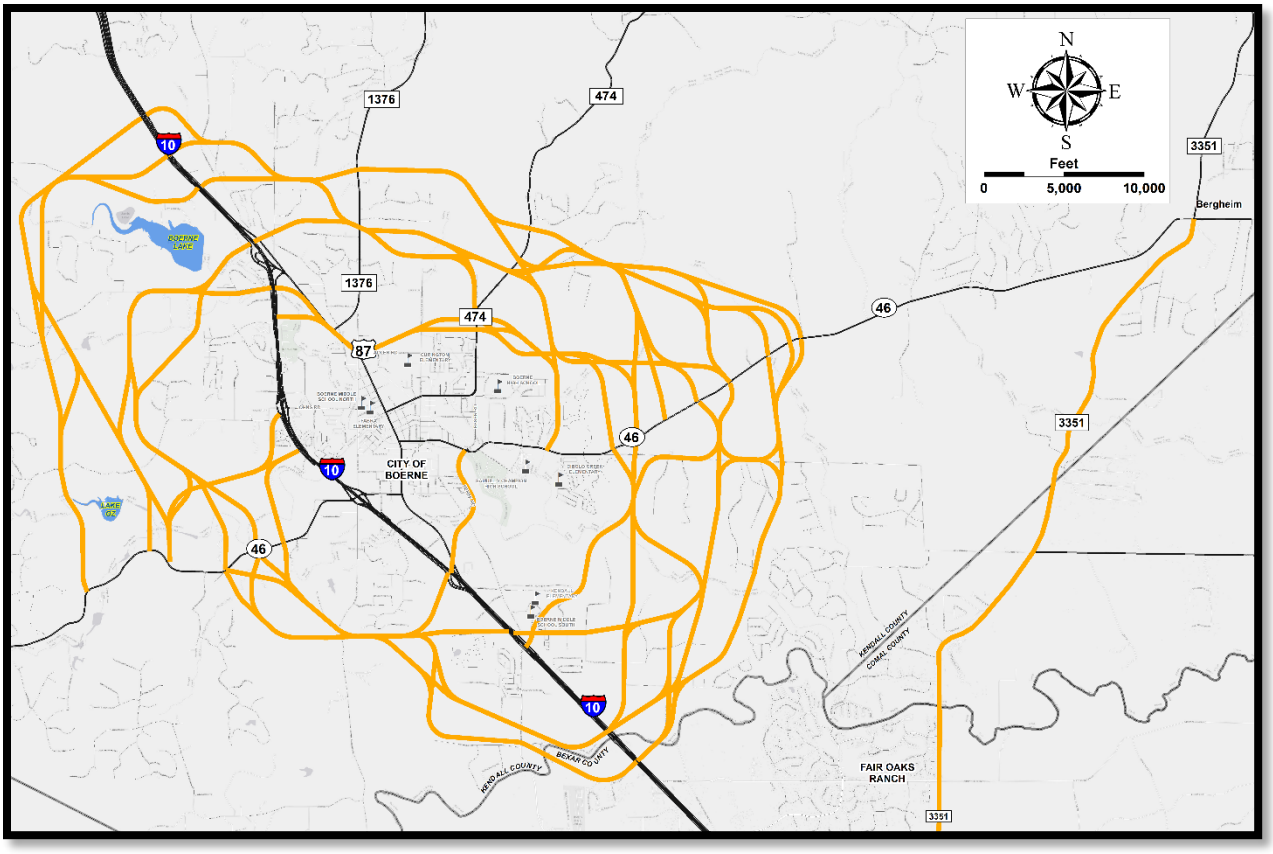

Figure 28: Universe of Concepts Map

Avoiding all impacts was not possible at this phase of concept development. Due to the residential/commercial density around Boerne, there were no clear paths along existing facilities or on new locations. Widening existing facilities generally had greater impacts on existing structures such as homes and businesses. New location corridors could impact fewer existing structures but require more ROW and impact ranch and farm land. For a closer look at the 200 combinations of corridor concepts comprising the universe of concepts, see **Appendix H**.

5.2. REASONABLE CONCEPTS

The TWG and SWG were combined for the third meeting to help narrow down the universe of concepts in August 2017 (see **Appendix H**). The participants were given a summary of the study to date, the

results of the public survey, and traffic findings around and through Boerne. Using all this information, the participants were asked to draw on the universe of concepts map, highlighting routes they preferred, crossing out routes they did not prefer, and drawing new routes, if deemed necessary.

There was no clear preferred route selected by the group. Some participants preferred the options closer to the city center while most preferred options further out.

5.2.1. FATAL FLAW ANALYSIS OF UNIVERSE OF CONCEPTS

A fatal flaw analysis was applied to the universe of concepts to screen for a subset of reasonable concepts. The fatal flaw analysis utilized a combination of the working groups crossed out routes and engineering judgement. The working group was presented the list of criteria and their ranking of importance from previous public input.

The working groups generally suggested a route furthest out from the city. The reasons given were twofold: less impacts and more of a longer-term solution. This was not unanimous; however, as some participants marked up portions of inner and intermediate options.

Another option that was suggested by multiple participants was to provide an east/west connection from FM 3351 to a proposed corridor. Some suggestions utilized Ammann Rd. north of Stone Creek Ranch while others suggested an extension of Ammann Rd. south of Stone Creek Ranch.

From the working group suggestions and engineering analysis, the universe of concepts was narrowed down to an inner, middle, and outer concept in each quadrant of the study area. This resulted in a total of 12 reasonable concepts. The reasons for choosing inner, middle, and outer concepts included:

- The working group majority suggested the outer-most option;
- To better differentiate how effective each concept was at removing the traffic from downtown, the engineers maintained an inner option;
- The greater the distance between the concepts, the clearer the results that show where a concept would be most effective;
- The middle concept was a logical hybrid of the inner and outer concepts; and
- To receive additional input from the public on how close or far they wanted the concept to be located from downtown Boerne.

As discussed above, the reasonable concepts are the 12 concepts (an inner, middle and outer concept in each of the four quadrants) that were vetted through public input and engineering analysis. Each of the concepts meet the purpose and need of the project and were refined to minimize the potential impacts and maximize effectiveness.

5.2.2. MATRIX CRITERIA EVALUATION

The list of criteria was used to examine the reasonable concepts. At this stage, each concept was given an in-depth analysis to add quantitative data to accurately compare each concept. All concepts used the same 300-foot wide corridor width and proposed typical section for this analysis. The following criteria were utilized:

Environmental/Socioeconomic:

- Direct Commercial Impacts– the number of commercial structures within corridor
- Direct Residential impacts– the number of residential structures (including barns, sheds, etc.) within corridor
- Parkland– acres of parkland within corridor
- Air Quality– the percentage of trucks removed from existing congested roads
- Stream Crossings– number of streams/creeks crossed
- Hazardous Materials Sites– number of hazardous sites within corridor
- Cemeteries– number of cemeteries within corridor
- Prime Farmlands– acres of prime farmlands within corridor
- Archeological/Historic Sites– number of sites within corridor
- Known Geological & Recharge Features– number of known features within corridor

Engineering Criteria:

- Time Reduced– percent change in time between common points, no-build versus concepts, from travel demand model (TDM)
- Level of Service– percent Average Daily Traffic (ADT) volume reduction from no-build traffic volumes along existing most congested major arterials
- Conformance to Regional Transportation Plan– yes or no, whether or not the proposed concepts were similar to proposed roads on the City of Boerne Thoroughfare Plan (for informational purposes only)
- Right-of-Way– number of acres of non-government ROW overlapped with concepts
- Parcels Affected– number of individual parcels touched
- Cost– high level cost estimate based on a cost per linear foot
- Drainage– number of acres of floodplain overlapped

All of the environmental and socioeconomic constraints were loaded into Geographic Information System software to accurately measure the impacts of each concept. The engineering criteria utilized travel demand modeling and the traffic analysis to measure the effectiveness of each concept, individually within a quadrant and as part of a full loop system. The public involvement helped highlight which of the criteria was deemed most important to the public. Additional criteria were highlighted as key differentiators and generally a common concern of the public.

5.2.3. FIRST ROUND OF PUBLIC INVOLVEMENT

The third working group meeting, that combined the TWG and SWG together, was the first public group to see the universe of concepts. As stated previously, input from this group was utilized to refine the universe of concepts to the reasonable concepts (see **Appendix H** and **Figure 29** below).

Figure 29: Universe of Concepts to Reasonable Concepts

5.2.4. ENVIRONMENTAL RESOURCES

Environmental data were continually refined during the first three working group meetings. Attendees were asked to review the environmental data presented on the constraints maps and provide any input on issues they saw. An example of this were cemeteries and local historical markers that were either depicted in the wrong location, missing, or were mis-labeled. By having a continuous conversation with stakeholders and technical attendees, the Study Team was able to refine information and utilize the best available data to aid in concept analysis. **Figure 30** is a clip of an environmental constraints map that was presented during the third working group meeting. These two comments, shown below in red, were analyzed and then incorporated into the environmental data. The comment to the left helped identify that a "historic family ranch" was in the study area and the comment to the lower right informed the Study Team that the Sultenfuss Ranch marker, a Family Heritage Site, needed to be shifted north.

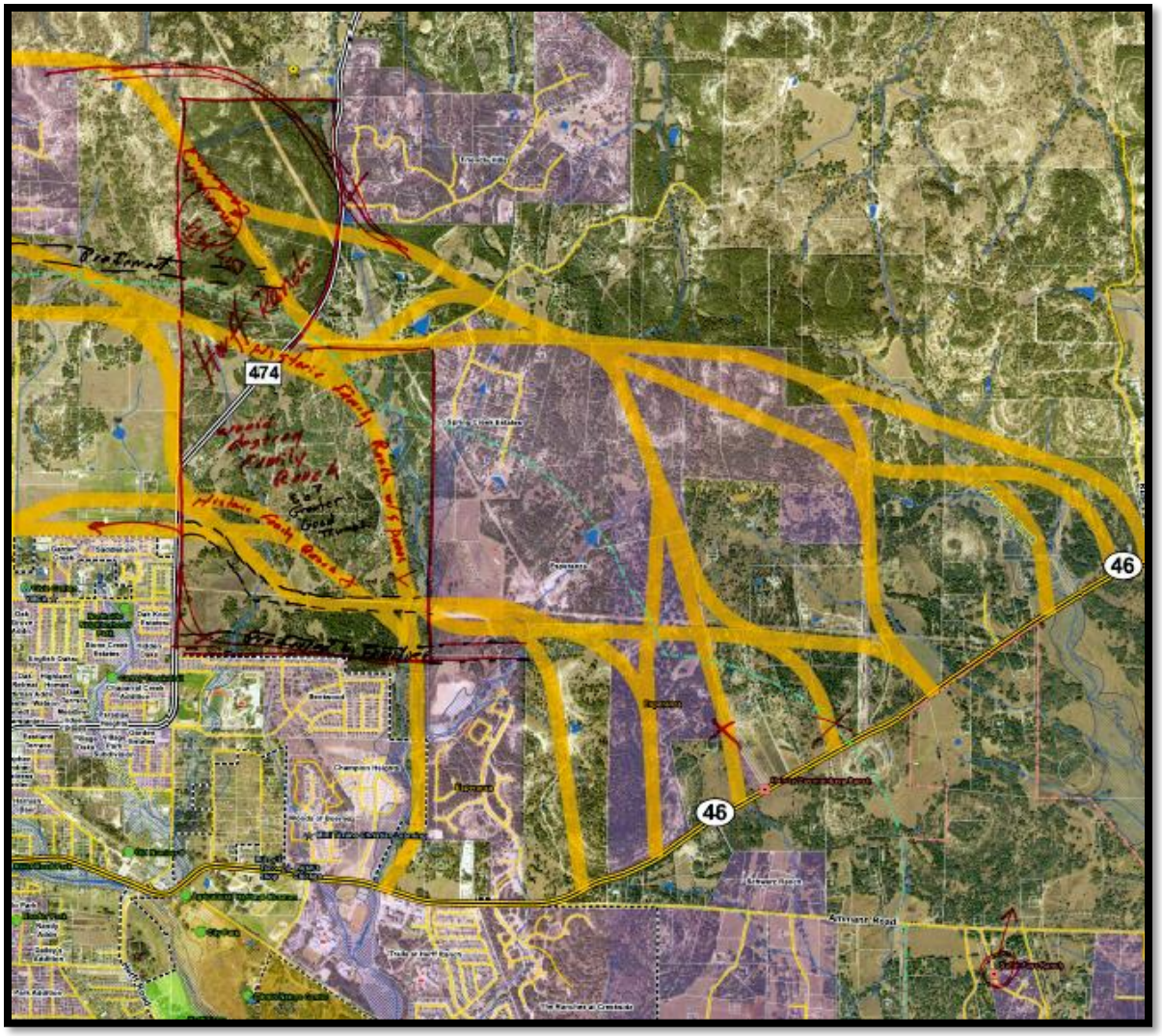

Figure 30: Comments on the Environmental Constraints Map from Working Group Attendees

5.2.5. TRAVEL DEMAND MODELING

In order to measure the effectiveness of the concepts, they needed to be incorporated in a TDM. A model of the existing system of roads and traffic patterns from the MPO was utilized for this study. This model was calibrated according to the traffic data collected as part of this project as well as potential future development. For the future traffic projections, the 2040 model incorporated the planned MPO projects (see **Appendix C**).

The proposed concepts were entered into this model and the software (TransCad) redistributed the traffic accounting for this new available connection. Generally, the vehicles going through the congestion roads may shift to the new option if the model calculates that it would be a faster alternative. The Study Team derived how much the proposed concepts reduced congestion on the existing roads.

The results of the modeling are in **Appendix B** and **Appendix C**. The primary criteria that the model supports are:

- Time Reduced– percent change in time between common points, using the no-build option versus the concepts (from the TDM);
- Level of Service– percent ADT volume reduction from the no-build traffic volumes along the existing most congested major arterials; and
- Air Quality– the percent of trucks removed from existing congested roads.

The time reduced and percent trucks removed (air quality) could be extracted directly from the model as seen in **Table 23** and **Table 24**.

Table 23: Vehicle Hours Traveled

Scenarios	2020		2040	
	VHT	%VHT Change	VHT	%VHT Change
No Build	7,500	_	14,700	_
Outer Loop	6,100	-19%	11,100	-24%
Middle Loop	5,600	-25%	9,900	-33%
Inner Loop	5,900	-21%	11,300	-23%
NW Outer	7,500	0%	14,700	0%
NE Outer	6,600	-12%	12,500	-15%
SW Outer	7,500	0%	14,500	-1%
SE Outer	7,100	-5%	13,100	-11%
NW Middle	7,500	0%	14,700	0%
NE Middle	6,200	-17%	11,200	-24%
SW Middle	7,500	0%	14,600	-1%
SE Middle	7,100	-5%	12,400	-16%
NW Inner	7,500	0%	14,700	0%
NE Inner	6,400	-15%	12,600	-14%
SW Inner	7,500	0%	14,600	-1%
SE Inner	7,200	-4%	13,300	-10%

Table 24: Percent Trucks Removed

Scenarios	2020		2040	
	Truck	%Truck Change	Truck	%Truck Change
No Build	3,200	_	3,800	_
Outer Loop	2,200	-31%	2,400	-37%
Middle Loop	1,800	-44%	2,100	-45%
Inner Loop	2,500	-22%	2,800	-26%
NW Outer	3,200	0%	3,800	0%
NE Outer	2,400	-25%	2,900	-24%
SW Outer	3,200	0%	3,700	-3%
SE Outer	3,000	-6%	3,400	-11%
NW Middle	3,200	0%	3,800	0%
NE Middle	2,000	-38%	2,500	-34%
SW Middle	3,200	0%	3,800	0%
SE Middle	3,000	-6%	3,300	-13%
NW Inner	3,200	0%	3,800	0%
NE Inner	2,600	-19%	3,100	-18%
SW Inner	3,200	0%	3,800	0%
SE Inner	3,100	-3%	3,600	-5%

The level of service (LOS) required some extra steps:

- Existing arterials were identified for each quadrant; and
- The no-build traffic volumes for the year 2040, per segment of arterial, were compared with the equivalent volume for the model results with a concept in place. This was done for both the concept in its quadrant by itself and if the entire system was built.

From this, the Study Team was able to tell how much traffic was reduced by each concept on the congested roads within each quadrant, and whether or not the concept distance relative to the core of Boerne modified those results (**Table 25** and **Table 26**). For example, in **Table 25**, the further the Southwest concept is to the core of Boerne, the better it performed.

Table 25: Reasonable Percent Removed on Existing Effected Roadways

% REMOVED ON EXISTING EFFECTED ROADWAYS (2040)				
QUAD	CONGESTED ROADS	Outer % REM	Middle % REM	Inner % REM
NW	% Removed from West SH 46	35%	23%	40%
NE	% Removed from North Main/East SH 46	23%	28%	18%
SW	% Removed from West SH 46	47%	38%	11%
SE	% Removed from South Main/East SH 46	10%	15%	9%
FULL LOOP	% Removed from SH 46 and Main Street	21%	27%	22%

Table 26: Average Volumes on Reasonable Concepts

AVERAGE VOLUMES ON REASONABLE CONCEPTS (2040)						
QUAD	Outer		Middle		Inner	
	Independent	Full Loop	Independent	Full Loop	Independent	Full Loop
NW	5001	1504	5387	4447	8095	9168
NE	7770	7595	11236	11229	12461	13253
SW	10452	11098	8653	8926	3844	2575
SE	14630	14281	11253	10179	7212	9126

5.2.6. RESULTS

As a result of the public involvement, fatal flaws analysis, and further engineering analysis, the universe of concepts were narrowed down to three concepts in each quadrant, resulting in a total of 12 concepts.

The reasonable concepts started from the available options of the universe of concepts. Viable working group suggestions were incorporated, and the concepts were continually modified to reduce impacts. The goal was to create the best, least impactful version of each corridor for future comparison.

The criteria results of all of the concepts were updated periodically to evaluate the impacts so that the team could continue to reduce them where feasible. This process had a significant impact on the outer concept in the southeast quadrant. Of the two options suggested by the working group to connect the new corridor to FM 3351 via Ammann Rd., the more southern option impacted over 20 residential structures while the northern option impacted only four. The Study Team considered that a fatal flaw of the southern option and proceeded to incorporate the northern option as part of the outer concept. **Table 27** is a sample of working criteria results. As a reminder, these were the criteria that the public found most important.

Table 27: Sample of Working Criteria Results

Public's Top 3 Criteria Results	Panel 2 Northeast			
	Outer	Middle	Inner	No-Build
Environmental				
Known Geologic & Recharge Features (#)	0	0	0	0
Stream Crossings (#)	16	12	8	0
Air Quality (Congested Traffic Volume)	61083	54217	56158	89036
Engineering				
Level of Service (% of Congestion Removed)	31%	39%	37%	0%
Time Reduced (%)	56%	44%	33%	0%
Drainage (Flood Zone acres)	0.0	2.1	7.1	0

Other Significant Criteria Results	Panel 2 Northeast			
	Outer	Middle	Inner	No-Build
Environmental				
Commerical Displacements (#)	0	3	1	0
Residential Displacements (#)	9	5	21	0
Engineering				
Right of Way (acres)	317	243	166	0
Parcels Affected (#)	56	65	66	0

The 12 remaining concepts (**Figure 31**) were refined, the criteria results were updated, and all findings were prepared for public presentation for additional input (see **Appendix D** for more criteria results).

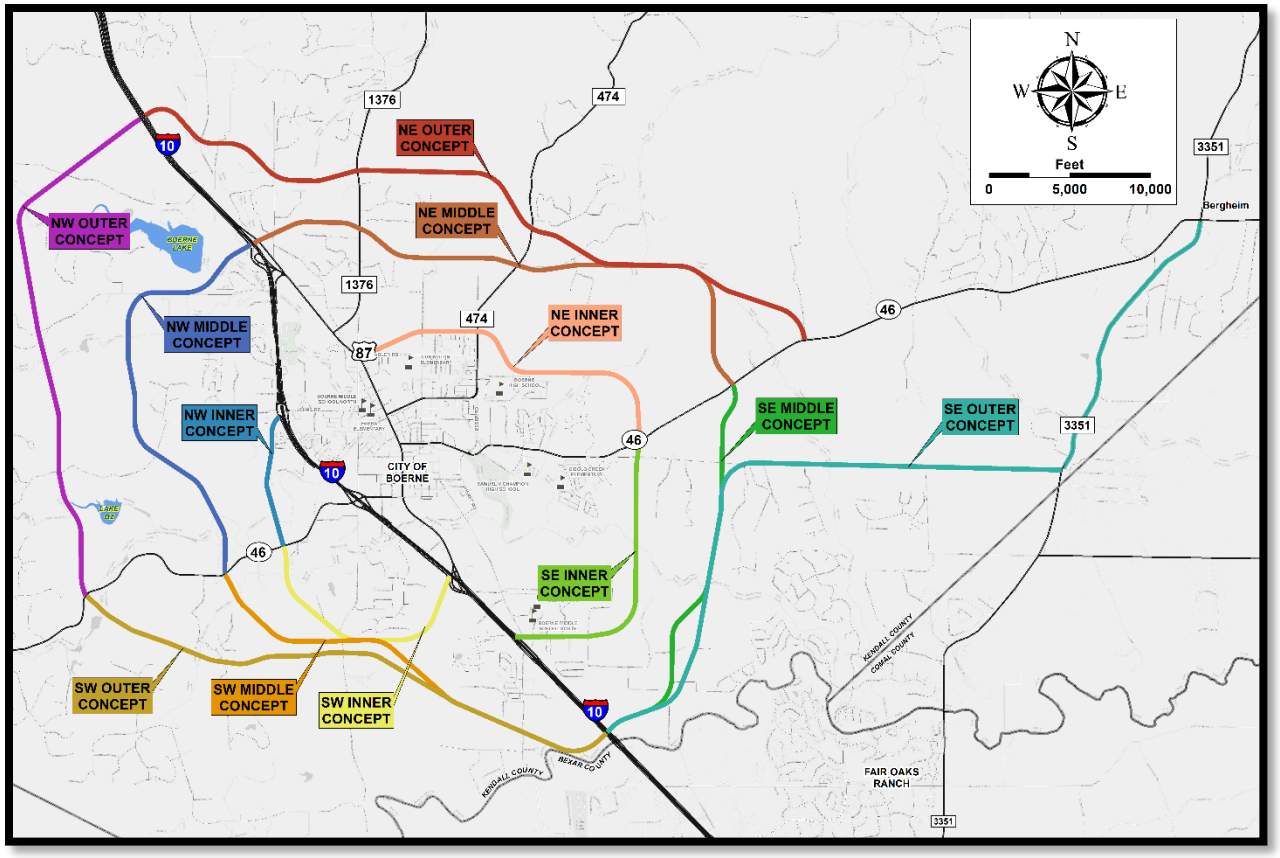

Figure 31: Reasonable Concepts Map

5.2.7. SECOND ROUND OF PUBLIC INVOLVEMENT

These reasonable concepts were then presented to the public at the second public open house. As seen in **Section 3.0** (and **Appendix D7**), the public was given multiple methods to comment. The traffic data were available as well as a summary of the public involvement process to date.

The MetroQuest survey (see **Appendix D8**) was utilized to gain more of an understanding of the public's thoughts, but also to help the public understand that there are challenging decisions in this process. From the feedback and comments received, the Study Team made modifications to some of the concepts. There was considerable feedback regarding Cascade Caverns and the concept that went over the property. Due to this, the most significant adjustment made was to realign the concept around the property. **Figure 32** and **Figure 33** illustrate the reasonable concepts and how public input guided modifications.

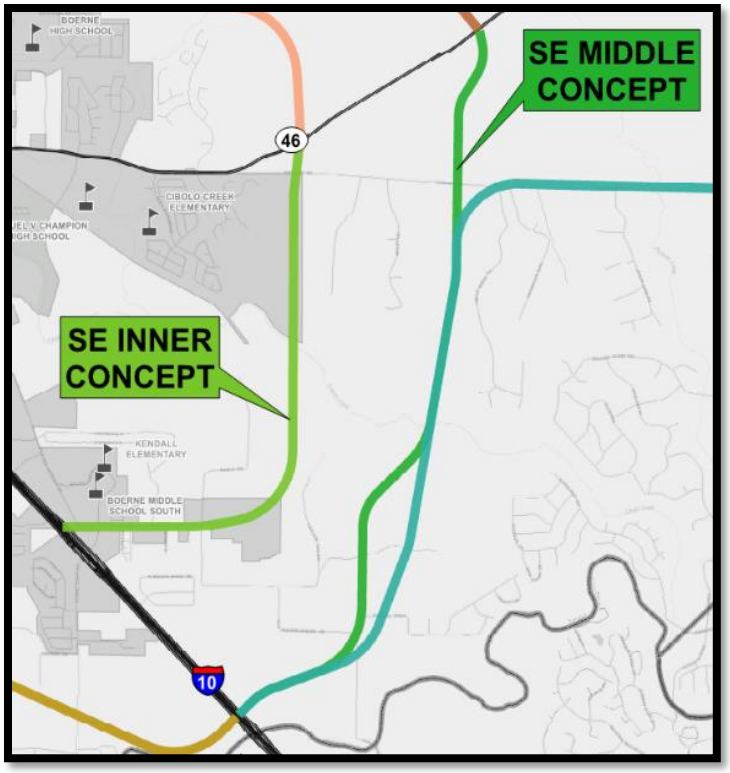

Figure 32: Reasonable Concepts Highlight

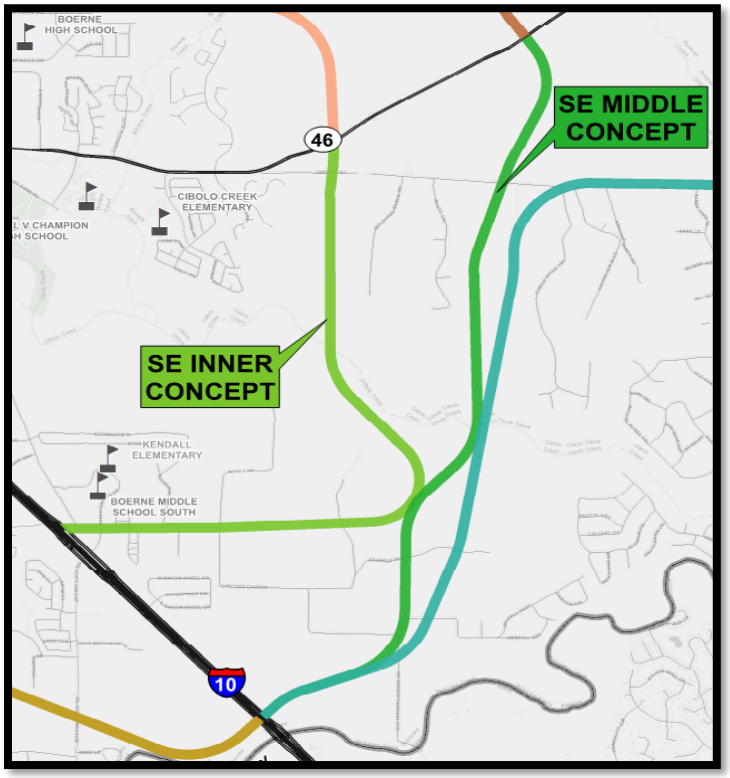

Figure 33: Modified Reasonable Concepts Highlight

The reasonable concepts were refined to continue reducing the impacts. The criteria results were updated again. No weight had been applied to the criteria so that the public could decide which was the most important. The quadrangle maps were prepared with the latest version of the reasonable concepts. **Figure 34** illustrates the modified reasonable concepts at the study area-level.

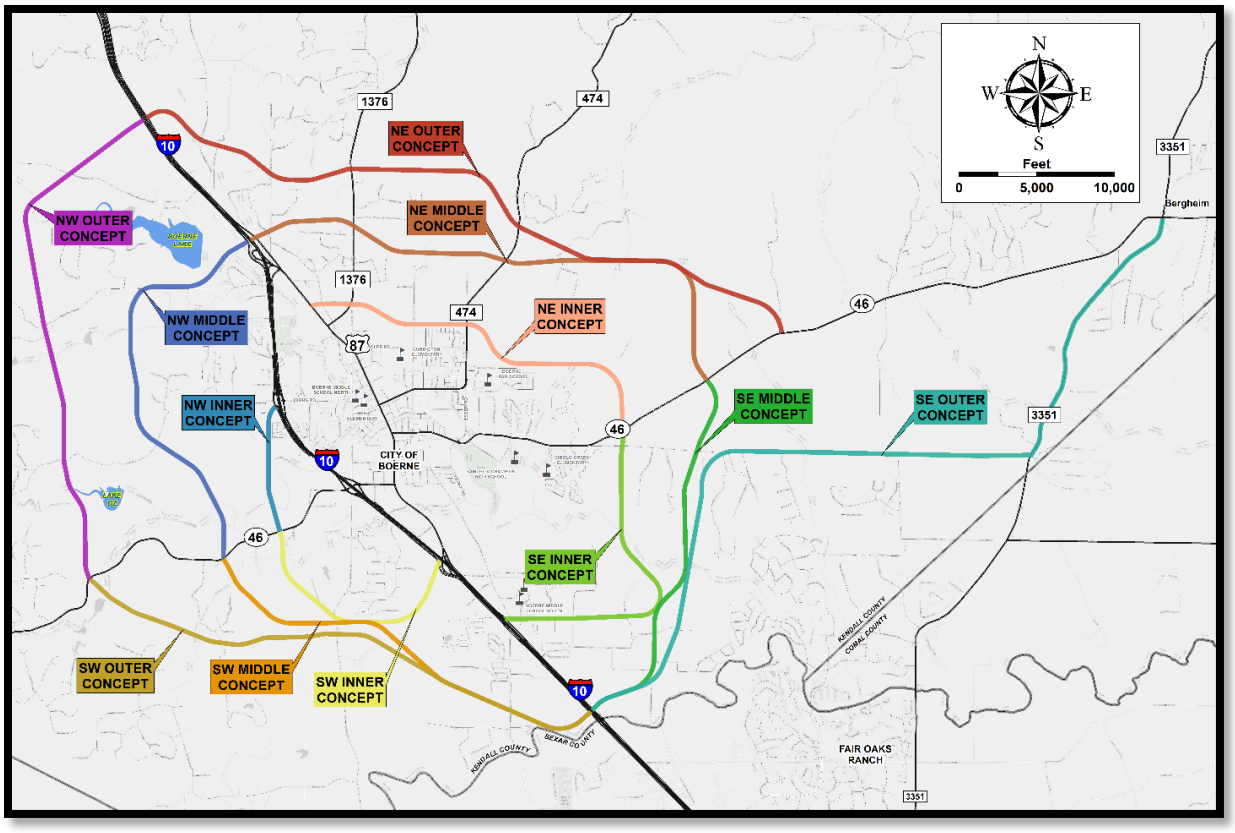

Figure 34: Modified Reasonable Concepts Map

5.3. RECOMMENDED CONCEPTS

The recommended concepts were the four concepts developed from public input, and a deeper engineering and environmental analysis. Each of the concepts met the purpose and need of the project and were refined to even further minimize potential environmental impacts.

5.3.1. PUBLIC INVOLVEMENT

In November 2017, the second open house meeting was held at Boerne Middle School South (see **Appendix D7**). There, the reasonable concepts were on display for the public to see and to make comments and suggestions. At the same time, an online interactive MetroQuest survey was offered to the public. Participants could rank their priorities and comment on each concept. This survey ended in December 2017 and received nearly 1,200 responses. Using this data, the reasonable concepts were modified to address applicable issues brought up from the public.

In February 2018, the fourth working group meeting was held (see **Appendix D9** and **Figure 35** below). This meeting began with an overview of public outreach activities, a traffic analysis summary, and a

summary of the modifications made to the concepts based on public comments received during the second public open house. The meeting also included a small group workshop. Seven tables were set up in the meeting room. Each table had one quadrant map laid out that illustrated three reasonable concepts. Participants selected the quadrant they were most interested in for the discussion.

Figure 35: Fourth Technical and SWG

The maps highlighted the evaluation criteria results for each concept (e.g. how many stream crossings and commercial/residential displacements per concept). Each table had a facilitator from the Study Team. Instructions for the workshop included:

- Pick a quad to focus on;
- Look at the maps;
- Assess impacts and improvements;
- Ask questions;
- Discuss as a group;
- Mark up maps;
- Recommend a concept or create a hybrid; and
- Reconvene in the large group during which each table group will present its recommendations.

Of the seven small groups that participated in this exercise, all recommended a concept. None of the groups chose the no-build option. All parties acknowledged that something needs to be done, despite the potential impacts, and that doing nothing is not an option.

The working group's suggestions were considered the primary screening tool to reduce the reasonable concepts down to the recommended concepts. The working group's recommendations are depicted in **Figure 36**.

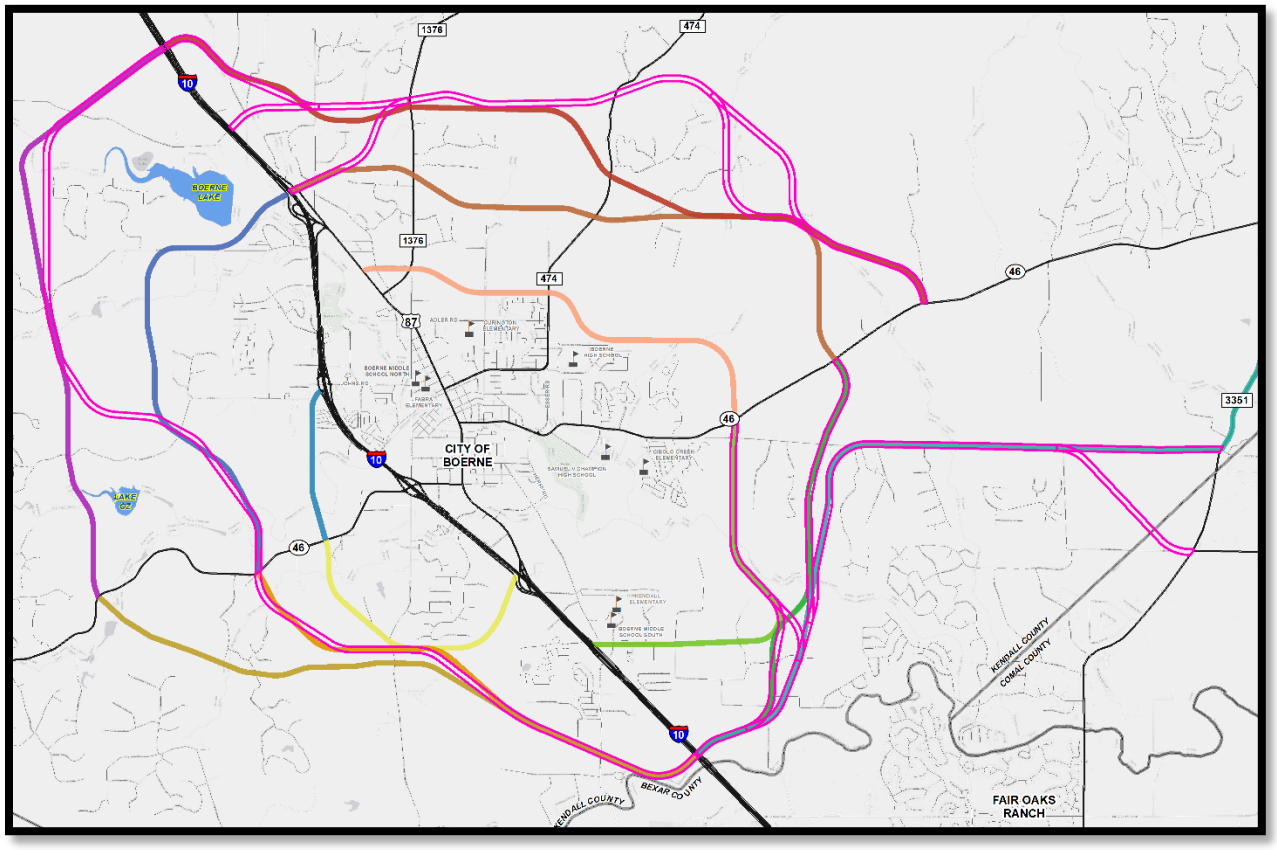

Figure 36: Recommendations from Technical and SWG #4

The following bullets summarizes the working group's findings for each quadrant. Of the seven groups, four groups were formed to analyze the southeast quadrant.

- **Northwest Quadrant**: The group's recommended concept was a hybrid of the Northwest Middle and Northwest Outer Concepts.
- **Northeast Quadrant**: The group's recommended concept was a hybrid of the Northeast Outer Concept; this hybrid concept is located farther out than the Northeast Outer Concept.
- **Southwest Quadrant**: The group's recommended concept was a hybrid of the Southwest Middle Concept.
- **Southeast Quadrant Group 1:** The group's recommended concept was a hybrid of the Southeast Middle and Outer Concept.
- **Southeast Quadrant Group 2:** The group's recommended concept was a hybrid of the Southeast Outer Concept or a hybrid of the Inner and Middle Concepts.

- **Southeast Quadrant Group 3**: This group suggests using existing roadways as much as possible. Recommended solutions provided by this group included:
  - Expand FM 3351 to four lanes plus a continuous left turn lane;
  - Expand SH 46 to four lanes plus a continuous left turn lane;
  - Choose a route that is straight across unimproved property; and
  - Preferred the Southeast Inner Concept with an optional connection to SH 46.
- **Southeast Quadrant Group 4**: Six of the eight group members prefer a hybrid to the Southeast Outer Concept, while the other two group members prefer a hybrid to the Southeast Inner Concept.

In May 2018, the recommended concepts were presented to the public at the third open house meeting at Boerne Middle School South (see **Appendix D10**). There, the public was able to see and to make comments and suggestions to the recommended concepts.

5.3.2. MATRIX CRITERIA AND RECOMMENDED CONCEPTS EVALUATION

The criteria results for all of the reasonable concepts were displayed and explained to the working group at the fourth meeting workshop. These results were taken under consideration when the groups deliberated and made recommendations pertaining to the recommended concepts. Of note, there were individual property owners in the working groups. The individual property owners made comments regarding their property. The Study Team collected and considered these comments; however, the individual property comments were not considered as working group comments.

Northwest Quadrant

Group's Recommendation: The group's recommended concept was a hybrid of the Northwest Middle and Northwest Outer Concepts.

Study Team's Approach: An engineered version of the suggestion was created and proposed for further evaluation. It had no fatal flaws and lined up well with the recommended concepts in the other quadrants. The concept was slightly modified to account for adverse terrain and reduce impacts (**Figure 37**).

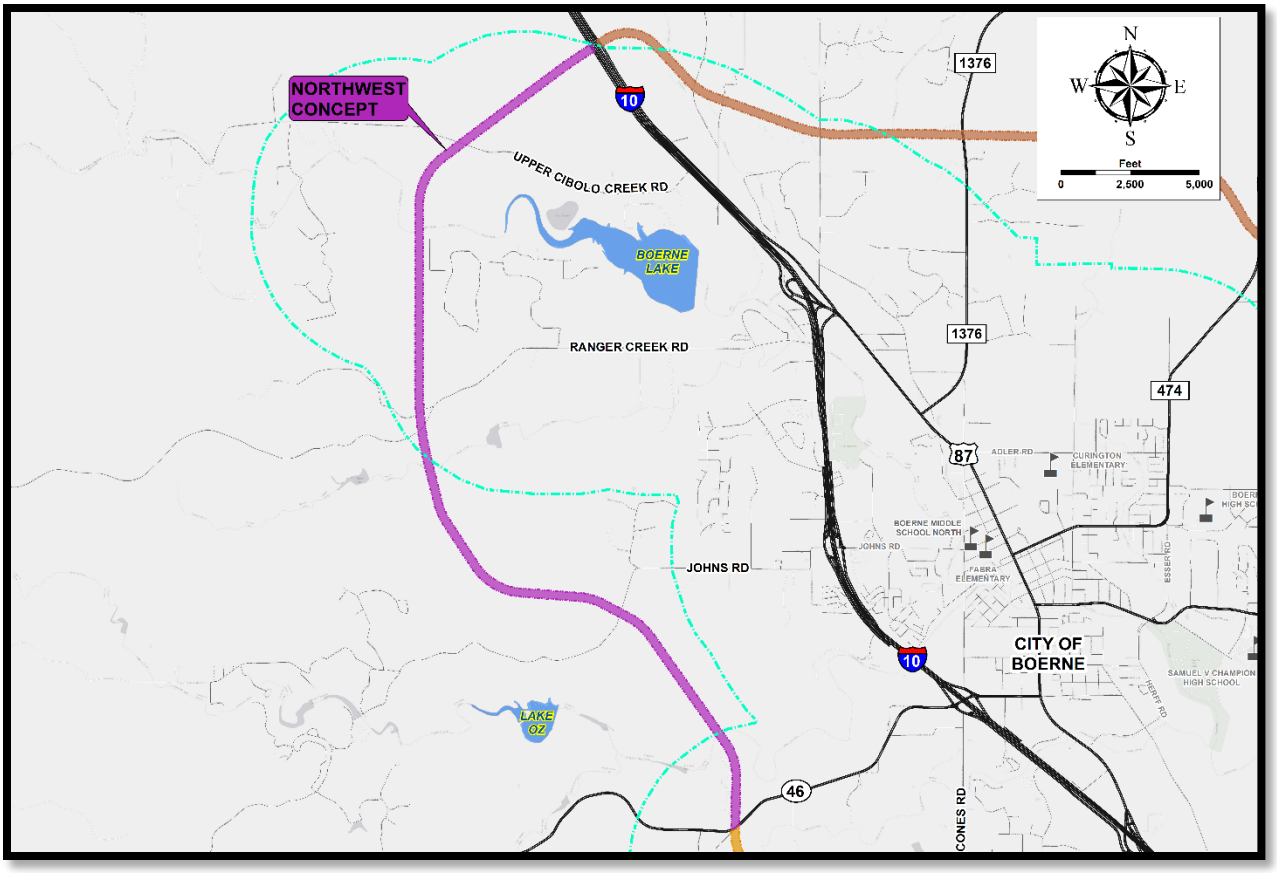

Figure 37: Northwest Recommended Concept

Northeast Quadrant

Group's Recommendation: The group's recommended concept was a hybrid of the Northeast Outer Concept; this hybrid concept is located farther out than the Northeast Outer Concept.

Study Team's Approach: An engineered version of the suggested outer concept drawn by this group was created and analyzed. The Study Team eliminated this recommendation due to the following reasons:

- Impacted more properties;
- Was in closer proximity to approximately seven more residences;
- Traversed more challenging terrain;
- Longer, therefore more expensive; and
- Slightly reduced performance.

The Study Team decided that the outer concept which impacted the fewest residences should be recommended. That concept was the Recommended Outer Concept with the eastern connection from the Middle Concept. The end points were coordinated with the adjacent concepts. The concept was slightly modified to account for adverse terrain and reduce impacts (**Figure 38**).

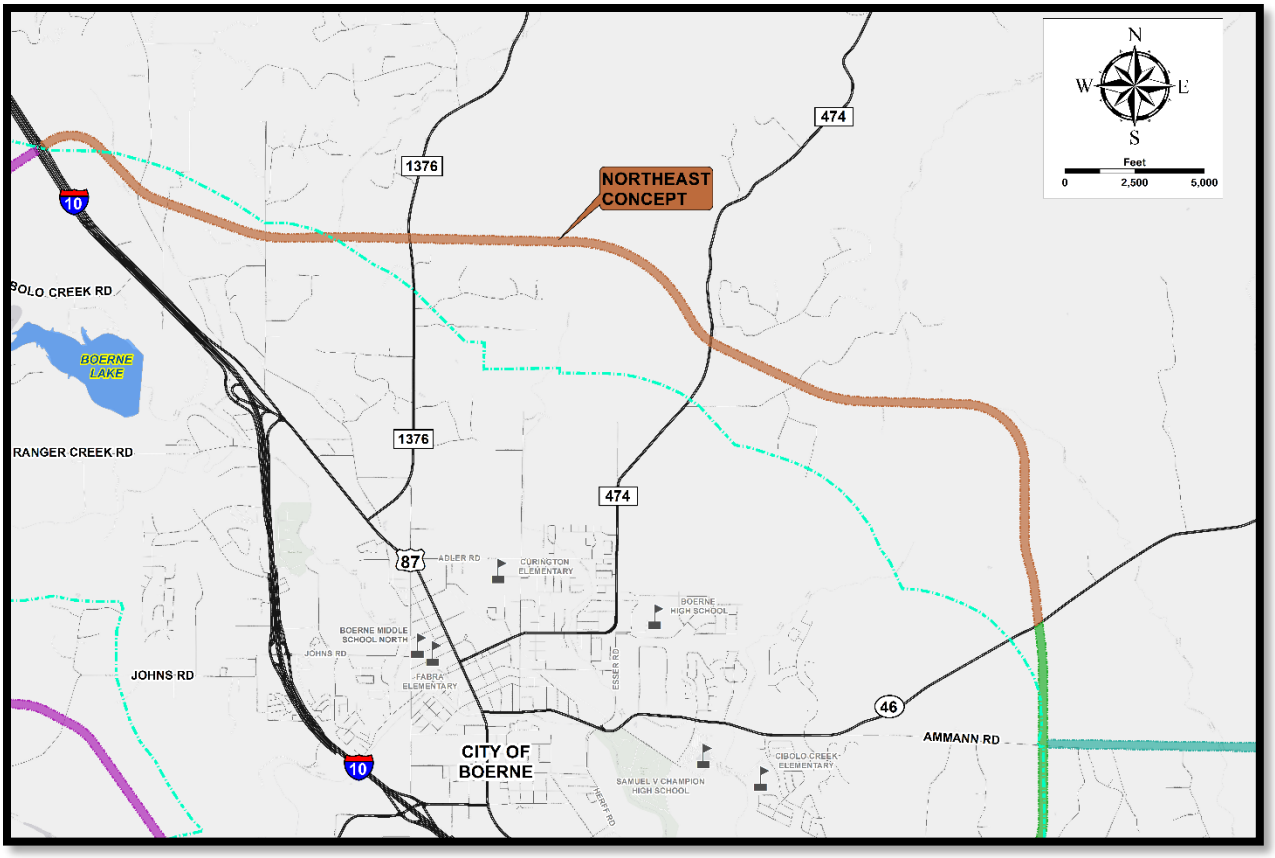

Figure 38: Northeast Recommended Concept

Southwest Quadrant

Group Recommendation: The group's recommended concept was a hybrid of the Southwest Middle Concept.

Study Team Approach: The Study Team considered suggestions to utilize some existing ROW along Upper Balcones Rd. and a hybrid concept was created that connected to the middle concept at its end points. The concept was slightly modified to account for adverse terrain and reduce impacts. The recommended concept utilized approximately one mile of Upper Balcones Rd. (**Figure 39**).

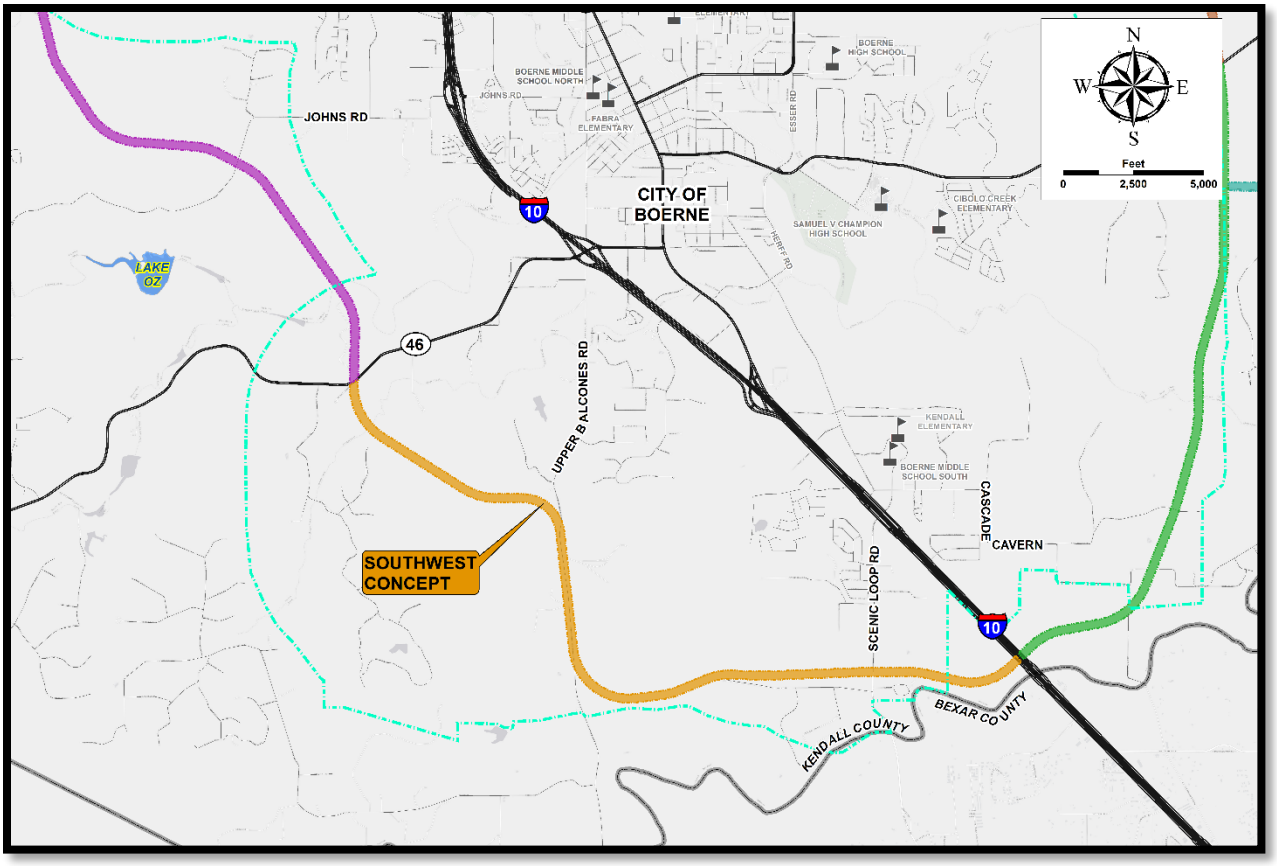

Figure 39: Southwest Recommended Concept

Southeast Quadrant

Group Recommendation: There were eight southeast quadrant suggestions from the four groups:

- A hybrid of the Southeast Middle and Outer Concepts;
- A hybrid of the Southeast Outer Concept;
- A hybrid of the Southeast Inner and Middle Concepts;
- A route that is straight across unimproved property connecting to FM 3351;
- A hybrid to the Southeast Inner and Middle Concepts;
- A hybrid of the Southeast Outer Concept that utilizes the FM 3351 connection and the Southeast Inner or Middle concept to connect to I-10; and
- A hybrid of the Southeast Middle Concept that utilizes either the Inner or Middle connection to I-10.

Study Team Approach: The Study Team discussed the multiple, varying suggestions from the working groups. With the inner concepts proximity to Cascade Caverns and its lower performance results, it was eliminated from further consideration. A hybrid version of the middle and outer concepts was developed that did not directly impact a single existing structure and connected efficiently with the adjacent quadrants. The Study Team also included the optional connection to FM 3351 as it was deemed important by most of the working groups (**Figure 40**).

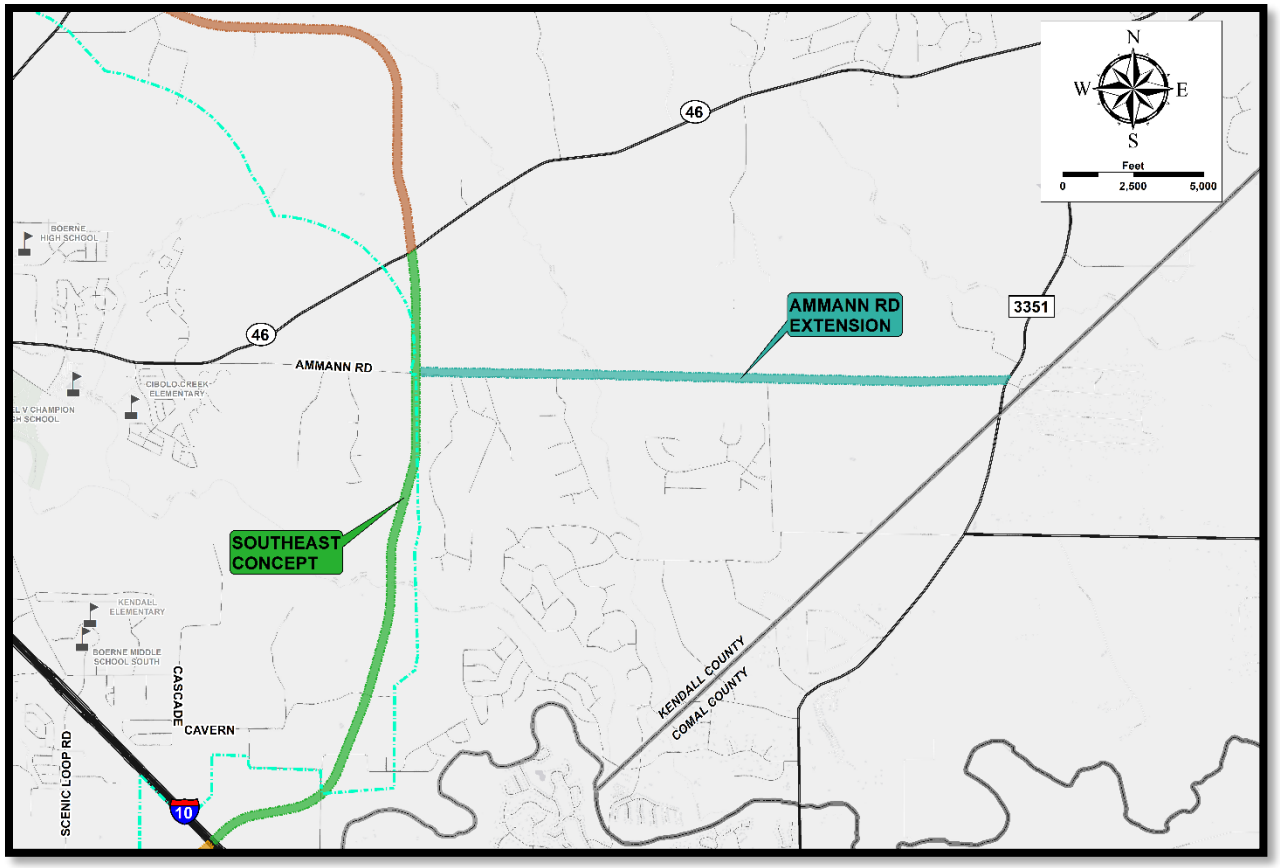

Figure 40: Southeast Recommended Concept

The final concepts were adjusted to capture the direction of the working groups as best as the Study Team deemed feasible and to minimize impacts. These were considered the recommended concepts. The same list of criteria was used to examine the recommended concepts as the reasonable concepts.

FM 3351 Concept

Many public comments suggested that widening FM 3351 alone would solve the purpose and need of this project. This was considered by the Study Team early on and analyzed.

The traffic analysis utilized the collected data and concluded that FM 3351 was already being utilized in this capacity. It was concluded that this is why the higher percentage of traffic going thru Boerne appears to be going north. A large portion of the southbound traffic is already using FM 3351.

The issue with utilizing FM 3351 is that it is too far from Boerne and the traffic that would benefit from it are already using it. Adding more lanes to FM 3351 showed no impact on the traffic going through Boerne. The growing congestion problem in Boerne is happening with a fully functional FM 3351 in place. If expansion of FM 3351 was the solution, travelers would not see any of the current traffic problems.

5.3.3. TRAVEL DEMAND MODELING

The same model that was used to measure the effectiveness of the reasonable concepts was updated to analyze the recommended concepts.

The results of the modeling are in **Appendix B** and **C**. The primary criteria that the model supports were:

- Time Reduced– percent change in time between common points, no-build versus concepts, from a TDM;
- Level of Service– percent ADT volume reduction from no-build traffic volumes along existing most congested major arterials; and
- Air Quality– the percent of trucks removed from existing congested roads.

The time reduced and percent trucks removed (air quality) could be extracted directly from the model as seen in **Table 28** and **Table 29**.

Table 28: Percent Trucks Removed

Scenarios	2020		2040	
	Truck	%Truck Change	Truck	%Truck Change
No Build	3,200	_	3,800	_
Full Loop	2,000	-38%	2,400	-37%
NW	3,200	0%	3,800	0%
NE	2,400	-25%	2,900	-24%
SW	3,200	0%	3,800	0%
SE	3,000	-6%	3,300	-13%

Table 29: VHT

Scenarios	2020		2040	
	VHT	%VHT Change	VHT	%VHT Change
No Build	7,500	_	14,700	_
Full Loop	5,800	-23%	10,200	-31%
NW	7,500	0%	14,700	0%
NE	6,500	-13%	12,300	-16%
SW	7,500	0%	14,600	-1%
SE	7,100	-5%	12,600	-14%

The LOS required some extra steps:

- Existing arterials were identified for each quadrant; and
- The no-build traffic volumes for the year 2040, per segment of arterial, were compared with the equivalent volume for the model results with the recommended concept in place. This was done for both the concept in its quadrant by itself and if the entire system was built.

From this, the Study Team was able to tell how much traffic was reduced by each concept on the congested roads within each quadrant, and with the full loop in place (**Tables 30** and **31**). For example, in the Southeast quadrant, the recommended concept on its own removed 13 percent of the traffic on the effected roadways. However, 23 percent of the traffic is removed in that area if the full loop is in place. While each concept on its own improves the level of service within each quadrant, the overall level of service in the Boerne area increased with the full loop in place.

Table 30: Recommended Percent Removed on Existing Effected Roadways

% REMOVED ON EXISTING EFFECTED ROADWAYS (2040)			
QUAD	CONGESTED ROADS	Recommended	
		Independent	Full Loop
NW	% Removed from West SH 46	9%	18%
NE	% Removed from North Main/East SH 46	23%	33%
SW	% Removed from West SH 46	17%	18%
SE	% Removed from South Main/East SH 46	13%	23%
FULL LOOP	% Removed from SH 46 and Main Street	-	23%

Table 31: Average Volumes on Recommended Concepts

AVERAGE VOLUMES ON RECOMMENDED CONCEPTS (2040)		
QUAD	Recommended	
	Independent	Full Loop
NW	2166	1813
NE	8039	8539
SW	8537	8544
SE	10325	12038

5.3.4. ENVIRONMENTAL RESOURCES

During the recommended concept analysis phase of the KGS, known environmental resources within each 300-ft concept were quantified. Results of this analysis is presented **Section 5.3.4.1**. **Appendix G** contains corresponding maps that depicted known resources occurring within and near the concepts such as: high mast transmission tower/lines, oil/gas pipelines, historical markers, cemeteries, family heritage sites, national registered historic properties, historic bridges, structures, creeks/streams, impaired waters, waterbodies, wetlands, designated floodway, 100-year floodplain, prime farmland soils, and parcels. None of the data presented in **Section 5.3.4.1** was verified from field surveys and only represents information that was obtained online or from public input.

Some resources presented in **Section 4.0** were not carried forward or quantified for the recommended route concepts, because field surveys would be needed to verify and quantify these resources and they were not part of the KGS. A survey-level investigation would be initiated should a project advance into further development during the NEPA compliance process.

5.3.4.1. ENVIRONMENTAL ANALYSIS OF RECOMMENDED CONCEPTS

Table 32 and **Table 33** illustrate that there were very few conflicts with major utilities such as pipelines and high mast electric transmission corridors. Less than two crossings would be needed for any of the recommended concepts. Major utility crossings are visually represented in **Appendix G.**

Table 32: Pipelines within Recommended Concepts

	Northeast	Northwest	Southeast	Southwest
Number of crossings	0	0	1	1

Source: BGE (2018)

Table 33: High Mast Transmission Corridors within Recommended Concepts

	Northeast	Northwest	Southeast	Southwest
Number of crossings	2	Through	0	0

Source: BGE (2018)

Impacts to structures (both residential and commercial) were quantified. Structures within 500-feet of a recommended concept are depicted in **Appendix G**. The Southwest Concept had the most potential structure impacts with a total of five. The recommended concept with the least amount of potential impacts to structures was the Northwest Concept (**Table 34**). Similar to the analysis of structural impacts, the Study Team quantified the total number of parcels each recommended concept would cross. The Northwest Concept performed the best, with only 30 parcels crossed. The Southeast Concept impacted the most parcels with a total of 56 (**Table 35**).

Table 34: Structures within Recommended Concepts

	Northeast	Northwest	Southeast	Southwest
Number of crossings	4	2	4	5

Source: BGE (2018)

Table 35: Recorded Parcels within Recommended Concepts

	Northeast	Northwest	Southeast	Southwest
Number of crossings	50	30	56	40

Source: BGE (2018)

As discussed in **Section 4.1.2.2.**, five farmland types occured within the study area according to the NRCS. **Table 36** depicts these five types and the total acreage occurring within each of the four recommended concepts. Focusing in on the prime farmland type, the Southeast Concept had the least impact. The Northwest Concept crossed the most prime farmland, with a total of 34 acres.

Table 36: Farmland Types within Recommended Concepts

Land Type	Northeast	Northwest	Southeast	Southwest
Non-Prime Farmland	281 Acres	197 Acres	266 Acres	110 Acres
Prime Farmland	22 Acres	34 Acres	0 Acres	28 Acres
Prime Farmland if Irrigated	10 Acres	20 Acres	46 Acres	78 Acres

Table 36: Farmland Types within Recommended Concepts

Land Type	Northeast	Northwest	Southeast	Southwest
Statewide Farmland	0 Acres	0 Acres	0 Acres	0 Acres
Statewide Farmland if Irrigated	0 Acres	6 Acres	0 Acres	0 Acres

Source: USDA (2018)

Table 37 summarizes the median household income within each of the recommended concepts by block group. Generally, the median household income within each of the four concepts ranged between $65,852 and $144,615. Data were also gathered to identify low income populations that occurred within each of the recommended concepts. As seen in **Table 38**, census data were obtained at the census tract level for each concept. None of the concepts had more than 10 percent of the population below the poverty line. As discussed in greater detail in **Section 4.1.4.2.**, the DHHS poverty guideline for a family of four in 2018 was $25,100. A four-person family earning below this amount is considered to be below the poverty line. The poverty guideline was compared to the median household income of the study area block groups from 2012 to 2016. No household exhibited a median household income below the poverty level.

Table 37: Median Household Income within Recommended Concepts

Concept	Block Group	Median Income
Northeast	9703.01 BG1	$66,823
Northeast	9704.02 BG2	$87,763
Northeast	9704.02 BG2	$144,615
Northeast	9704.02 BG4	$72,188
Northwest	9703.02 BG3	$65,852
Northwest	9703.02 BG2	$99,352
Southeast	9704.01 BG1	$84,389
Southeast	9704.01 BG3	$99,262
Southwest	9704.01 BG2	$107,653
Southwest	9703.02 BG3	$65,852

Source: U.S. Census, ACS, 2012-2016 "Median Household Income in 2016 Inflation-Adjusted Dollars" (B19013).

Table 38: Low Income Population within Recommended Concepts

Concept	Census Tract	Population for Whom Poverty Status is Determined	Persons Below Poverty	Percentage of Population Below Poverty
Northeast	9703.01	5,490	313	6

Table 38: Low Income Population within Recommended Concepts

Concept	Census Tract	Population for Whom Poverty Status is Determined	Persons Below Poverty	Percentage of Population Below Poverty
	9704.02	7,022	505	7
Northwest	9703.02	4,064	204	5
Southeast	9704.01	8,715	233	3
Southwest	9704.01	8,715	233	3
	9703.02	4,064	204	5

Source: U.S. Census, ACS, 2012-2016 "Poverty Status in the Past 12 Months" (S1701).

Water resources were analyzed for the recommended concepts. The Study Team reviewed impacts to surface water (rivers/streams/creeks, waterbodies, and wetlands), water wells, and FEMA floodways/floodplains. As seen in **Table 39**, there were very few recorded water wells that occurred within any of the recommended concepts. Only one well occured within the Northeast Concept, and only two occured within the Northwest, Southeast, and Southwest Concepts. There were numerous streams and creeks around the City of Boerne and Kendall County, with Cibolo Creek being one of the most prominent. Therefore, it was difficult to avoid all water features.

Table 39: Recorded Water Wells within Recommended Concepts

Database	Northeast	Northwest	Southeast	Southwest
Submitted Driller's Reports Database	1	2	2	1
Groundwater Database Wells	0	0	0	1

Note: Counts above could reflect wells that appear in multiple databases

As seen in **Table 40**, within the 300-foot wide corridor of each of the recommended concepts, there were between 3,140 linear feet and 5,934 linear feet of streams that occurred within the concepts. Wetlands and waterbodies were quantified by acreage. According to data from National Hydrography Dataset (NHD) and USFWS, no forested or emergent wetlands occured within the concepts. No waterbodies were mapped in the concepts either.

Table 40: Surface Waters Mapped within Recommended Concepts

Feature Type	Northeast	Northwest	Southeast	Southwest
NHD Rivers/Streams/Creeks	4,289 feet	5,934 feet	4,430 feet	3,140 feet
NHD Waterbody	0 acres	0 acres	0 acres	0 acres
NWI Wetlands	0 acres	0 acres	0 acres	0 acres

Source: NHD (2017), USFWS (2017)

Finally, FEMA floodplain data were reviewed to quantify the amount of floodway/floodplain that occurred within the concepts. Only the Northwest Concept crossed designated floodway. The Northeast Concept performed the best, with no floodway or floodplain occurring within the limits of the concept (**Table 41**).

Table 41: FEMA Floodplains within Recommended Concepts

Watershed	Northeast	Northwest	Southeast	Southwest
Designated Floodway	0 acres	1.09 acres	0 acres	0 acres
100-year Floodplain (studied base flood elevation)	0 acres	0 acres	0 acres	0.51 acres
100-year Floodplain (unstudied base flood elevation)	0 acres	3.4 acres	4.7 acres	7.82 acres

Source: FEMA (2017)

TPWD EMST data were reviewed. Generally, all four recommended concepts were dominated by the Edwards Plateau Savannah, Woodland, and Shrubland vegetation type as shown in **Table 42**. The Northwest Concept had the most Riparian vegetation and the Southwest Concept had the least, with a total of 8.8 acres mapped within the limits of the concept.

Table 42: TPWD EMST MOU Classification within Recommended Concepts

Name	Northeast	Northwest	Southeast	Southwest
Edwards Plateau Savannah, Woodland, and Shrubland	298.2 acres	234.0 acres	285.2 acres	201.5 acres
Urban	4.6 acres	1.6 acres	4.1 acres	3.3 acres
Riparian	12.2 acres	23.8 acres	12.3 acres	8.8 acres
Disturbed Prairie	3.7 acres	3.1 acres	8.6 acres	1.5 acres
Agriculture	2.2 acres	3.8 acres	0.2 acres	0 acres

Source: TPWD (2017)

Similar to the findings in **Section 4.4.3**., all species identified by TPWD and the USFWS lists of rare, threatened, endangered, and candidate species had the potential to occur within any of the four recommended concepts (**Table 43** and **Table 44**). According to the online USFWS critical habitat for threatened and endangered species map, no critical habitat was within any of the recommended concepts.

Table 43: USFWS Federal List of Threatened, Endangered, and Candidate Species

Name	Listing Status
San Marcos Salamander (*Eurycea nana*)	Threatened
Texas Blind Salamander (*Typhlomolge rathbuni*)	Endangered

Table 43: USFWS Federal List of Threatened, Endangered, and Candidate Species

Name	Listing Status
Bracken Bat Cave Meshweaver *(Cicurina venii)*	Endangered
Cokendolpher Cave Harvestman (*Texella cokendolpheri)*	Endangered
Government Canyon Bat Cave Meshweaver (*Cicurina vespera)*	Endangered
Government Canyon Bat Cave Spider (*Neoleptoneta microps)*	Endangered
Madla's Cave Meshweaver (*Cicurina madla)*	Endangered
Robber Baron Cave Meshweaver (*Cicurina baronia)*	Endangered
Golden-cheeked Warbler (*Setophaga chrysoparia)*	Endangered
Least Tern (*Sterna antillarum*)	Endangered
Piping Plover (*Charadrius melodus*)	Threatened
Red Knot (*Calidris canutus rufa)*	Threatened
Whooping Crane (*Grus Americana*)	Endangered
Golden Orb (*Quadrula aurea*)	Candidate
Texas Fatmucket (*Lampsilis bracteate*)	Candidate
Texas Fawnsfoot (*Truncilla macrodon*)	Candidate
Texas Pimpleback (*Quadrula petrina*)	Candidate
Peck's Cave Amphipod (Stygobromus *Stygonectes) pecki*)	Endangered
Fountain Darter (*Etheostoma fonticola*)	Endangered
Bracted Twistflower (*Streptanthus bracteatus*)	Candidate
Texas Wild-rice (*Zizania texana*)	Endangered
Tobusch Fishhook Cactus (*Sclerocactus brevihamatus ssp. Tobuschii*)	Threatened
[no Common Name] Beetle (*Rhadine exilis)*	Endangered
[no Common Name] Beetle (*Rhadine infernalis)*	Endangered
Comal Springs Dryopid Beetle (*Stygoparnus comalensis)*	Endangered
Comal Springs Riffle Beetle (*Heterelmis comalensis)*	Endangered
Helotes Mold Beetle (*Batrisodes venyivi)*	Endangered

Source: U.S. Fish & Wildlife Service IPaC Resource List (generated May 23, 2018)

Table 44: TPWD County List of Rare Species for Kendall County and Bexar County

Name	Listing Status
Cascade Caverns Salamander *(Eurycea latitans complex)*	Threatened
Comal blind Salamander *(Eurycea tridentifera)*	Threatened
American Peregrine Falcon *(Falco peregrinus anatum)*	Threatened
Arctic Peregrine Falcon (*Falco peregrinus tundrius)*	DL
Bald Eagle *(Haliaeetus leucocephalus)*	Threatened
Black-capped Vireo *(Vireo atricapilla)*	Endangered
Golden-cheeked Warbler *(Dendroica chrysoparia)*	Endangered
Interior Least Tern *(Sterna antillarum athalassos)*	Endangered
Peregrine Falcon (*Falco peregrinus)*	Threatened
Whooping Crane *(Grus americana)*	Endangered
Zone-tailed Hawk *(Buteo albonotatus)*	Threatened
Black Bear (*Ursus americanus*)	Threatened
Gray Wolf *(Canis lupus)*	Endangered
Red Wolf *(Canis rufus)*	Endangered
False Spike Mussel *(Quadrula mitchelli)*	Threatened
Golden Orb *(Quadrula aurea)*	Threatened
Texas Fatmucket *(Lampsilis bracteate)*	Threatened
Texas Pimpleback *(Quadrula petrina)*	Threatened
Cagle's Map Turtle *(Graptemys caglei)*	Threatened
Texas Horned Lizard *(Phrynosoma cornutum)*	Threatened

Source: Texas Parks & Wildlife Department, Wildlife Division, Diversity and Habitat Assessment Programs, Kendall County List of Texas Rare Species. (last revised August 8, 2018; accessed August 27, 2018)

5.3.5. RESULTS

The recommended concepts (**Figure 41**) were presented to the public at the third public meeting (**Section 3.5** & **Table 45**). Public comments were received and documented.

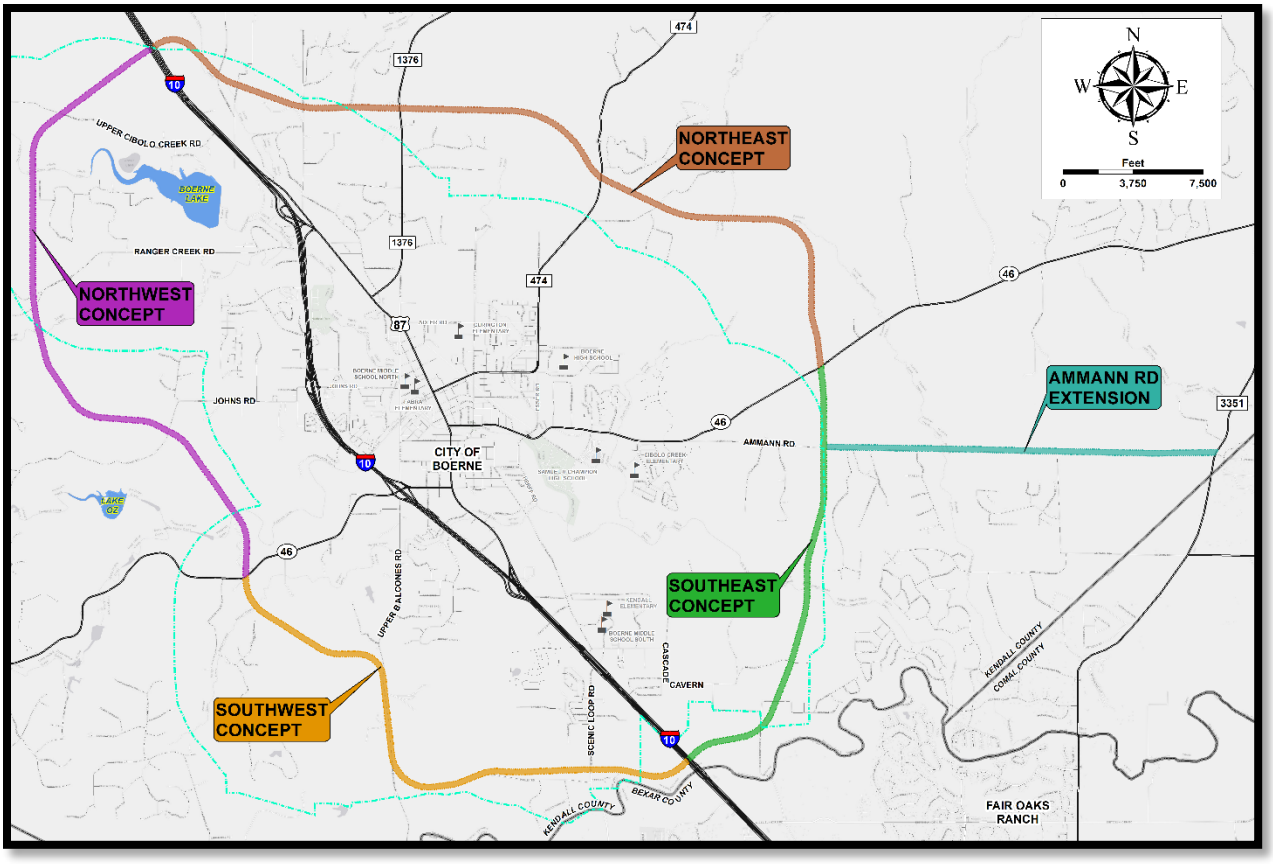

Figure 41: Recommended Concepts Map

Important results/benefits to highlight included:

- On average, the concepts removed almost 40 percent of the trucks traveling through Boerne in 2040.
- The recommended concepts provided an alternative route for traffic travelling on SH 46 through downtown Boerne with destinations elsewhere.
- The recommended concepts provided reduction of travel time inside the city core, estimated at 23 percent.
- The recommended concepts provided reduction of traffic on the existing effected roadways in the city core, estimated at 19 percent.
- The concepts did not substantially impact any known/identified geologic and recharge features.
- The concepts did not directly impact commercial establishments.
- The recommended concepts could be implemented independently and phased, beginning with a two-lane facility until travel demand warrants expansion.
- The 300-foot ROW width was selected for planning purposes only and can be narrowed/refined based upon subsequent detailed studies and local input.
- The recommended concepts provided east/west connectivity, additional capacity for the anticipated growth and redundancy within the roadway network, particularly critical for emergency services.

- Of the 26.1 miles of total proposed concepts, only nine structures were physically impacted. Of those nine, four appeared to be sheds or barns and are not residential.
- The concepts all had a positive impact on congestion in Boerne, as stand-alone options, but performed more positively as a complete system.
- All of the concepts appeared to be utilized by more than just the pass-through traffic, increasing the overall accessibility of Boerne.

Table 45: Recommended Criteria Results

Criteria Results	Northwest	Northeast	Southwest	Southeast	Full Loop
Environmental					
*Known Geologic & Recharge Features (#)	0	0	0	0	0
*Stream Crossings (#)	10	14	10	5	39
*Air Quality (% Trucks Removed)	0%	24%	0%	13%	37%
Direct Commercial Impacts (#)	0	0	0	0	0
Direct Residential Impacts (#)	2	2	5	0	9
Engineering					
*Level of Service (% of Congestion Removed 2040 Within Each Quadrant Independent of Full Loop)	9%	23%	17%	13%	N/A
*Level of Service (% of Congestion Removed 2040)	0%	11%	1%	8%	19%
*Time Reduced (%)	0%	11%	1%	10%	23%
*Drainage (Flood Zone acres)	4	0	8	2	15
Right of Way (acres)	254	309	206	164	933
Parcels Affected (#)	30	50	40	33	153
Length of Roadway (miles)	7.0	8.6	5.9	4.6	26.1
* Public's Top 3 Criteria Results					

5.3.5.1. CONSTRUCTION COST ESTIMATES

The preliminary construction cost estimate was broken down into the four different and independent concepts with the estimated total costs for each of them. The grand total preliminary cost of the interim two-lane construction was estimated at $86 million. The grand total preliminary cost of the ultimate four-lane construction was estimated at $152 million. These were calculated based on the typical sections discussed in **Section 5.1.1.**, using the average bid costs from TxDOT San Antonio District along with statewide data (see **Appendix I**). Drainage costs were estimated at 10 percent of construction cost, mobilization was estimated at 8 percent of construction cost, and overall contingency was estimated at 20 percent of construction cost. These costs were used for comparison purposes only and may vary in the future with final design and construction of the concept. None of the estimates included the cost of procuring the right-of-way or engineering.

Interim – Two-lane

The interim concept would consist of an undivided, two-way roadway (one lane each direction). To meet TxDOT standards, the travel lanes and shoulders would be 12 feet and eight feet wide, respectively, adding up to a roadway width of 40 feet. All intersections would be at-grade with signalized intersections at major collector crossings. During this phase, the 300-foot ROW was assumed to be procured, and that cost was not included in this preliminary estimate. Each concept was independent of each other, but if all concepts were chosen for construction, the grand total of the concepts is $86 million (**Table 46**).

Table 46: Preliminary Cost Estimate – Interim 2-Lanes

PRELIMINARY COST ESTIMATE - INTERIM 2 LANES					
Roadway Element		**Northwest**	**Northeast**	**Southwest**	**Southeast**
Roadway:		$ 8,480,000	$ 10,420,000	$ 7,170,000	$ 5,510,000
Earthwork:		$ 5,080,000	$ 6,190,000	$ 4,260,000	$ 3,290,000
Bridges:		-	-	-	$ 450,000
TCP:		$ 140,000	$ 140,000	$ 140,000	$ 140,000
Preparing ROW:		$ 850,000	$ 1,040,000	$ 720,000	$ 560,000
Drainage:		$ 1,560,000	$ 1,990,000	$ 1,390,000	$ 1,100,000
Misc:		$ 1,240,000	$ 2,300,000	$ 1,710,000	$ 1,170,000
SUB TOTAL:		**$ 17,500,000**	**$ 22,000,000**	**$ 15,500,000**	**$ 12,000,000**
Mobilization:	8%	$ 1,400,000	$ 1,760,000	$ 1,240,000	$ 960,000
Contigency:	20%	$ 3,500,000	$ 4,400,000	$ 3,100,000	$ 2,400,000
TOTAL:		**$ 22,500,000**	**$ 28,000,000**	**$ 20,000,000**	**$ 15,500,000**
GRAND TOTAL:			**$ 86,000,000**		

Ultimate – Four-lane

The ultimate concept would consist of a divided, four-lane roadway (two lanes each direction). To meet TxDOT standards, the travel lanes would be 12 feet wide, with the inside and outside shoulders being four feet and 10 feet wide, respectively, adding up to a total roadway width of 76 feet. All intersections would be at-grade with signalized intersections at major collector crossings. During this phase, the 300-foot ROW was assumed to be procured, and that cost was not included in this preliminary estimate. Each concept was independent of each other, but if all concepts were chosen for construction, the grand total of the concepts would be $152 million (**Table 47**).

Table 47: Preliminary Cost Estimate – Ultimate 4-Lanes

PRELIMINARY COST ESTIMATE - ULTIMATE 4 LANES					
Roadway Element		**Northwest**	**Northeast**	**Southwest**	**Southeast**
Roadway:		$ 15,700,000	$ 19,310,000	$ 13,290,000	$ 10,210,000
Earthwork:		$ 10,280,000	$ 12,520,000	$ 8,620,000	$ 6,650,000
Bridges:		$ -	$ -	$ -	$ 860,000
TCP:		$ 180,000	$ 180,000	$ 180,000	$ 180,000
Preparing ROW:		$ 850,000	$ 1,040,000	$ 720,000	$ 560,000
Drainage:		$ 2,810,000	$ 3,520,000	$ 2,440,000	$ 1,950,000
Misc:		$ 1,380,000	$ 2,470,000	$ 1,830,000	$ 1,260,000
SUB TOTAL:		**$ 31,200,000**	**$ 39,040,000**	**$ 27,080,000**	**$ 21,670,000**
Mobilization:	8%	$ 2,500,000	$ 3,120,000	$ 2,170,000	$ 1,730,000
Contigency:	20%	$ 6,240,000	$ 7,810,000	$ 5,420,000	$ 4,330,000
TOTAL:		**$ 40,000,000**	**$ 50,000,000**	**$ 34,500,000**	**$ 27,500,000**
GRAND TOTAL:			**$ 152,000,000**		

6.0 PRIORITIZATION OF CONCEPTS

6.1. QUANTITATIVE PRIORITIZATION

Many variables influenced the prioritization of the quadrant concepts. Which environmental and engineering criteria was the most important could vary greatly between all parties involved. To avoid subjectivity, the Study Team weighed the concepts against one another instead of assigning priority to each of the criteria. The rankings utilized an order of magnitude method that adjusts the percent score based on a comparative level of impact. The lower the score, the higher the priority (**Table 48**).

Table 48: Recommended Criteria Rank Results

Criteria Rank Results	Northwest	Northeast	Southwest	Southeast	Recommended First Phase
Environmental					
*Known Geologic & Recharge Features (#)	0%	0%	0%	0%	**Tie**
*Stream Crossings (#)	26%	36%	26%	13%	Southeast
*Air Quality (% Trucks Removed)	33%	12%	33%	22%	Northeast
Direct Commercial Impacts (#)	0%	0%	0%	0%	**Tie**
Direct Residential Impacts (#)	22%	22%	56%	0%	Southeast
Engineering					
*Level of Service (% of Congestion Removed 2040 Within Each Quadrant Independent of Full Loop)	28%	21%	24%	26%	Northeast
*Level of Service (% of Congestion Removed 2040)	33%	15%	32%	20%	Northeast
*Time Reduced (%)	33%	17%	32%	18%	Northeast
*Drainage (Flood Zone acres)	30%	0%	56%	13%	Northeast
Right of Way (acres)	27%	33%	22%	18%	Southeast
Parcels Affected (#)	20%	33%	26%	22%	Northwest
Length of Roadway (miles)	27%	33%	23%	18%	Southeast
Cost ($M)	26%	33%	23%	18%	Southeast
Concept Efficiency Factor ($M/%)	41%	20%	19%	20%	Southwest
Rank					
Total Score	3.48	2.74	3.72	2.07	**Southeast**
Rank	**3**	**2**	**4**	**1**	
* Public's Top 3 Criteria Results					

This method showed that the Southeast Concept (quadrant) was the best scoring concept when all criteria impacts were considered along with cost and concept efficiency. The prioritization would be:

1. Southeast
2. Northeast
3. Northwest
4. Southwest

6.1.1. CONCEPT EFFICIENCY FACTOR

The concept efficiency factor was used as a criterion to evaluate the return on investment per vehicle mile for each concept (quadrant). This was calculated by dividing the cost of the concept by the percent of traffic it removed from the existing affected roadways (**Table 49**).

Table 49: Concept Efficiency Factor

Concept Efficiency Factor	Northwest	Northeast	Southwest	Southeast
Cost ($M)	39.9	50.0	34.7	27.7
Level of Service (% of Congestion Removed 2040 Within Each Quadrant Independent of Full Loop)	9%	23%	17%	13%
Concept Efficiency Factor ($M/%)	**4.3**	**2.1**	**2.0**	**2.1**

6.1.2. QUALITATIVE PRIORITIZATION

The prioritization above was based solely on data results and did not incorporate engineering/planning judgement or weighting of any scores. Qualitative prioritization considered those results from a practical planning perspective.

The Southeast Concept received the best score overall. Qualitatively, this concept was the most appropriate to start with also because it had:

- Fewest stream crossings;
- No residential structures impacted;
- Greatest time reduction;
- Fewest ROW acres required;
- Shortest length; and
- Lowest cost.

The Bluetooth data showed that a majority of through-traffic coming from the east was going to the north. The Southeast Concept provided access for this movement as illustrated in **Figure 42**. The Study Team calculated the estimated time it would take a vehicle traveling from the east to the north if its only options were through town (no-build) or the Southeast Concept. The Southeast Concept would be a longer, but faster option. Most vehicles would choose the faster, less restricted option even if it is slightly longer. See **Appendix D8 [Section 3.2]** for the MetroQuest survey.

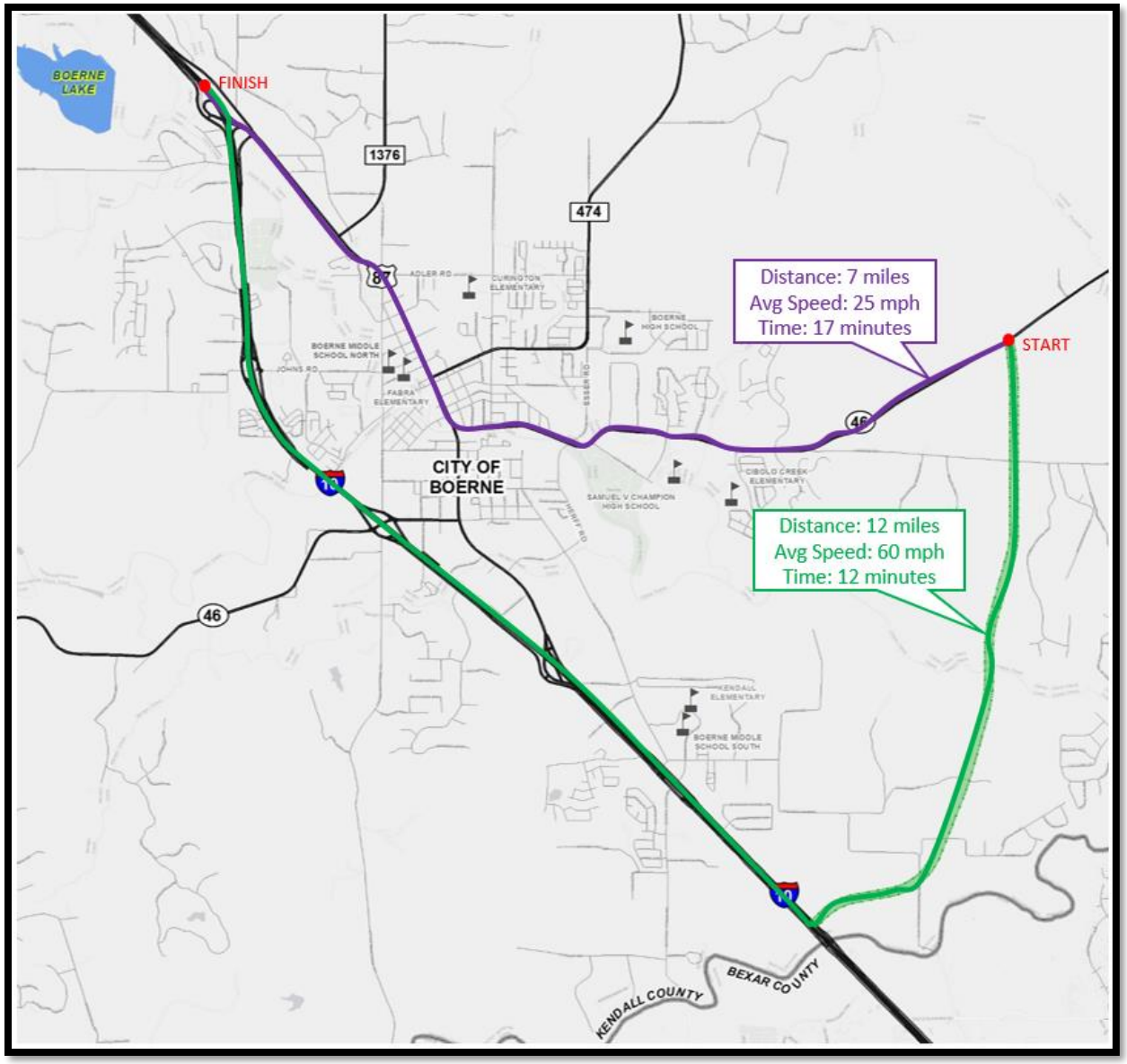

Figure 42: Using the Southeast Concept to go North

To address the lack of east-west corridors within the study area, the combination of Southeast and Southwest Concepts (southern concepts), illustrated in **Figure 43**, were further ranked and compared to the Northeast and Northwest Concept combination (northern concepts). The combined southern or northern concepts would provide the alternate east-west route to SH 46 around downtown Boerne and through the study area. The results are summarized in **Tables 50** and **51**.

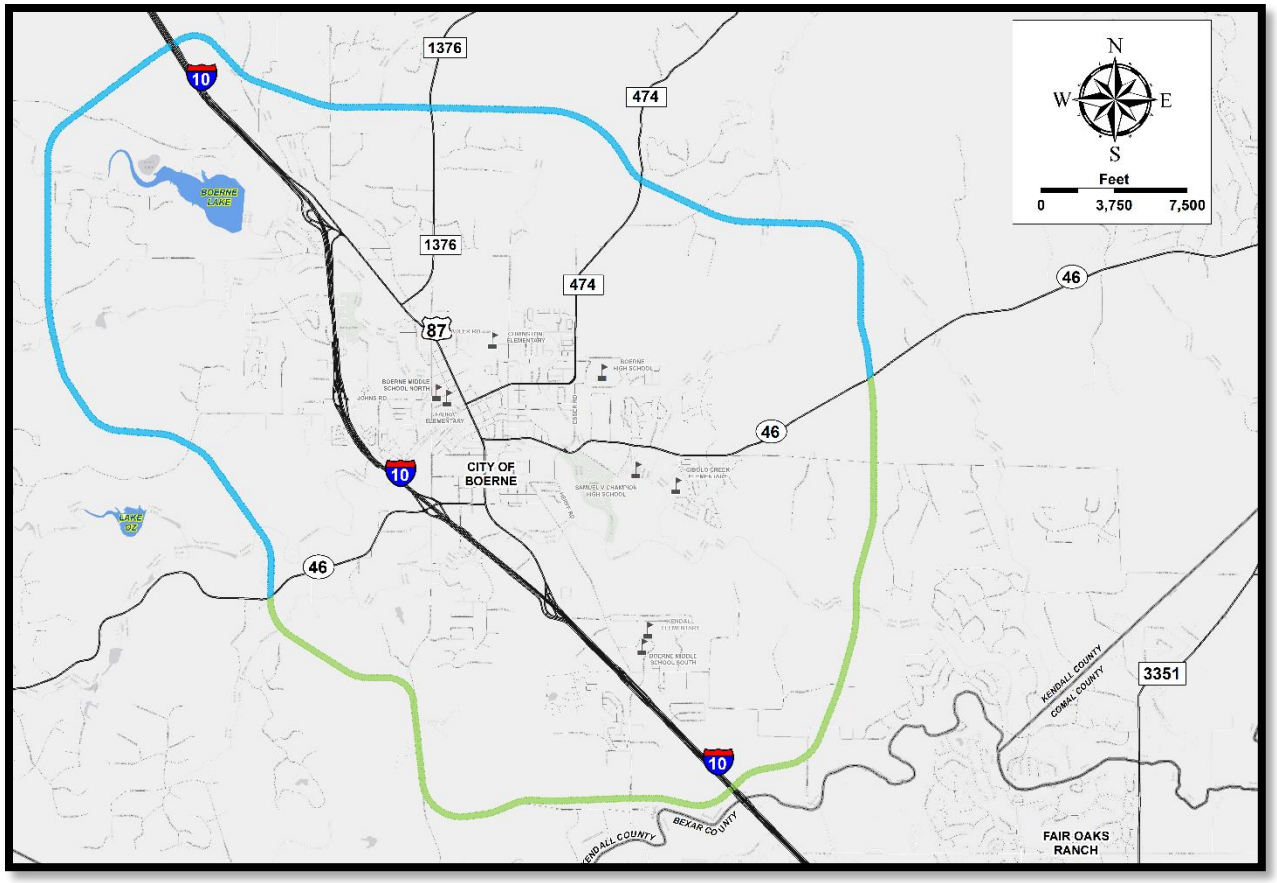

Figure 43: Recommended Northern vs. Southern Concepts Map

Table 50: Northern vs. Southern Criteria Results

Criteria Results	North	South
Environmental		
*Known Geologic & Recharge Features (#)	0	0
*Stream Crossings (#)	24	15
*Air Quality (% Trucks Removed)	24%	13%
Direct Commercial Impacts (#)	0	0
Direct Residential Impacts (#)	4	5
Engineering		
*Level of Service (% of Congestion Removed 2040 Within Each Quadrant Independent of Full Loop)	33%	30%
*Level of Service (% of Congestion Removed 2040)	11%	9%
*Time Reduced (%)	11%	11%
*Drainage (Flood Zone acres)	4	10
Right of Way (acres)	563	370
Parcels Affected (#)	80	73
Length of Roadway (miles)	16	10
Cost ($M)	$ 89.9	$ 62.4
Concept Efficiency Factor ($M/%)	2.8	2.1

Table 51: Northern vs. Southern Criteria Rank Results

Criteria Rank Results	North	South	Recommended First Phase
Environmental			
*Known Geologic & Recharge Features (#)	0%	0%	Tie
*Stream Crossings (#)	62%	38%	South
*Air Quality (% Trucks Removed)	35%	65%	North
Direct Commercial Impacts (#)	0%	0%	Tie
Direct Residential Impacts (#)	44%	56%	North
Engineering			
*Level of Service (% of Congestion Removed 2040 Within Each Quadrant Independent of Full Loop)	48%	52%	North
*Level of Service (% of Congestion Removed 2040)	45%	55%	North
*Time Reduced (%)	50%	50%	Tie
*Drainage (Flood Zone acres)	30%	70%	North
Right of Way (acres)	60%	40%	South
Parcels Affected (#)	52%	48%	South
Length of Roadway (miles)	60%	40%	South
Cost ($M)	59%	41%	South
Concept Efficiency Factor ($M/%)	57%	43%	South
Rank			
Total Score	6.03	5.97	South
Rank	2	1	
* Public's Top 3 Criteria Results			

Considering the results from the quantitative and qualitative prioritization exercise, the Study Team recommended the Southeast Concept be prioritized first, followed by the Southwest Concept and subsequently the Northeast and Northwest Concepts.

Individual Concept Phasing

Regardless of which of the four recommended concepts would be implemented first, they each have their own phasing possibilities. The following phasing plans could be utilized if the respective concept moves forward, but is unable to be fully constructed at one time.

Southeast Concept Recommendations (Figure 44)

1. Segment between Ammann Rd. and Old Fredericksburg Rd. provided east/west redundancy
2. Segment between SH 46 and Ammann Rd. provided connection to SH 46
3. Segment between Old Fredericksburg Rd. and I-10 provided connection to I-10

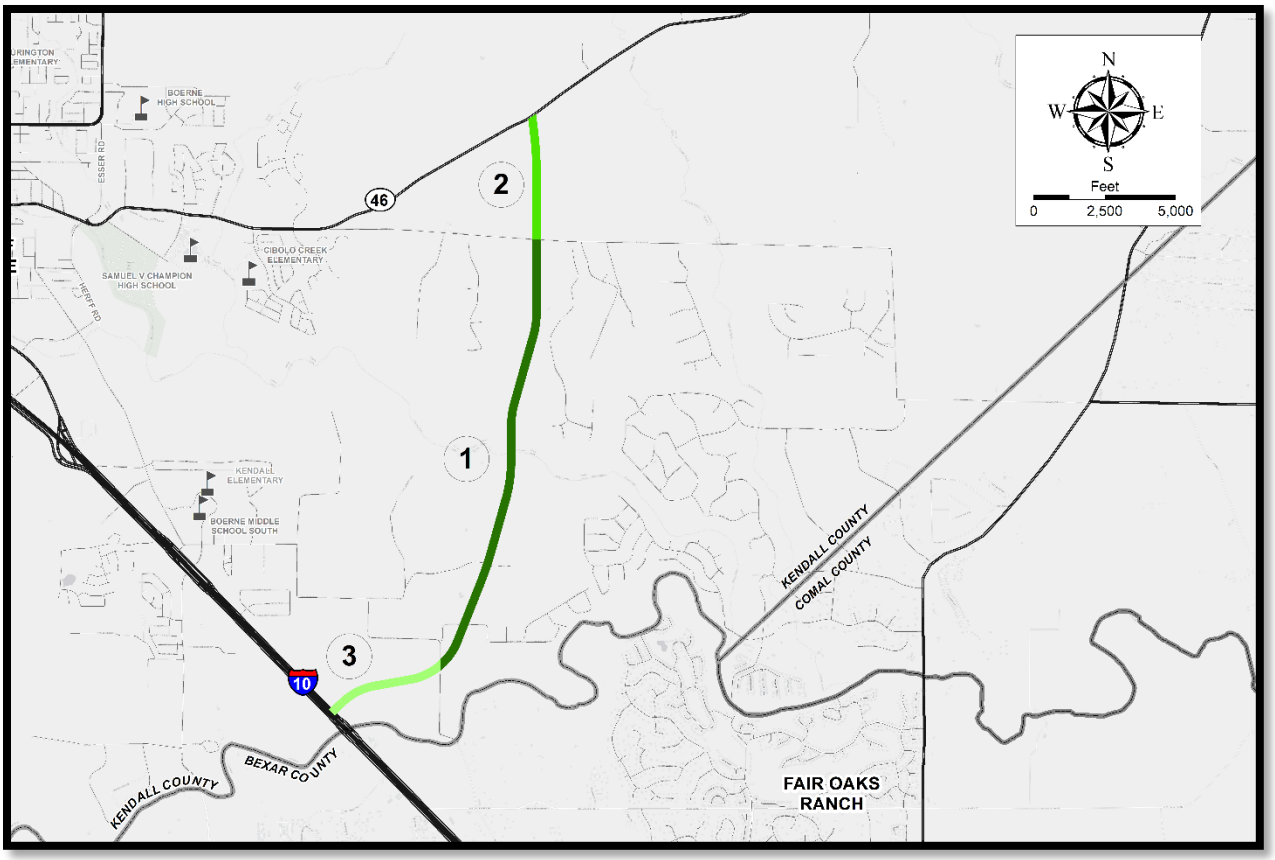

Figure 44: Recommended Concepts Southeast Phasing

Southwest Concept Recommendations (Figure 45)

1. Segment between SH 46 and Upper Balcones Rd. provided east/west redundancy
2. Segment between Upper Balcones Rd. and Scenic Loop Rd. extended east/west connection
3. Segment between Scenic Loop Rd. and I-10 provided connection to I-10

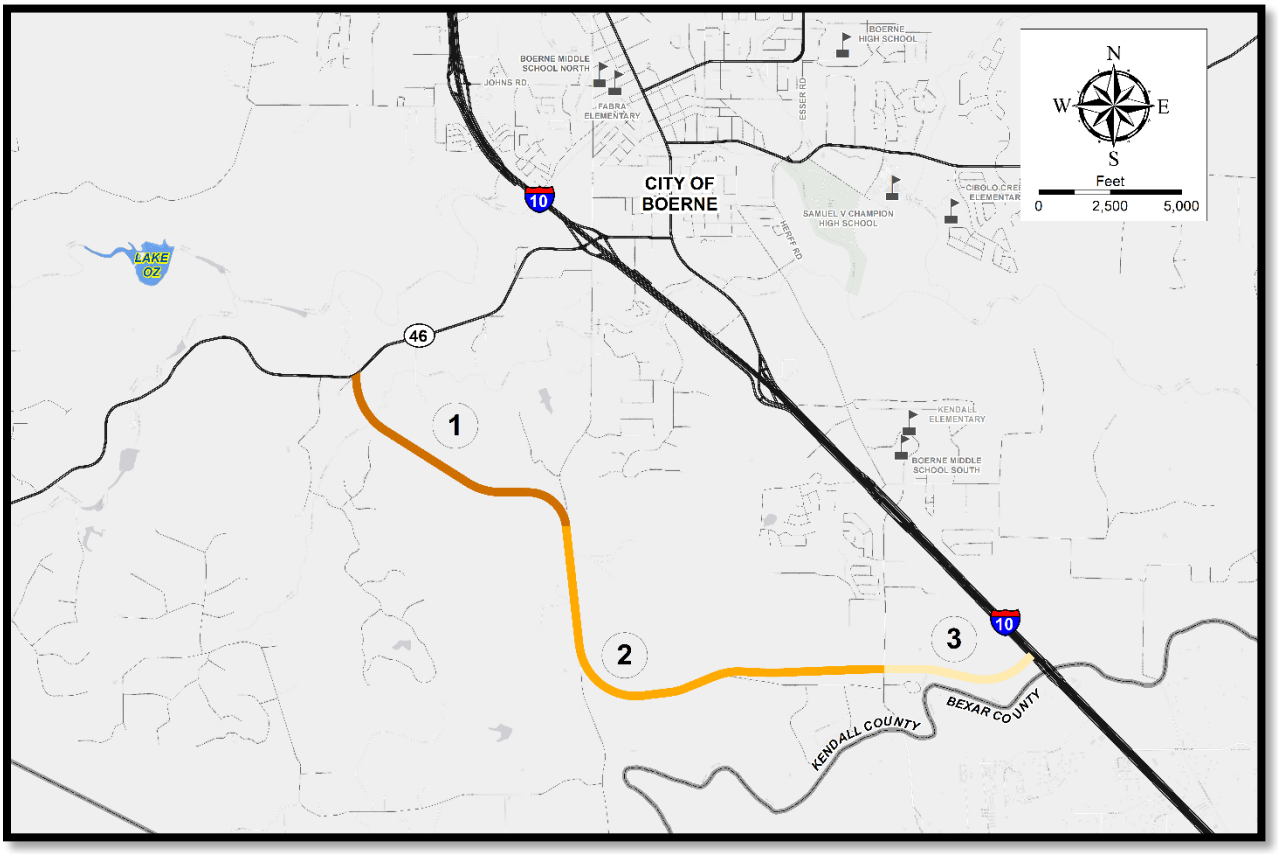

Figure 45: Recommended Concepts Southwest Phasing

Northeast Concept Recommendations (Figure 46)

1. Segment between SH 46 and FM 474 provided east/west redundancy
2. Segment between FM 474 and FM 1376 extended east/west connection
3. Segment between FM 1376 and I-10 provided connection to I-10

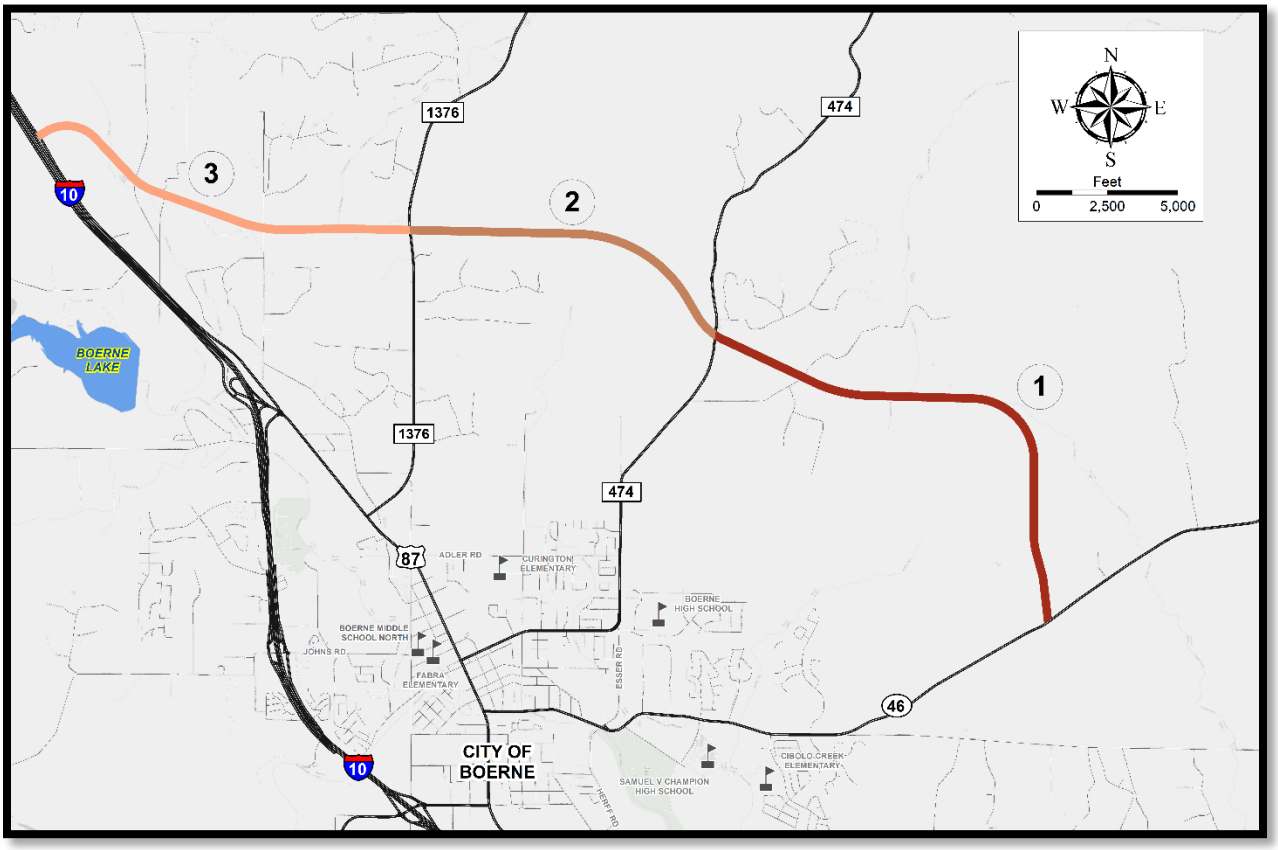

Figure 46: Recommended Concepts Northeast Phasing

Northwest Concept Recommendations (Figure 47)

1. Segment between SH 46 and Ranger Creek Rd. provided east/west redundancy
2. Segment between Ranger Creek Rd. and I-10 provided connection to I-10

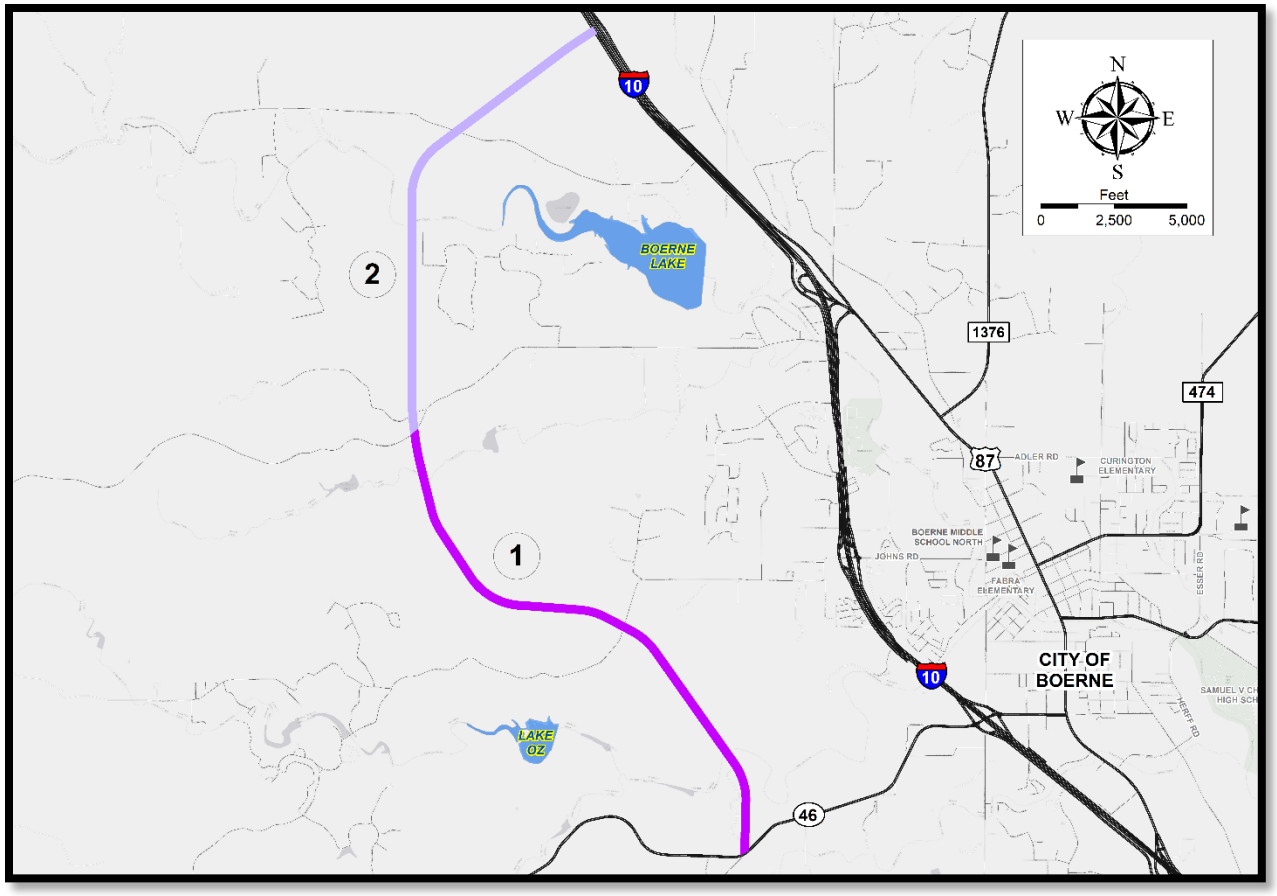

Figure 47: Recommended Concepts Northwest Phasing

7.0 INTERIM IMPROVEMENTS

In addition to the recommended concepts, the Study Team also considered other interim projects that could improve overall operations in the shorter term. The construction of any one of the recommended concepts is a long-range solution towards meeting the purpose and needs identified in the KGS. However, some short-range solutions could be implemented to better accommodate the local traffic in Boerne. These improvements included, but are not limited to, the following: widen existing roadways, add parking lots on currently vacant lots downtown, connect inner neighborhood streets, construct innovative intersections, and add through and turn lanes to various intersections.

All of these suggested interim improvements would perform better and be more appropriately designed if they are considered in conjunction with the recommended concepts.

SH 46 along River Rd.

Currently, River Rd. from S. Main St. to the intersection of S. Esser Rd. and Herff Rd. is a two-lane roadway with eight-foot shoulders. There is approximately 1,400 liner feet of parallel parking along the southern edge of River Rd. from Pecan St. to Elm St. (**Figure 48**).

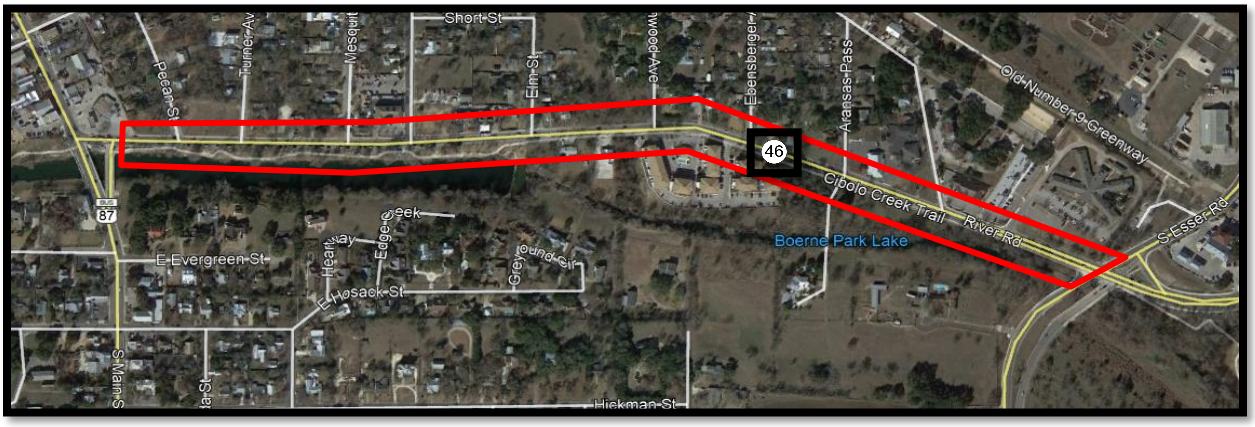

Figure 48: SH 46 Along River Rd.

Observation

The 2040 projected volumes along this stretch are 11,242 VPD. If the recommended concepts were implemented, this volume would be reduced to 8,095 VPD, which is on the threshold of needing more than two-lanes given the frequency of driveways and side streets (**Figure 49**).

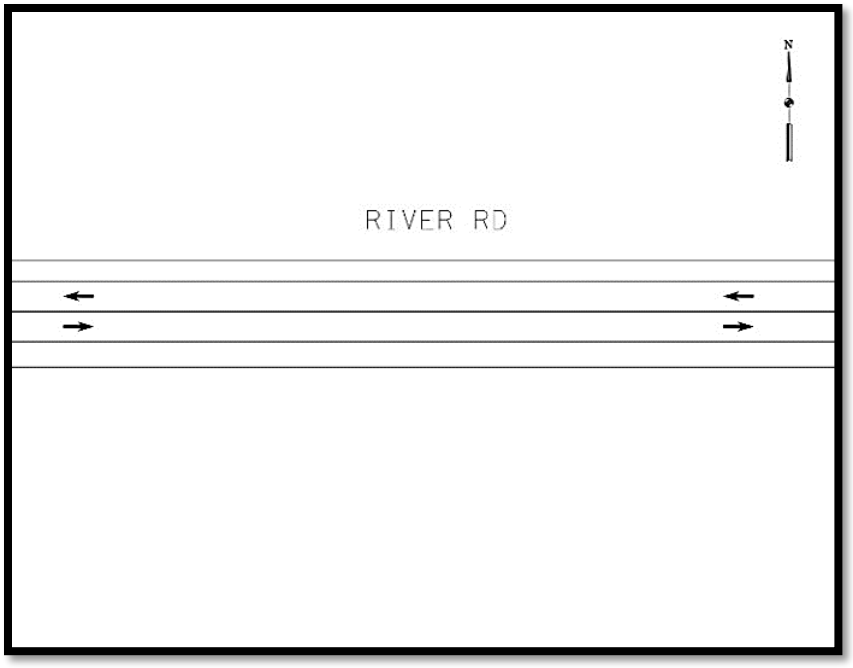

Figure 49: Existing River Rd.

Suggestion

Utilize the parking and shoulder width to widen the facility to a three or four-lane, undivided roadway, to accommodate the increasing traffic in Boerne (**Figure 50**). It would also provide safer turning options to access local establishments in the vicinity.

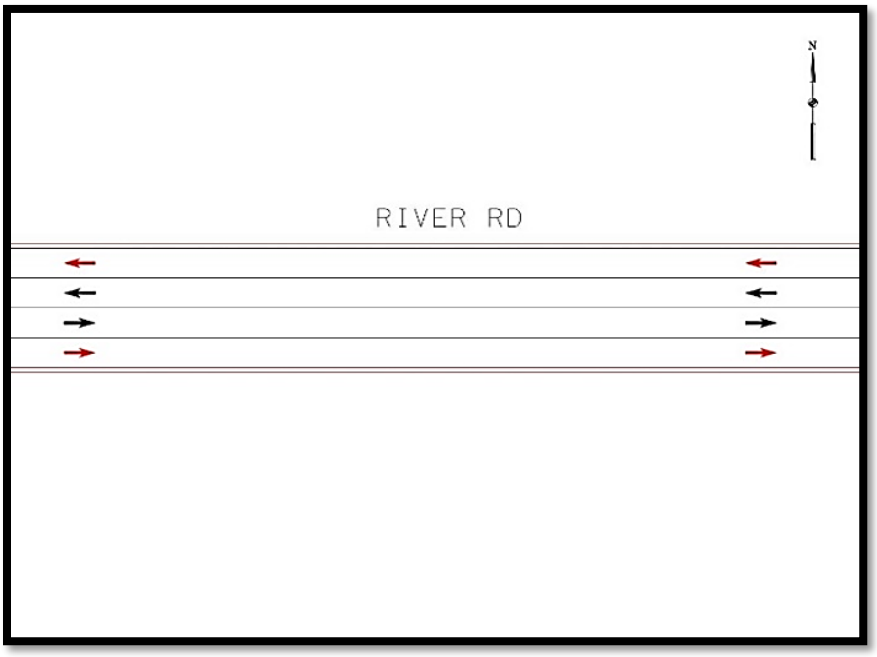

Figure 50: Proposed River Rd.

SH 46 from Ammann Rd. to FM 3351

Currently, SH 46 from Ammann Rd. to FM 3351 is an undivided two-lane road with a super-two configuration adding passing lanes as shown below in **Figure 51**. SH 46 is currently being widened from S. Esser Rd. to Ammann Rd. to a four-lane roadway with a two way left turn lane (TWLTL).

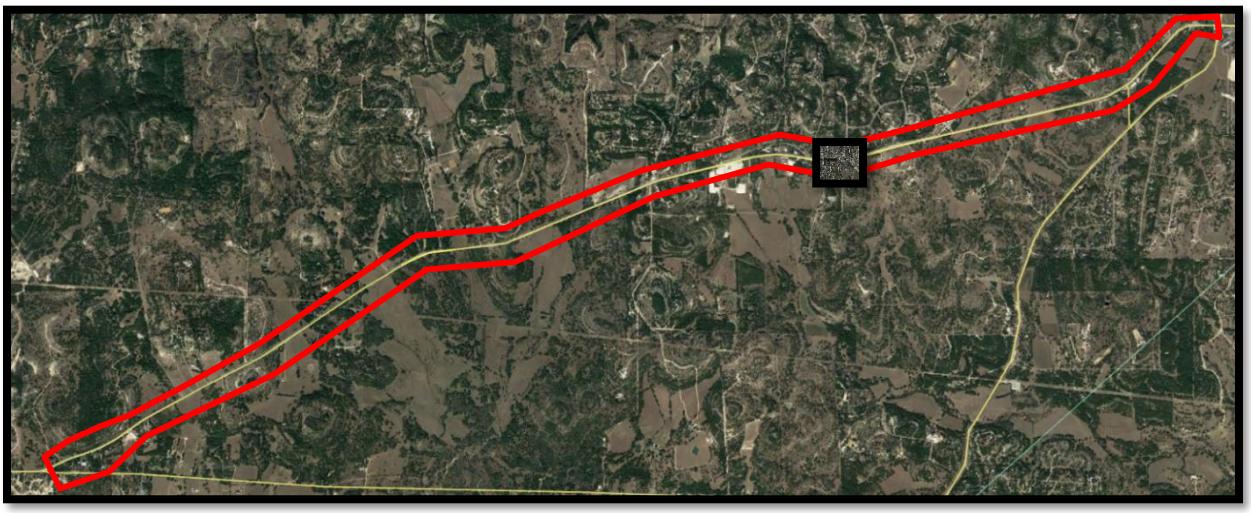

Figure 51: SH 46 From Ammann Rd. to FM 3351

Observation

The 2040 projected traffic volumes along this stretch are 15,335 VPD. If the recommended concepts were implemented, this volume would still be above 12,000 VPD to the east of the concepts, which is on the threshold of needing more than two-lanes (**Figure 52**).

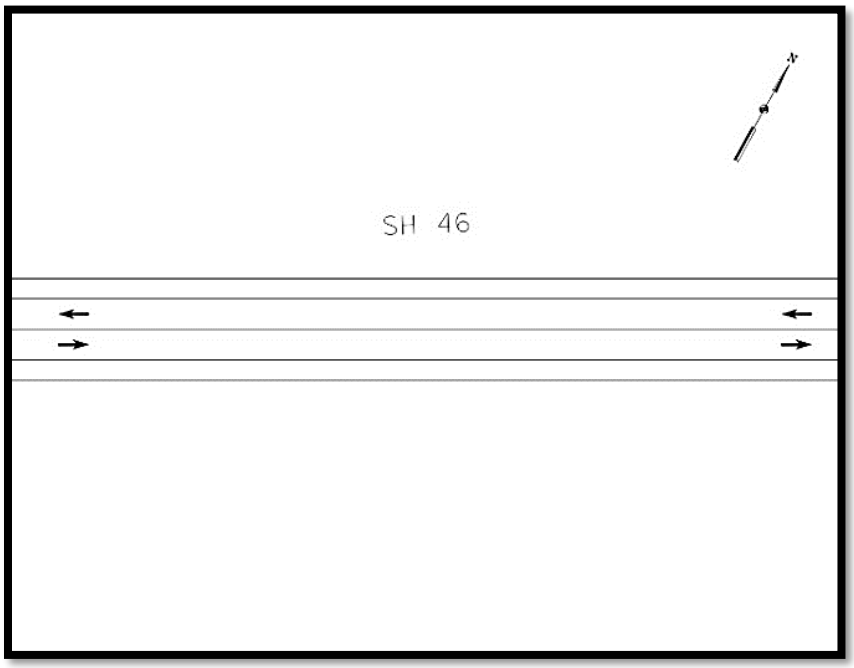

Figure 52: Existing SH 46

Suggestion

Widen the facility to a five-lane undivided roadway to accommodate the increasing traffic and match the new section up to Ammann Rd. (**Figure 53**).

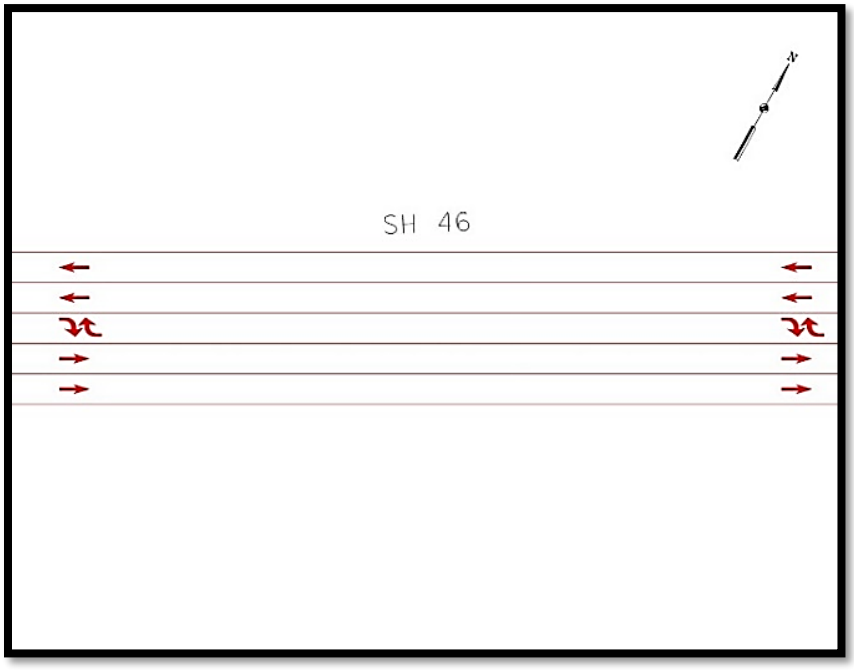

Figure 53: Proposed SH 46

Parking along Main St. Downtown

Street side parking is available along the shopping district of S. Main St. between W. San Antonio Avenue (Ave.) and River Rd. The parking spaces are parallel to the travel lanes.

Observation

This is adequate for low volume roads, but presents safety concerns as those volumes increase, particularly with the presence of heavy pedestrian traffic. The 2040 projected traffic volumes along this stretch are 20,558 VPD. If the recommended concepts were implemented, this volume could be reduced to 13,994 VPD which is adequate for four lanes.

Suggestions

The on-street parking could be removed and replaced with additional public parking lots added through downtown Boerne to create a safer pedestrian environment. The available width remaining could be used to add either:

- A continuous TWLTL which would help provide refuge for turning vehicles, or
- Expanded sidewalks and/or bike lanes and other pedestrian enhancements. This is a primary walkable area in town that would benefit from enhanced elements.

The suggestion is to add five parking lots at these five locations:

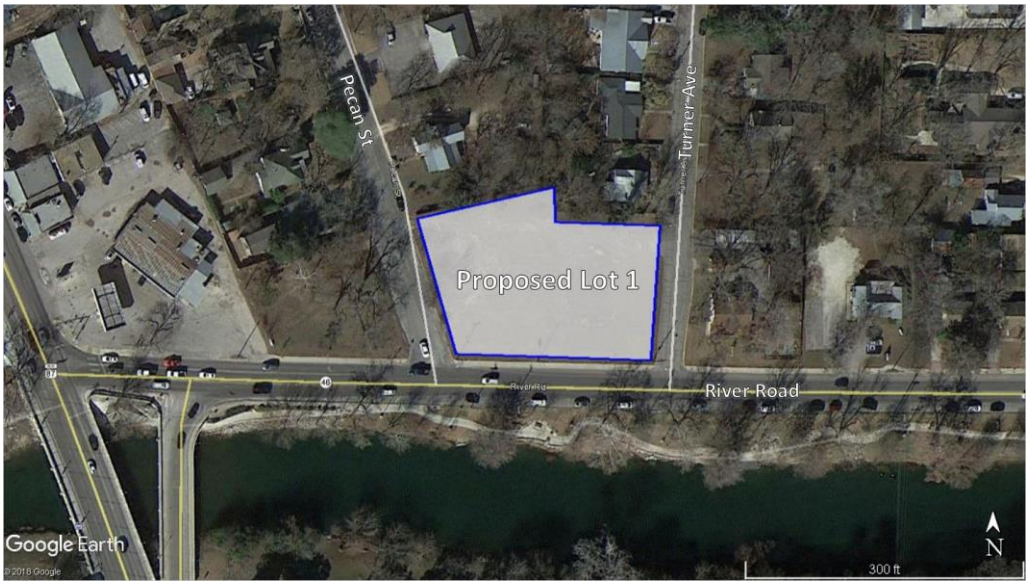

Figure 54: Location One – Vacant Lots at 135 Pecan St. & 440 Turner Ave.

- Zoned B-3 (**Figure 54**)
- CC (Conditional, subject to city council review and approval) for a parking lot or parking garage
- Proposed area needed: 0.76 acres

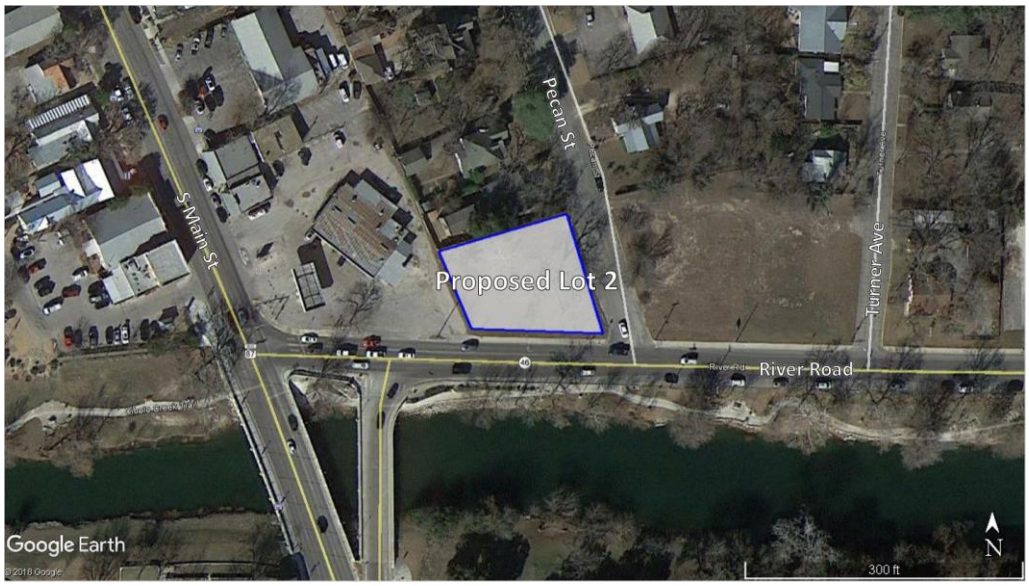

Figure 55: Location Two – Vacant Lot at 130 Pecan St.

- Zoned B-3 (**Figure 55**)
- CC (Conditional, subject to city council review and approval) for a parking lot or parking garage
- Proposed area needed: 0.37 acres

Figure 56: Location Three - City Property and Vacant Lot at 121 Theissen St.

- Zoned city property (**Figure 56**) and R-C (respectively)
- CC (Conditional, subject to city council review and approval) for a parking lot or parking garage
- Proposed area needed: 1.10 acres

Figure 57: Location Four – Portions of lots located at 262 Main St., 308 S. Main St., 322 S. Main St., 116 Theissen St., and the lot between 116 and 112 Theissen St.

- All lots zoned R-C (**Figure 57**)
- CC (Conditional, subject to city council review and approval) for a parking lot or parking garage
- Proposed area needed: 1.73 acres

Figure 58: Location Five – Portions of lots located at 200 Ryan St. and Blanco Rd.

- Zoned B-2 (**Figure 58**)
- CC (Conditional, subject to city council review and approval) for a parking lot or parking garage
- Proposed area needed: 2.39 acres

<u>Intersection of River Rd. and S. Main St.</u>

This intersection is not typical. It is a 'T' type signalized intersection but has a separate bridge for the northbound right turn and no additional turn bays (**Figure 59**).

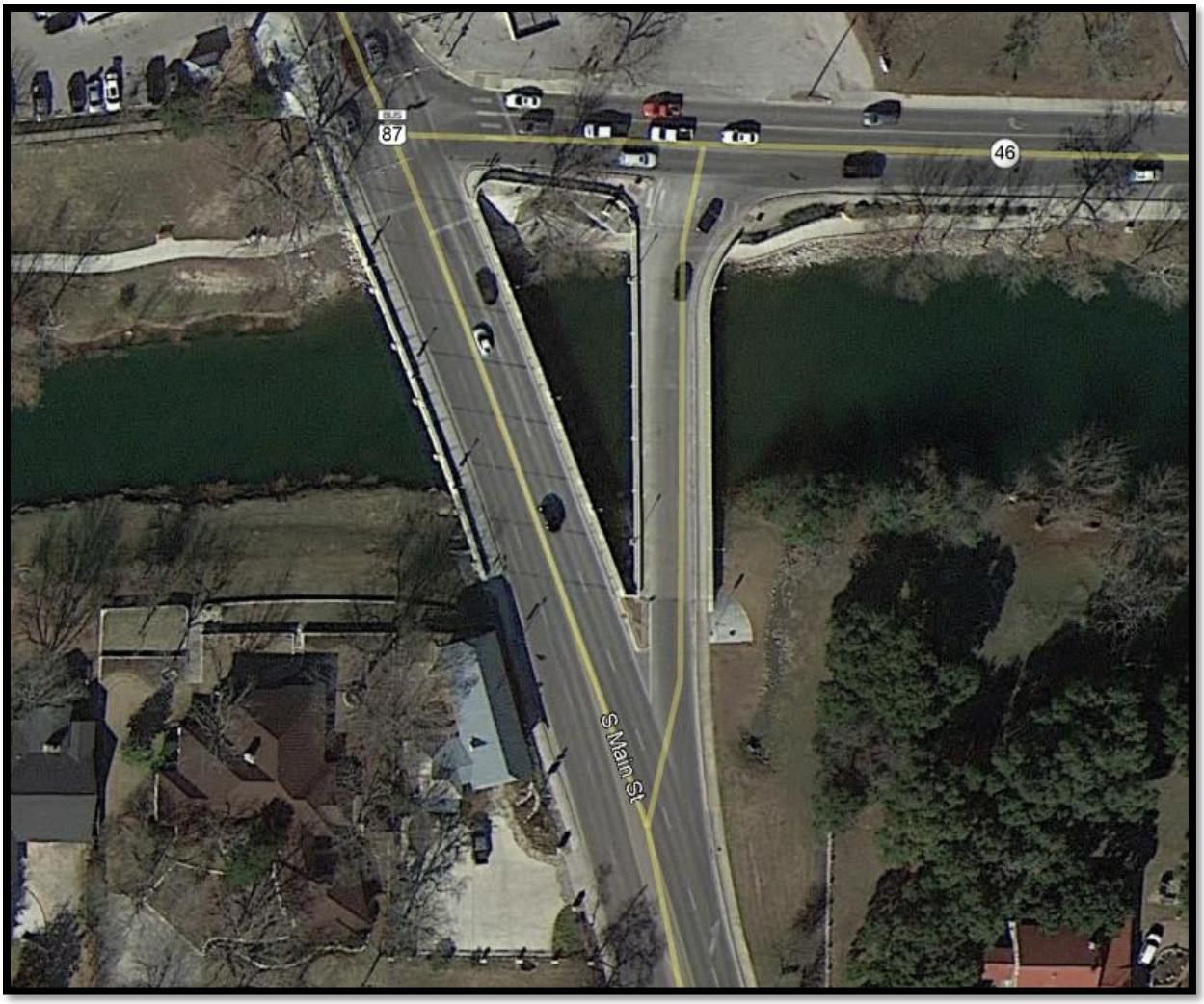

Figure 59: Existing Intersection of River Rd. and S. Main St.

Observation

The left turn from eastbound River Rd. to southbound S. Main St. is an acute angle. This is a difficult turn for trucks to make. With the northbound right turn being offset over 100 feet from the main signalized intersection it creates an additional and unusual conflict point. This particular intersection had, by far, the highest crash rate within the study area.

Suggestion

Because of the skewed angle and commercial and historic structures in close proximity, traditional intersection expansion are not a preferred solution. The Study Team suggested considering an innovative intersection such as a roundabout or traffic circle. The roundabout eliminates the concerns caused by the skew angle and may be more efficient at keeping this popular destination area flowing more consistently. This could be a scenic addition to the center of town and bridge over the river (**Figure 60**).

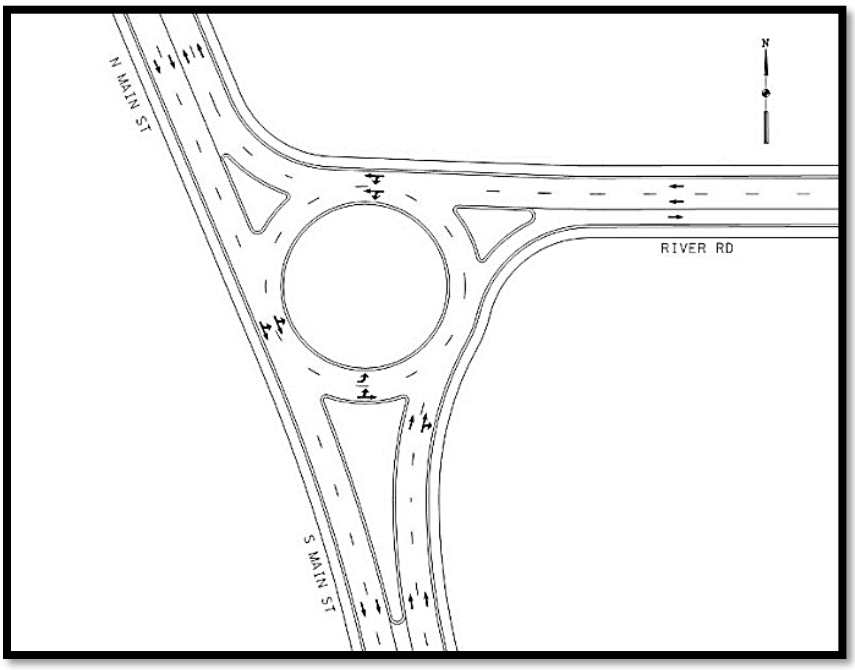

Figure 60: Proposed Roundabout: S. River Rd. and Main St.

Intersection of River Rd. and S. Esser Rd.

This is a typical signalized intersection with a skewed angle. There are turn bays available in all directions (**Figure 61**).

Figure 61: Existing Intersection of River Rd. and S. Esser Rd.

Observation

This intersection is flood prone during significant storm events. If there is an opportunity to reconstruct and elevate this intersection to reduce its flood potential, there may be an opportunity for other intersection configurations to be considered.

Suggestion

Because of the skewed angle and the space provided by the setback of adjacent buildings, this may be an opportunity to consider an innovative intersection such as a roundabout or traffic circle. The roundabout eliminates the concerns caused by the skewed angle and may be more efficient at keeping this area operating more efficiently (**Figure 62**).

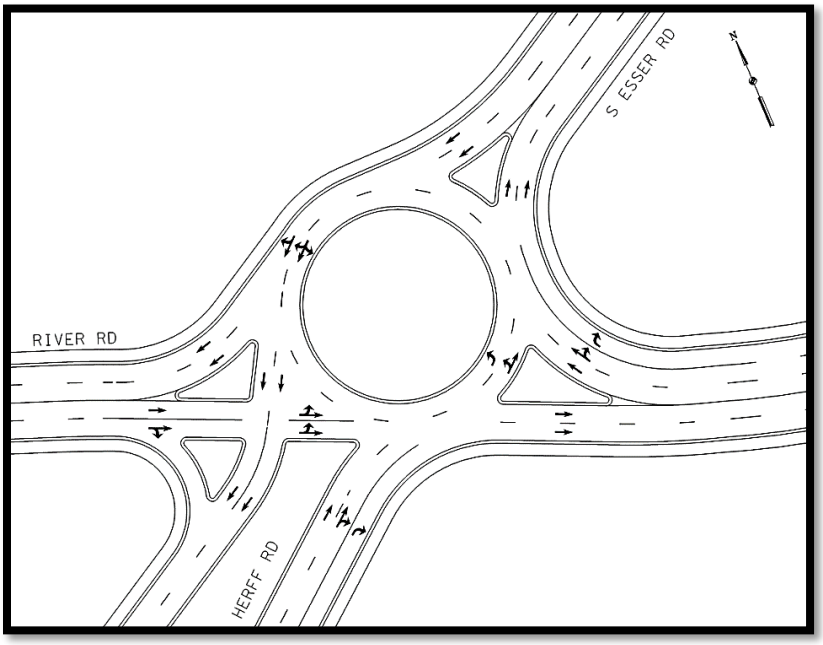

Figure 62: Proposed Roundabout: River Rd. and Herff Rd.

Other Improvement Suggestions

The following are a few suggestions that would improve the overall efficiency of the intersection or facility.

- Add a dedicated right-turn only lane northbound on S. Main St. onto eastbound Herff Rd. (**Figures 63**, **64**, and **65**).

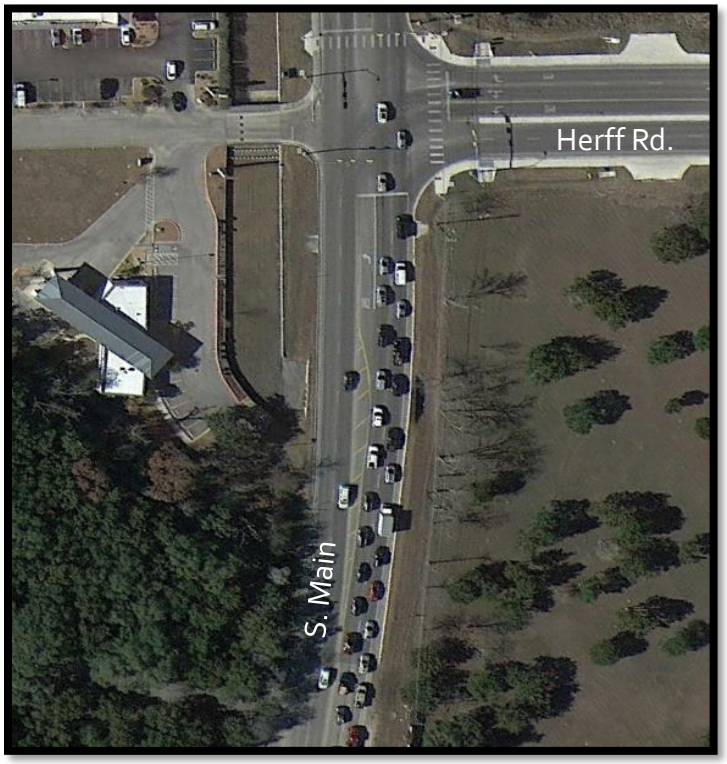

Figure 63: Congestion at Intersection of S. Main St. and Herff Rd.

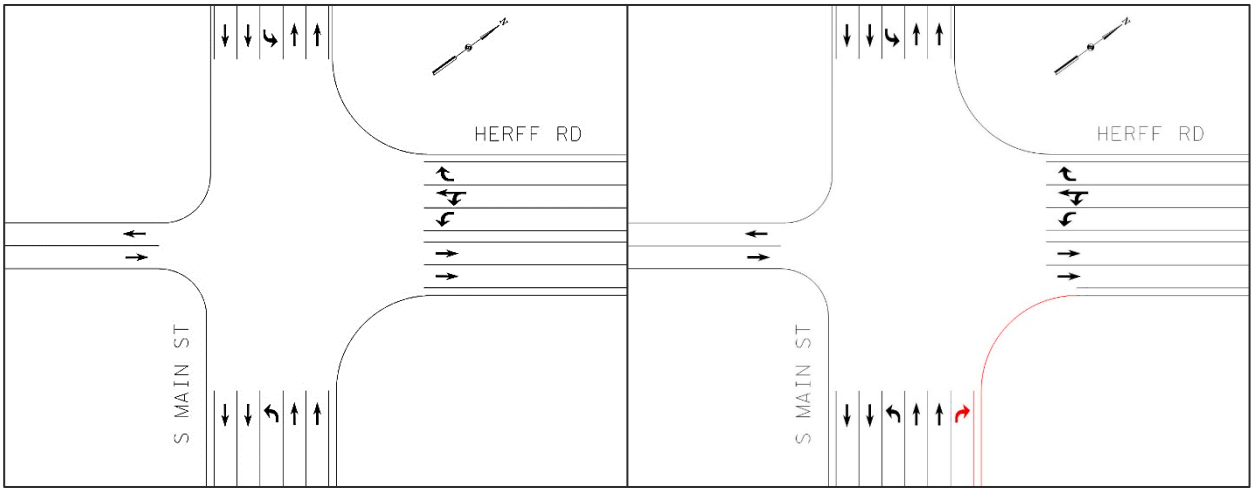

Figure 64: Existing Intersection of S. Main St. and Herff Rd.

Figure 65: Proposed Intersection of S. Main St. and Herff Rd.

- Add another through lane (**Figure 66** and **Figure 67**).

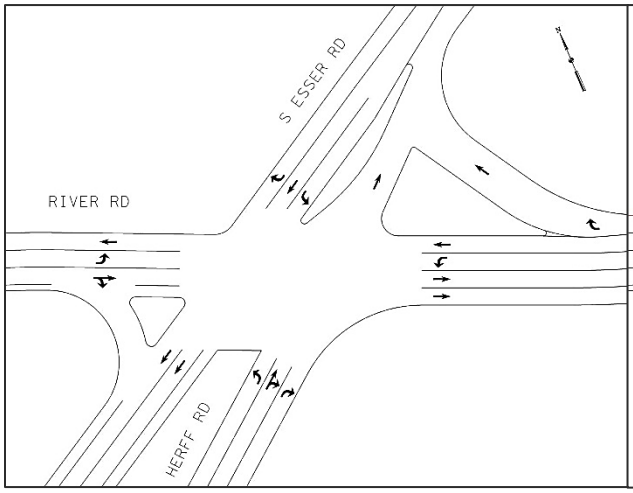

Figure 66: Existing Intersection of River Rd. and Herff Rd.

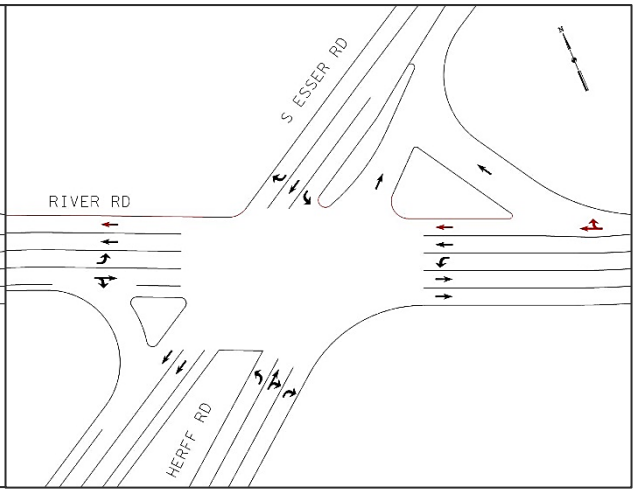

Figure 67: Proposed Intersection of River Rd. and Herff Rd.

- Widen Ammann Rd. and extend directly eastward to FM 3351 (**Figure 68** and **Figure 69**).

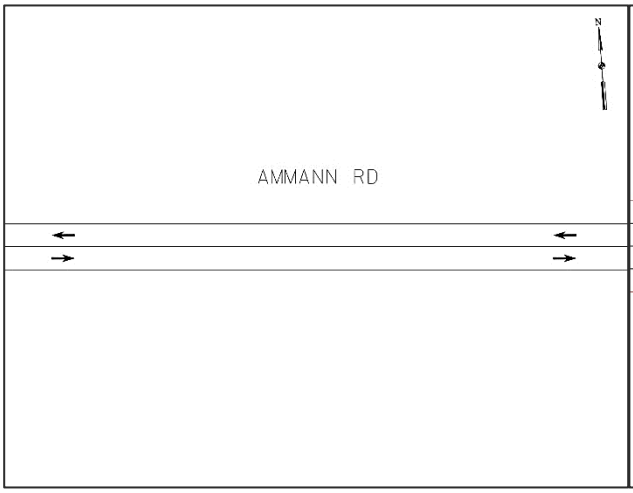

Figure 68: Existing Roadway of Ammann Rd.

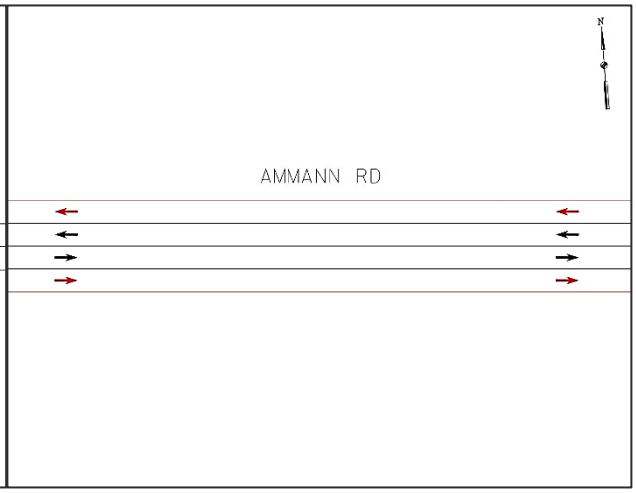

Figure 69: Proposed Roadway of Ammann Rd.

<u>Connect Inner Neighborhood Streets</u>

Neighborhoods with individual access locations, one location in and out, decrease circulation options. This should be considered with all new subdivision plats. The Study Team also highlighted a few existing locations that could be considered. This could be challenging in regards to HOA boundaries, private vs. public streets, and gated access, and would be addresses with public outreach at that time.

Providing more outlets to these neighborhoods could spread the demand and could provide options to the residents to seek alternate paths.

<u>Four Locations</u>

- Location 1: Extend City Park Rd. to the southern end of Lasso Falls in Herff Ranch Subdivision (**Figure 70**).

Figure 70: Extending City Park Rd. to Lasso Falls

- Location 2: Southern end of Deer Creek along Vista Verde Drive (Dr.) to the northern edge of Deer Creek along Destiny Dr. (**Figure 71**).

Figure 71: Connecting Deer Creek

- Location 3: A three-way connection between Bentwood Dr., Sharon Dr. East (E.), and Destiny Dr. (**Figure 72**).

Figure 72: Three-Way Connection of Bentwood Dr., Sharon Dr. E., and Destiny Dr.

- Location 4: Eastern edge of Bentwood Dr. to southwestern edge of Cordova in the Esperanza Subdivision (**Figure 73**).

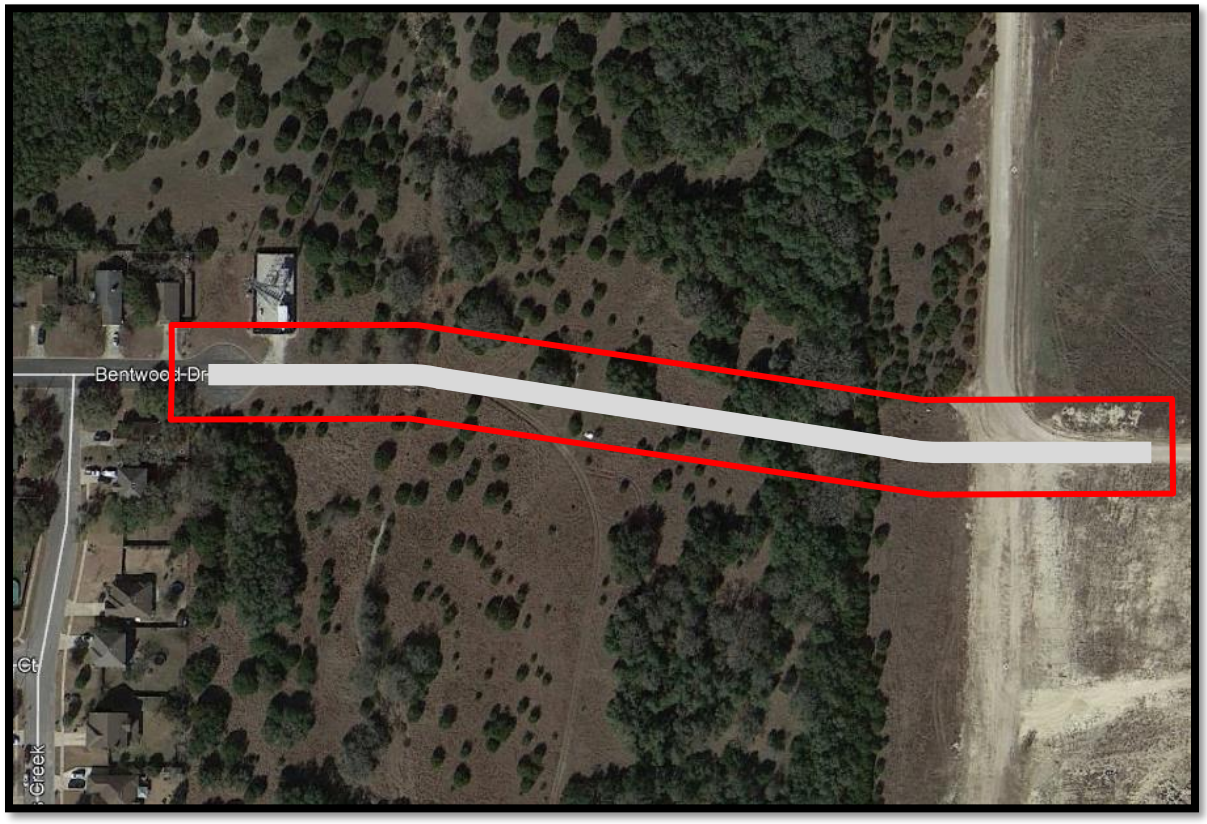

Figure 73: Connecting Bentwood Dr. to Cordova

Local Traffic Downtown

The travel demand downtown would remain high even with full implementation of the recommended concepts. The concepts would remove considerable through-traffic; however, it would free capacity for more local traffic. The primary attractions downtown, such as Walmart and HEB, are major traffic generators.

More interior connections as proposed in the City of Boerne's Thoroughfare Plan would help create more redundancy in the network. This should be coordinated with any plans for big traffic generators, for example, Walmart or HEB, regarding potential locations. Another major shopping option away from current locations, but still accessible to Boerne residents, could reduce demand in town.

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