

City of Keller

Citywide Sub-Area Traffic Model and Intersection Analysis

September 2022



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INTRODUCTION

Kimley-Horn and Associates, Inc. was retained by the City of Keller, TX to develop an update to the City's current Master Thoroughfare Plan (MTP) through a series of tasks used to evaluate the current status of the major arterials, collectors, and signalized and unsignalized intersections within the City. The purpose of this report is to document the methodology behind the analysis and evaluation procedures, as well as providing recommendations to the City's overall traffic network as a result of these procedures.

The first task required the development of a citywide, sub-area traffic model with the ability to analyze the City's roadway network based on volume and future land use. The completed model allows a user to apply distinct land use categories throughout the City to simulate new development being "constructed" in locations that are currently undeveloped. Based on the land uses added, the model calculates simulated vehicle trips that are introduced into the roadway network as a result of the "new construction" in the City. From here, the model calculates the sum of the simulated volumes and Existing (2020) volumes to generate an overall citywide volume projection for forty-five (45) major signalized and unsignalized intersections, as well as all thoroughfares currently outlined on the City's MTP. Once final projected volumes have been calculated, the model can contribute to capacity analysis procedures for both intersections and thoroughfares.

The second task of the MTP update involves the analysis of Keller's current traffic network, with an emphasis on the City's MTP-specific thoroughfares and major intersections. Using the sub-area traffic model and *Synchro 10TM* software, forty-five (45) total major intersections and all roadways (or links) on the thoroughfare plan were analyzed based on existing capacity conditions. Based on the intersection and link level of service analysis results, it is the intent of this report to identify traffic generation characteristics and potential traffic related impacts throughout the City, with the overall purpose of providing recommendations and mitigation measures based on the analysis and observations.

A report outlining the results and outcomes of the model was submitted to the City in December 2020, with an updated addendum submitted in July 2021. The July addendum outlines updates made to the methodology and assumptions behind the construction of the traffic model based on comments provided by City staff and proposed mitigations from the Tarrant County 2021 Transportation Bond Program Call for Projects. **This updated report will incorporate results from both documents, as well as additional recommendations provided by the City, to present an updated thoroughfare plan—renamed the Major Thoroughfare Plan—for the City of Keller, as well as a documented outline of the recommended changes to the 2012 edition of the MTP.**

DATA COLLECTION

The primary methods of data collected that were used for this study are outlined in the following section. Key components of the collection process included the acquisition of citywide traffic count data, in-field observations, and an evaluation of historical crash data.

Traffic Counts

Current and historical turning movement count data was obtained from City of Keller staff for analysis and evaluation. Traffic counts were conducted at all forty-five (45) major intersections on regular weekdays (Tuesday-Thursday) during the AM and PM peak hours.

To estimate existing (2020) citywide traffic patterns, historical volumes (2010-2018) were obtained along US 377, north and south of its signalized intersection with FM 1709. These counts were provided by the Texas Department of Transportation (TxDOT) *Statewide Planning Map*. Using this method, an average annual growth rate of 1.6% was calculated. This growth rate was rounded to 2.0% and used in calculations for a conservative growth estimate. **Table 1** presents this historical count data.

Table 1. US 377 Historical Count Data

Count Station Location	Year	24-Hour Volume	Annual Growth Rate
US 377, north of FM 1709	2008	22,000	-
	2009	22,000	0.0%
	2010	23,000	4.5%
	2011	26,000	13.0%
	2012	25,000	-3.8%
	2013	26,916	7.7%
	2014	23,396	-13.1%
	2015	27,022	15.5%
	2016	27,128	0.4%
	2017	27,308	0.7%
2018	25,571	-6.4%	
Average Growth Rate (North)			1.9%
US 377, south of FM 1709	2008	27,000	-
	2009	33,000	22.2%
	2010	29,000	-12.1%
	2011	28,000	-3.4%
	2012	31,000	10.7%
	2013	31,569	1.8%
	2014	31,316	-0.8%
	2015	34,212	9.2%
	2016	33,615	-1.7%
	2017	31,979	-4.9%
2018	29,491	-7.8%	
Average Growth Rate (South)			1.3%
Total Average Growth Rate			1.6%
Conservative Growth Rate			2.0%

Turning movement count data for the following intersections was collected in 2018, and subsequently grown at a rate of 2.0% per year for two (2) years to obtain a 2020 volume estimate:

- US 377 & Mount Gilead Road
- US 377 & Johnson Road
- US 377 & FM 1709
- FM 1709 & Bourland Road
- FM 1709 & Rufe Snow Drive
- FM 1709 & Keller Smithfield Road
- FM 1709 & Pearson Lane
- US 377 & Bear Creek Parkway (S)
- US 377 & North Tarrant Parkway

Turning movement count data for the following intersections was collected in 2019, and subsequently grown at a rate of 2.0% per year for one (1) year to obtain a 2020 volume estimate:

- US 377 & Marshal Ridge Drive
- Roanoke Road & Knox Road
- Ottinger Road & Melody Lane
- Summer Lane & Pearson Lane
- Mount Gilead Road & Bourland Road
- Mount Gilead Road & Roanoke Road
- Pearson Lane & Fawkes Lane
- Fawkes Lane & Randol Mill Avenue
- Bancroft Road & Bourland Road
- Bancroft Road & Mount Gilead Road
- Keller Smithfield Road & Ottinger Road
- Pearson Lane & Florence Road
- Johnson Road & Bourland Road
- Johnson Road & Pate Orr Road
- Johnson Road & Rufe Snow Drive
- Johnson Road & Keller Smithfield Road
- Johnson Road & Pearson Lane
- Elm Street & Vine Street
- Bear Creek Parkway (N) & Rufe Snow Drive
- Bear Creek Parkway (N) & Keller Smithfield Road
- Elm Street & Pecan Street
- Bear Creek Parkway (S) & Elm Street
- Bear Creek Parkway (S) & Rufe Snow Drive
- Bear Creek Parkway (S) & Keller Smithfield Road
- Bear Creek Parkway (S) & Preston Lane
- Whitley Road & Wall Price Keller Road
- Whitley Road & Rapp Road
- Willis Lane & Rapp Road
- Rufe Snow Drive & Rapp Road
- Rufe Snow Drive & Shady Grove Road
- Keller Smithfield Road & Shady Grove Road
- North Tarrant Parkway & Willis Lane
- North Tarrant Parkway & Rufe Snow Drive

Turning movement count data for the following intersections was collected in January 2020, with no subsequent growth applied:

- Cherokee Trail & Anita Avenue
- Bear Creek Parkway (N) & Town Center Lane

An additional intersection—North Tarrant Parkway & Whitley Road—was incorporated into the model using adjacent traffic volumes following the December 2020 report submittal.

Exhibits 1 and 2 present Existing (2020) turning movement counts for the City of Keller, with **Exhibit 1** depicting intersection volumes north of FM 1709 and **Exhibit 2** outlining volumes south of FM 1709.

LEGEND

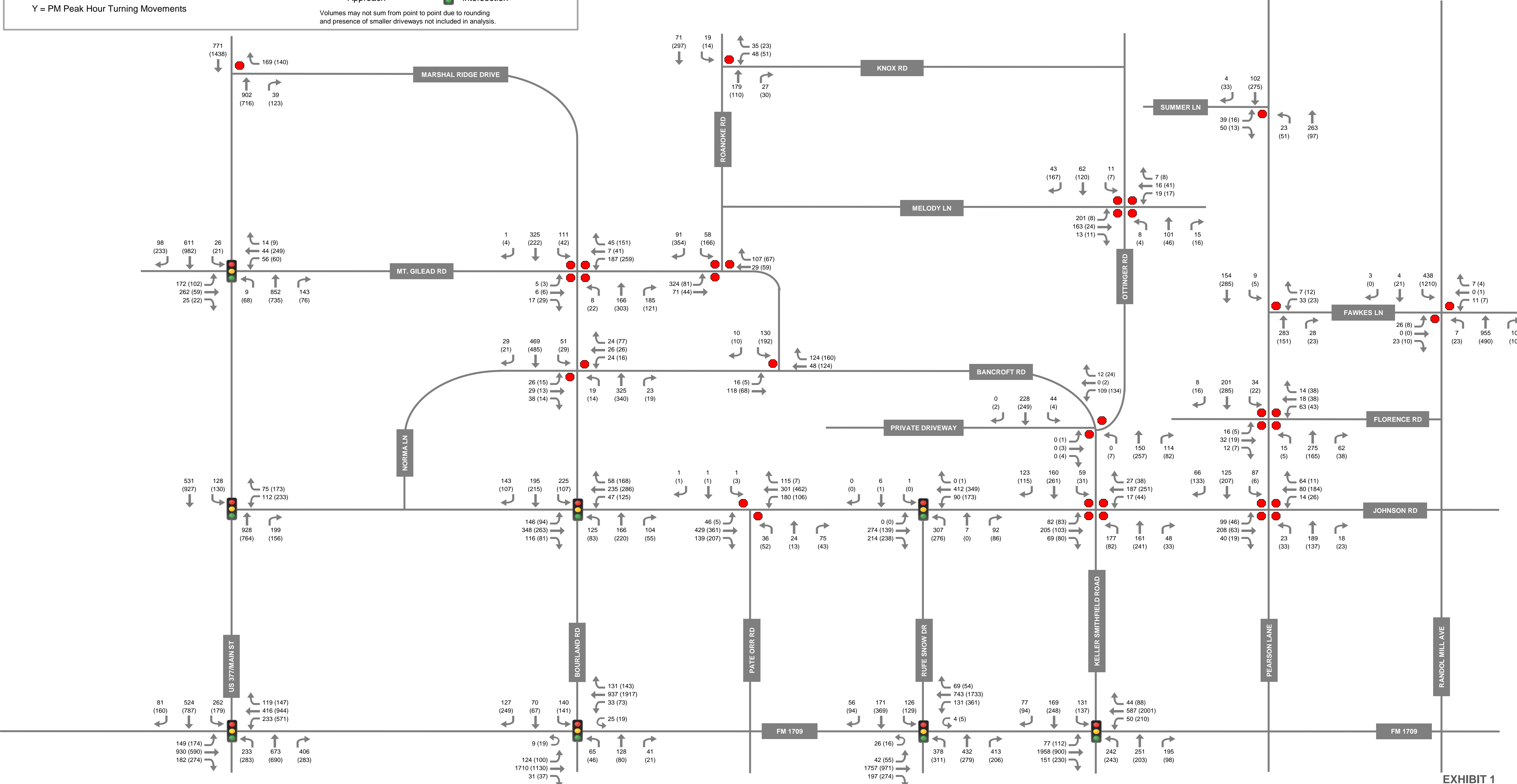
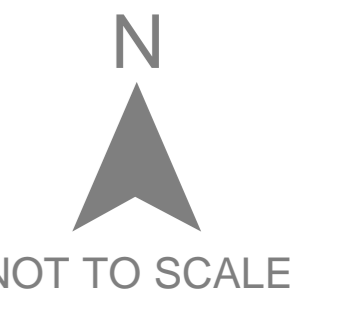
X (Y)
 X = AM Peak Hour Turning Movements
 Y = PM Peak Hour Turning Movements

Existing Facility

● Stop-Controlled Approach

🚦 Signalized Intersection

Volumes may not sum from point to point due to rounding and presence of smaller driveways not included in analysis.



LEGEND

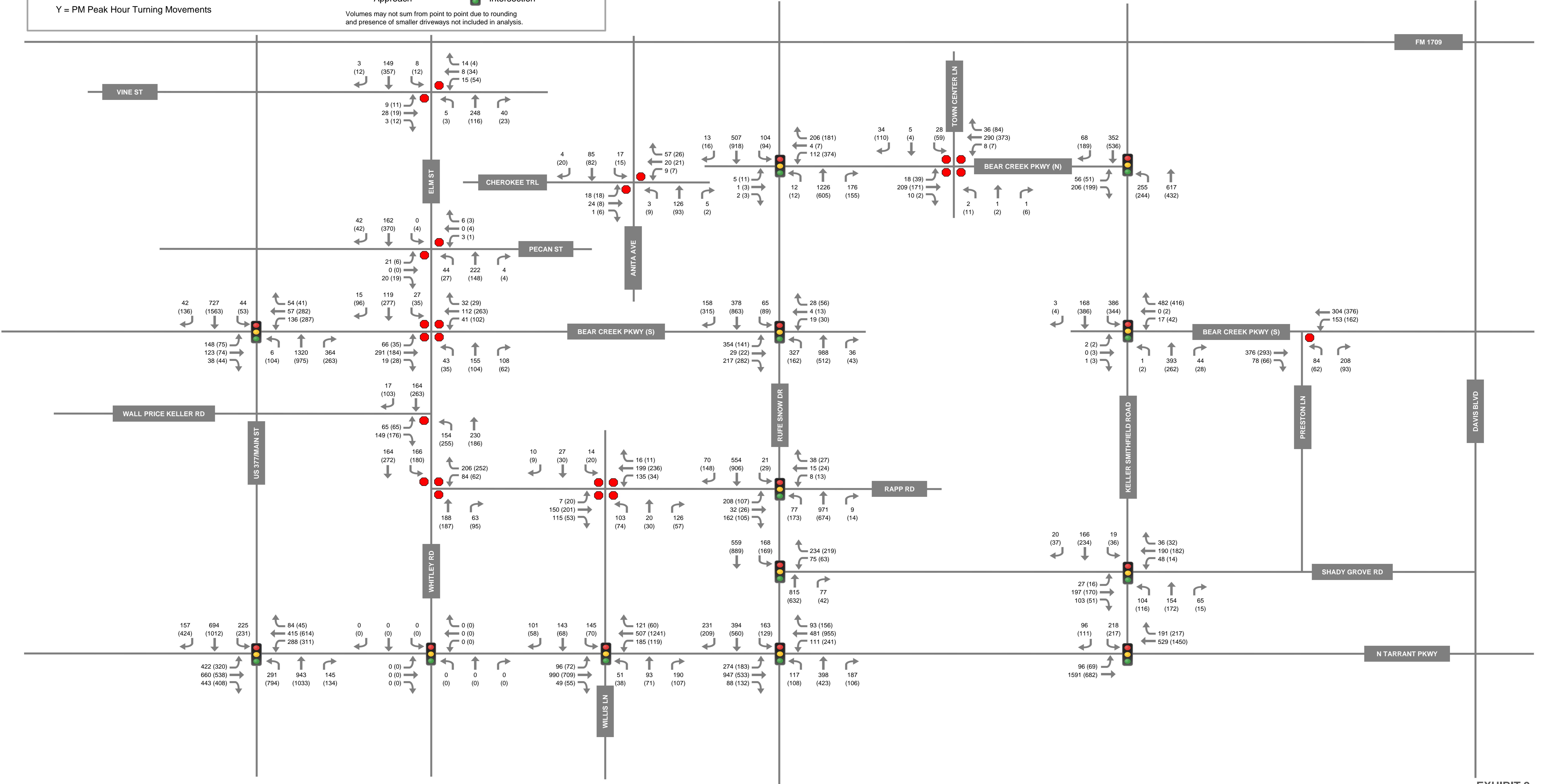
X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

Existing Facility

● Stop-Controlled Approach

🚦 Signalized Intersection

Volumes may not sum from point to point due to rounding and presence of smaller driveways not included in analysis.



Field Observations

Field observations were made on Tuesday, November 10, 2020 and Thursday, November 12, 2020. During field visits, general observations were made, along with confirmation of speed limits, lane assignments, and preliminary recommendations. Based on these efforts, the following global recommendations are provided for the City's intersections:

- Establish consistent signal timing and phasing along signalized corridors.
- Eliminate split phasing wherever possible by isolating lane movements at certain intersection approaches.
- Incorporate flashing yellow arrows (FYA) at signalized intersections that currently have (or potentially could have) a form of Protected/Permitted left turn phasing. (discussed further in *Historical Crash Evaluation*)
- Explore dual lefts at a potential enhancement in locations where opposing peak traffic are left turns are near or greater than 200 vehicles-per-hour (vph) on arterials and 150 vph on less collectors.
- Certain intersections with curb ramps that were in poor condition and may not be compliant with the best practices as defined by the Americans with Disabilities Act (ADA). It is recommended that all major signalized intersections have adequate ramps to serve all possible pedestrian crossing movements.



Figure 1. Keller Pedestrian Field Observations

Historical Crash Evaluation

Kimley-Horn also conducted an examination of Keller’s 2019 crash history to help identify which of the study locations could have improved safety measures. To observe accident history, a crash heat map (**Figure 2**) was created using data collected from TxDOT’s Crash Records Information System (CRIS). Based on the heat map data, crashes appear to be concentrated heavily along the following thoroughfares:

- US 377, Mount Gilead Road to North Tarrant Parkway
- FM 1709, US 377 to Pearson Lane
- North Tarrant Parkway, US 377 to Keller Smithfield Road
- Rufe Snow Drive, Johnson Road to North Tarrant Parkway
- Bear Creek Parkway, Keller Smithfield Road to Davis Boulevard
- Keller Smithfield Road, Bancroft Road to Bear Creek Parkway (S)
- Bancroft Road, Mount Gilead Road to Ottinger Road
- Bourland Road, Bancroft Road to Mount Gilead Road
- Davis Boulevard, Bear Creek Parkway (S) to Precinct Line Road
- Johnson Road, US 377 to Bourland Road

Based on the common concentrated crash locations, it is recommended that the implementation of flashing yellow arrows (FYAs) along thoroughfares within the City be considered to improve safety at the more densely populated locations. Specific FYA intersection location recommendations will be outlined further into the report, with special concern for safety improvements given to these intersections throughout analysis procedures.

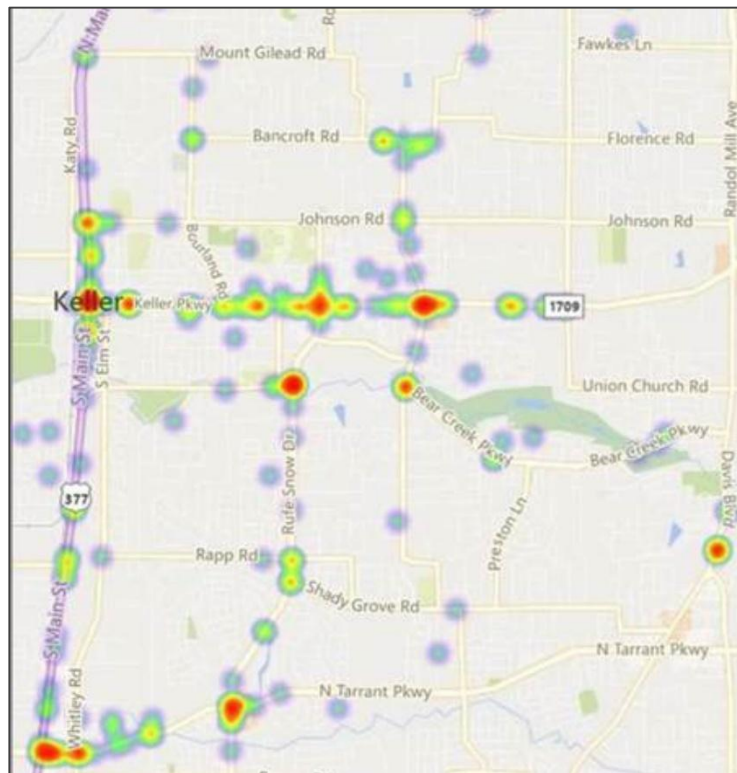


Figure 2. Keller Crash Heat Map (2019)

SUB-AREA TRAFFIC MODEL

The first task of Keller’s MTP update required the development of a citywide, sub-area traffic model with the ability to analyze the City’s roadway network based on volume and future land use. The completed model allows a user to apply distinct land use categories throughout the City to simulate new development being “constructed” in locations that are currently undeveloped. Based on the inputs provided, the model is able to generate an overall citywide volume projection for forty-five (45) major signalized and unsignalized intersections, as well as all thoroughfares currently outlined on the City’s MTP. The methodology behind the design of the traffic model is outlined in the next sections.

Land Use Assumptions

Model development began with the establishment of the City’s land use assumptions, providing the basis for residential and non-residential growth projections within the City. The growth projections formulated in this report were performed using reasonable and generally accepted planning principles. The following factors were considered in developing these projections:

- Keller’s Future Land Use Plan (FLUP), adopted April 2021
 - **NOTE: This stage of model development was originally completed prior to the adoption of the April 2021 Future Land Use Plan update. As such, land use assumptions have since been updated since the December 2020 report submittal, based on the 2021 FLUP.**
- Current zoning plans;
- Historical and anticipated growth trends;
- Location of undeveloped parcels;
- Physical restrictions (i.e. flood plains, railroads, gas wells); and
- Physical development carrying capacity of Keller.

The following steps outline the process used to develop the land use assumptions:

Step 1: Establish Developed and Undeveloped Parcels

The first step was determining which of the City’s parcels were developed versus those that were undeveloped. Based on information provided by the City and aerial survey, parcel level development was able to be estimated based on total acreage. **Exhibit 3** summarizes parcel development status within the City Limits.

Step 2: Determine Estimates of Developed Parcels

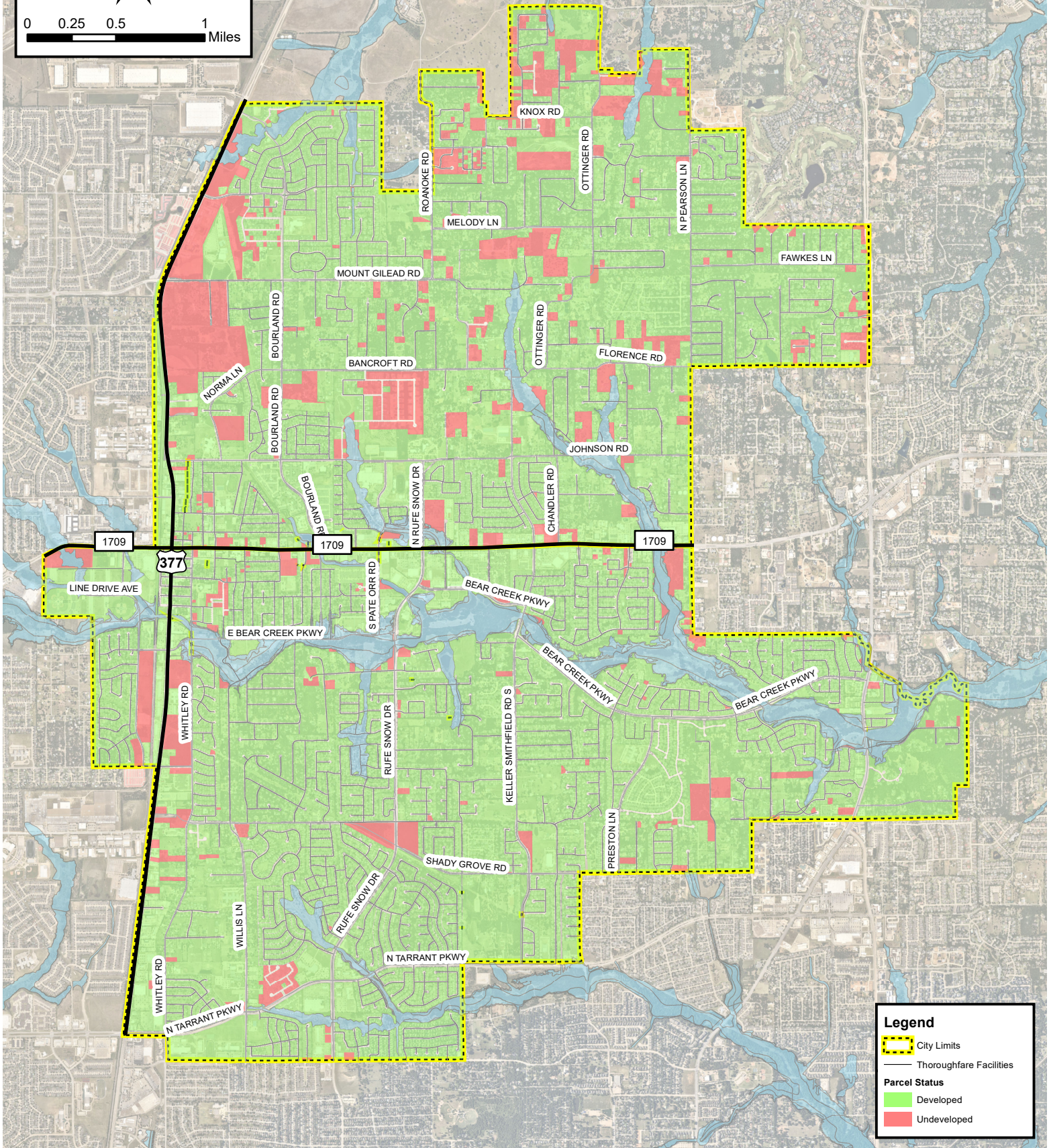
For the developed parcels identified, existing residential and non-residential estimates were obtained using existing building information provided by the City and aerial survey of existing development. These estimates—as well as the residential and non-residential projections to be calculated in **Step 3**—were compiled in accordance with the following categories:

- Units:** Number of dwelling units, both single and multi-family.
- Employment:** Square feet of building area based on three (3) different classifications. Each classification has unique trip making characteristics.
 - Basic:** Land use activities that produce goods and services such as those which are exported outside of the local economy, including manufacturing, construction, transportation, wholesale, trade, warehousing, and other industrial uses.
 - Service:** Land use activities which provide personal and professional services, such as government and other professional offices.
 - Retail:** Land use activities which provide for the retail sale of goods which primarily serve households and whose location choice is oriented toward the household sector, such as grocery stores and restaurants.



0 0.25 0.5 1 Miles

Exhibit 3. Developed and Undeveloped Parcels City of Keller, TX September 2022 Kimley»Horn



Legend

- City Limits
- Thoroughfare Facilities

Parcel Status

- Developed
- Undeveloped

Step 3: Determine Development Carrying Capacity (Growth Potential) of Undeveloped Parcels

For the remaining undeveloped areas, assumptions based upon the City's future growth were used to estimate the carrying capacity, or growth potential, of land within the City for both residential and non-residential land uses. We recognize, however, that prior to the recent April 2021 Future Land Use Plan update, the City's latest edition of the FLUP had not been updated since 1998. Therefore, the following sources and methodologies were used in conjunction to project future growth:

- Keller's Future Land Use Map (**Exhibit 4**); adopted April 2021
 - **NOTE: This stage of model development was originally completed prior to the adoption of the April 2021 Future Land Use Plan update. As such, land use assumptions have since been updated since the December 2020 report submittal, based on the 2021 FLUP.**
- Historical (10-year) growth trends;
- Anticipated (10-year) growth trends; and
- Coordination with City staff during the 2021 FLUP updates.

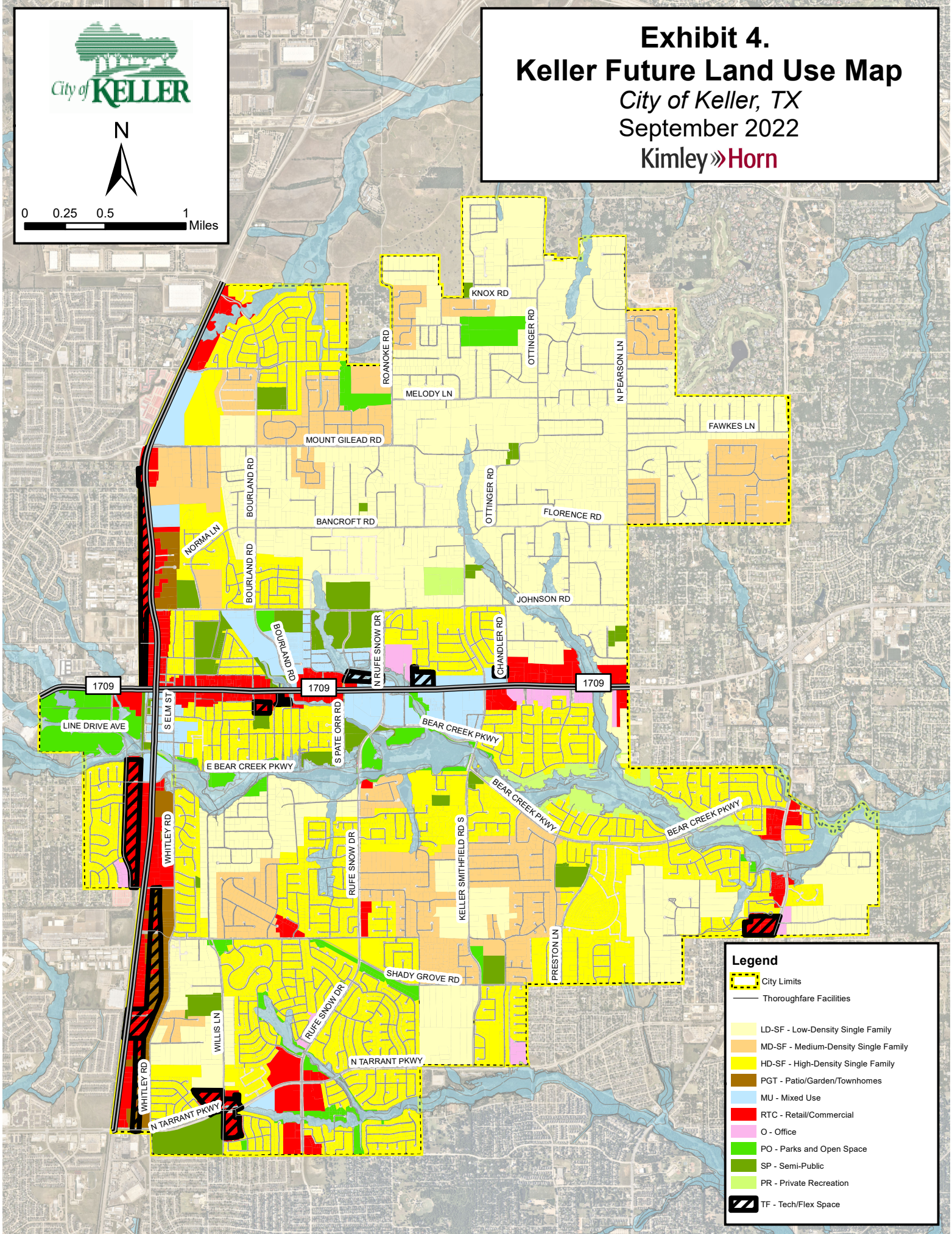
The carrying capacity was calculated in two basic steps, outlined below and presented in **Table 2**:

- 1) Determine the future land use and development patterns for undeveloped parcels based on previous planning efforts completed by the City.
 - a. Residential – Calculated through an assumed density (dwelling units/acre) to be applied to each projected residential parcel based on classification (Single Family vs. Multi-Family).
 - b. Non-Residential – Calculated through a floor area ratio (FAR) to be applied to each projected non-residential parcel based on classification (Basic vs. Service vs. Retail).
- 2) Determine the number of dwelling units and employment building space (square feet) that could occupy every parcel – i.e. the parcel's "Development Carrying Capacity" – based on the future land use development types.



0 0.25 0.5 1 Miles

Exhibit 4. Keller Future Land Use Map City of Keller, TX September 2022 Kimley»Horn



Legend

- City Limits
- Thoroughfare Facilities
- LD-SF - Low-Density Single Family
- MD-SF - Medium-Density Single Family
- HD-SF - High-Density Single Family
- PGT - Patio/Garden/Townhomes
- MU - Mixed Use
- RTC - Retail/Commercial
- O - Office
- PO - Parks and Open Space
- SP - Semi-Public
- PR - Private Recreation
- TF - Tech/Flex Space

Table 2. Future Land Use Assumptions

			Undeveloped Land	Residential		Non-Residential			Total Non-Residential
			Acres	Single Family	Patio/Garden/Townhomes/Mixed Use	Industrial	Retail/Commercial	Office	
						FAR 0.1*	FAR 0.2**	FAR 0.2**	
SERVICE AREA 1 (NORTH OF FM1709)	Low Density - Single Family	LD-SF	379	379					-
	Medium Density - Single Family	MD-SF	148	296					-
	High Density - Single Family	HD-SF	59	235					-
	Patio/Garden/Townhomes	PGT	12		96				-
	Mixed Use	MU	73		882		320,000	320,000	640,000
	Retail/Commercial	RTC	45				395,000		395,000
	Office	O	11					97,000	97,000
	Parks and Open Space	PO	22			0			0
	Semi-Public	SP	6					55,000	55,000
	Private Recreation	PR	0			0			0
	Total			756	910	978	0	715,000	472,000
SERVICE AREA 2 (SOUTH OF FM1709)	Low Density - Single Family	LD-SF	56	56					-
	Medium Density - Single Family	MD-SF	4	7					-
	High Density - Single Family	HD-SF	68	271					-
	Patio/Garden/Townhomes	PGT	31		248				-
	Mixed Use	MU	6		72		26,000	26,000	52,000
	Retail/Commercial	RTC	90				784,000		784,000
	Office	O	12					107,000	107,000
	Parks and Open Space	PO	27			0			0
	Semi-Public	SP	1					10,000	10,000
	Private Recreation	PR	1			6,000			6,000
	Total			296	335	320	6,000	810,000	143,000
TOTAL	Low Density - Single Family	LD-SF	435	435					-
	Medium Density - Single Family	MD-SF	152	304					-
	High Density - Single Family	HD-SF	127	506					-
	Patio/Garden/Townhomes	PGT	43		344				-
	Mixed Use	MU	79		954		346,000	346,000	692,000
	Retail/Commercial	RTC	135				1,179,000		1,179,000
	Office	O	23					204,000	204,000
	Parks and Open Space	PO	49						0
	Semi-Public	SP	7					65,000	65,000
	Private Recreation	PR	1			6,000			6,000
	Total			1,052	1,245	1,298	6,000	1,525,000	615,000

*FAR of 0 applied to Parks and Open Space Land Use.

**FAR of 0.1 applied to Mixed Use Land Use to determine non-residential population estimates.

Citywide Trip Generation

Traffic Analysis Zones

To properly dissect the traffic operations throughout the study area, the model breaks the City into twenty-six (26) distinct analysis zones, presented in **Exhibits 5** and **6**. When land use projections are determined for the model, they are assigned based on their zone location. The model allows for each of the twenty-six (26) zones to have up to twelve distinct land use inputs at a time. Based on these inputs, the model is able to present the projected trips for the overall citywide network, as well as for each individual zone.

Trip Generation Projections

Citywide traffic projections were prepared for the model based on the trip generation rates found in the 10th edition of the Institute of Transportation Engineers (ITE) *Trip Generation Manual*. This recognized standard for trip generation is based on actual surveys (traffic counts) of existing types of development. **Table 3** provides the equations included in the ITE *Trip Generation Manual*, as well as the entering and exiting distribution splits. For the purposes of conservative trip estimations, two land use types were incorporated to assume residential and non-residential trip generation estimates throughout the City and for each of the twenty-six (26) analysis zones.

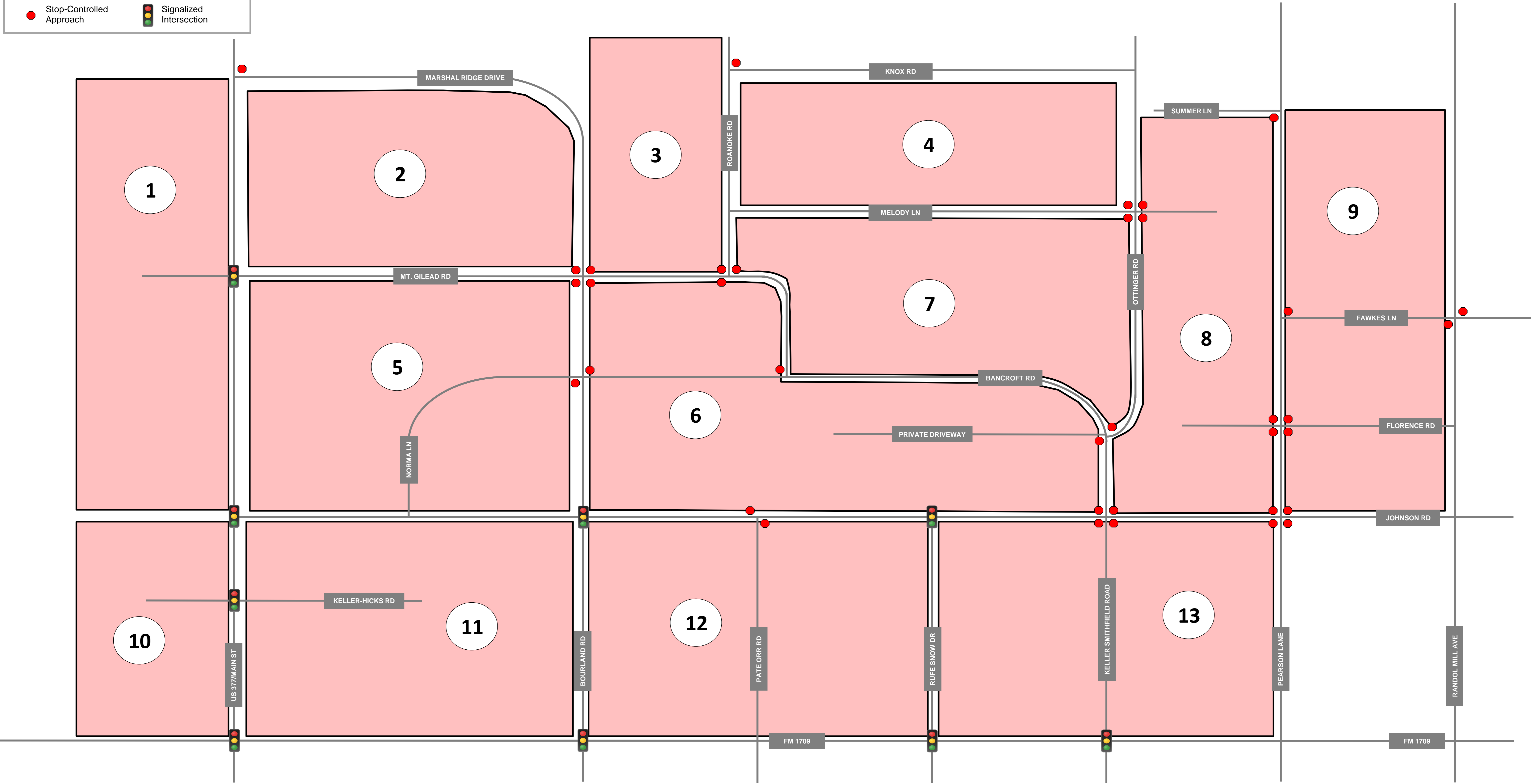
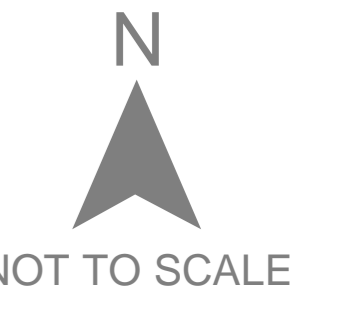
Table 3. Trip Generation Equations

Land Use Description	Variable	Daily	
		Rate	Split
Single-Family Detached Housing (ITE #210)	Dwelling Units	9.44 * (X)	50% In 50% Out
Shopping Center (ITE #820)	1,000 Sq. Ft. GLA	37.75 * (X)	50% In 50% Out
Number of trips generated = Trip Rate * (Development Unit); X = Number of Development Units			

Based on the sum of existing volumes and all projected trip inputs from the twenty-six (26) available zones, the traffic model can project an overall network of traffic volumes for the entire City, which is available via two additional exhibits that can be found in the model. This projection is editable based on the land use inputs provided by the user, which will, in turn, change the trips within the network and adjacent to each analysis zone. The distribution of traffic throughout the City based on these individual zones is discussed in the next section.

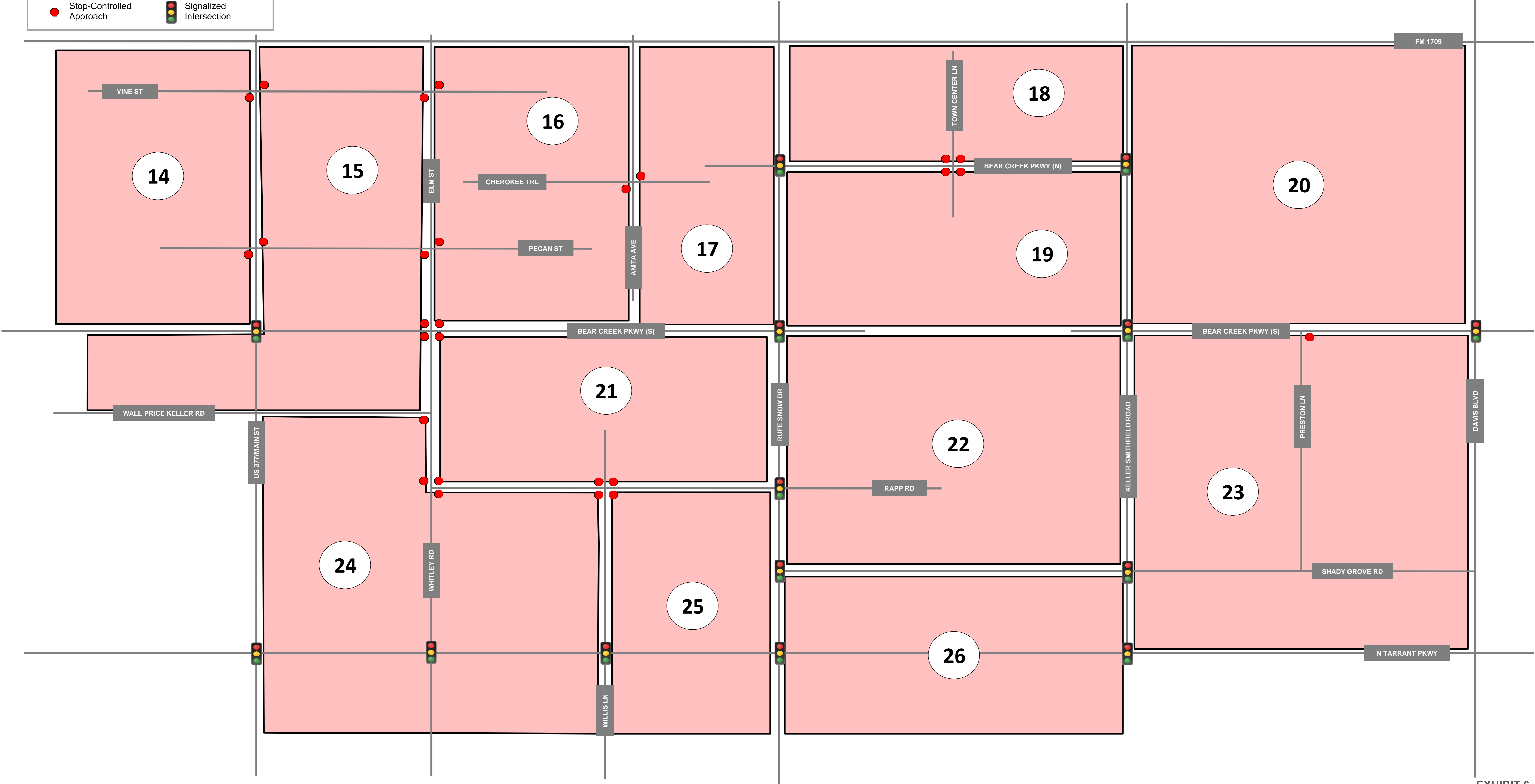
LEGEND

- Existing Facility
- Stop-Controlled Approach
- Signalized Intersection



LEGEND

- Existing Facility
- Stop-Controlled Approach
- Signalized Intersection



Trip Distribution and Assignment

Based on the trip generation estimates for each of the twenty-six (26) analysis zones, a percentage distribution of traffic was calculated to establish the anticipated patterns of trips entering and exiting each respective zone. Trip distribution and subsequent trip assignment of citywide traffic were based on examination of existing traffic volumes, the existing roadway network, and anticipated projections from the FLUP and ITE trip generation patterns. The following global inbound and outbound directional distribution percentages were assumed for the citywide traffic network:

North Keller

- 10% along US 377, north of Marshall Ridge Drive
- 20% along FM 1709, west of Parkway
- 10% along FM 1709, east of Pearson Lane
- 25% along US 377, south of FM 1709
- 20% along Rufe Snow Drive, south of FM 1709
- 15% along Randol Mill Avenue, south of FM 1709

South Keller

- 15% along FM 1709, west of Sports Parkway
- 5% along US 377, north of FM 1709
- 5% along Davis Boulevard, north of FM 1709
- 15% along FM 1709, east of Davis Boulevard
- 15% along North Tarrant Parkway, west of US 377
- 15% along North Tarrant Parkway, east of Davis Boulevard
- 15% along US 377, south of North Tarrant Parkway
- 15% along Rufe Snow Drive, south of Bursey Road

Following the December 2020 report submittal, the following updates were applied to the projected distribution of the City's trips:

- **North Keller Distribution:** A percentage of northbound traffic along Rufe Snow Drive was pulled to proceed north along Keller Smithfield Road.
- **South Keller Distribution:** A percentage of southbound traffic traveling along US 377 was pulled to proceed south along Keller Smithfield Road and Pearson Lane.

The following updated global inbound and outbound directional distribution percentages were assumed for the citywide traffic network, with notable changes in red:

North Keller

- 10% along US 377, north of Marshall Ridge Drive
- 20% along FM 1709, west of Sports Parkway
- 25% along FM 1709, east of Pearson Lane
- 25% along US 377, south of FM 1709
- 10% along Rufe Snow Drive, south of FM 1709
- 10% along Keller Smithfield Road, south of FM 1709

South Keller

- 5% along FM 1709, west of Sports Parkway
- 10% along US 377, north of FM 1709
- 5% along FM 1709, east of Davis Boulevard
- 10% along Pearson Lane, north of FM 1709
- 10% along Keller Smithfield Road, north of FM 1709
- 15% along North Tarrant Parkway, west of US 377
- 15% along North Tarrant Parkway, east of Davis Boulevard
- 15% along US 377, south of North Tarrant Parkway
- 15% along Rufe Snow Drive, south of Bursey Road

Individual exhibits for the trip distribution for each of the twenty-six (26) traffic analysis zones can be found in the traffic model. These exhibits display global and local inbound and outbound trip distributions throughout the City for each scenario.

Thoroughfare Capacity (Link LOS) Component

An additional component of the traffic model and subsequent update of the City’s MTP involves the use of the model to analyze the major roadways (or links) on the current thoroughfare plan in terms of existing capacity. In order to evaluate the capacity of the facilities on the MTP, a thoroughfare capacity analysis was performed to determine the appropriate number of lanes needed to serve existing and future demand. Information and guidelines that were utilized for link LOS analysis come from the North Central Texas Council of Governments (NCTCOG).

The traffic condition criteria are based on the volume-to-capacity ratio for traffic volumes and roadway capacity. The roadway capacity values used in this analysis are shown in **Figure 3**. Acceptable grades are assigned to roadways with V/C ratios below 0.65, while a tolerable grade is attributed to roadways with a V/C ratio between 0.65 and 1.00. Both of these conditions indicate that carry capacity has been met. Roadways with grades over 1.00 are considered to be operating at failing conditions, indicating that the roadway’s carry capacity has been exceeded.

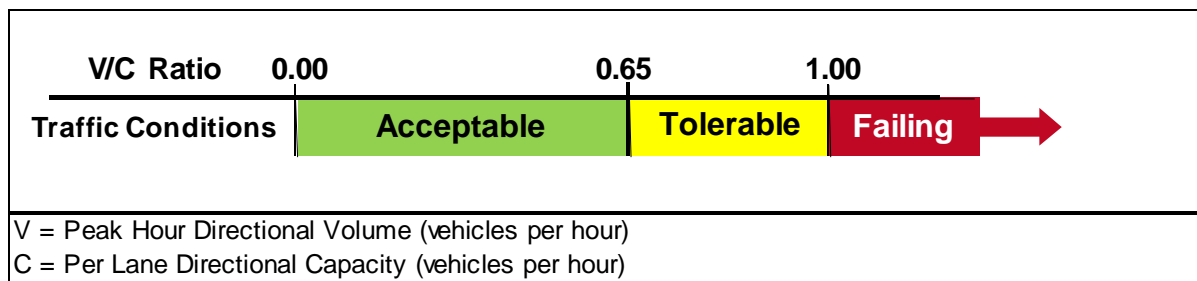


Figure 3. Traffic Condition Criteria for Thoroughfare Capacity

Under the guidance of NCTCOG, standard hourly vehicle capacities per lane are provided for multiple roadway facility types based on area type (CBD, rural, etc.). Due to the nature of the traffic conditions and operations in the City of Keller, the thoroughfare capacity analysis classifies the entire city as a *Suburban Residential* area type. Based on these factors, the following roadway capacity values (**Table 4**) were implemented into the model to calculate a V/C ratio.

Table 4. Suburban Residential Thoroughfare Capacity Thresholds (NCTCOG)

Existing Configuration	Keller MTP Classification		NCTCOG Classification	Directional Capacity (vphpl)
2U-C	Collector	Undivided	Local	395
2U-ULT	Collector	Undivided	Collector	525
3U	Collector	Undivided	Collector	525
4D	Arterial	Divided	Minor Arterial	900
4U	Collector	Undivided	Collector	525
5U	Arterial	Undivided	Minor Arterial	825
6D	Arterial	Divided	Principal Arterial	925
6U	Arterial	Undivided	Principal Arterial	875
7U	Arterial	Divided	Principal Arterial	925

Based on the capacity thresholds and existing volumes, AM and PM peak hour V/C ratios were calculated for each roadway facility listed on the City’s thoroughfare plan with available volume data. Based on the analysis results, notable failures include:

- Bear Creek Parkway, from US 377 to Rufe Snow Drive
- Bourland Road, from Mount Gilead Road to Johnson Road
- Johnson Road, from Bourland Road to Keller Smithfield Road
- Keller Smithfield Road, Bear Creek Parkway to Rosewood Drive
- Mount Gilead Road, from US 377 to Roanoke Road
- Roanoke Road, from Melody Lane to Mount Gilead Road
- Whitley Road, from Bear Creek Parkway to Rapp Road

Capacity conditions at these and other locations were taken into consideration during both intersection capacity analysis and recommendations procedures for specific intersections and the overall City of Keller. Specific capacity improvement recommendations will be outlined further into the report, with particular attention given to the intersections along and adjacent to the City’s more active thoroughfares. The results from the analysis are provided in the traffic model.

Prioritization of Roadway Projects

To begin the process of prioritizing roadway projects, the traffic model calculates an average prioritization factor that measures the overall capacity of the thoroughfare in question. This thoroughfare prioritization factor is based on the AM and PM peak hour directional V/C ratios collected for each roadway segment. The model then categorizes each roadway facility based on the criteria outlined in **Figure 4**. Thoroughfare prioritization procedures are provided in the traffic model with the thoroughfare capacity results.

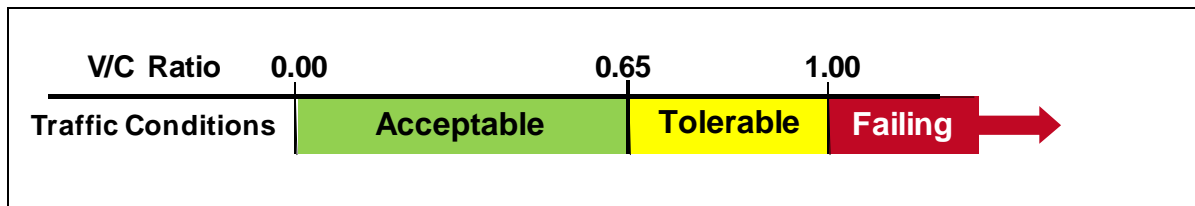


Figure 4. Thoroughfare Prioritization Criteria

The results of the thoroughfare capacity analysis are a major component in the development of the prioritization of roadway projects. However, the overall prioritization also takes the following factors into consideration during evaluation, and adjustments were made accordingly:

- Adjacent intersections with notable concerns;
- Thoroughfares with a significant crash history;
- Correspondence with the City of Keller; and
- Any roadway facilities that are currently built to completion or nearing completion. These were removed from prioritization consideration.

An overall map of prioritized roadway recommendations can be found further into the report on **Exhibit 13 (pg. 32)**, which also presents prioritized intersection recommendations, discussed in a later section.

CITYWIDE INTERSECTION EVALUATION

The second task of the MTP update involves the analysis of Keller’s current traffic network, with an emphasis on the City’s MTP-specific thoroughfares and major intersections. The evaluation of the existing roadway system was comprised of the Weekday AM and PM peak hour level of service analysis. For the forty-five (45) study area intersections, analysis was accomplished via the construction of a citywide traffic model in *Synchro 10™* software. The purpose of this analysis was to analyze any potential deficiencies within the network and to establish a baseline condition.

Capacity defines the volume of traffic that can be accommodated by a roadway at a specified “level-of-service.” Capacity is affected by various geometric factors including roadway type (e.g. divided or undivided), number of lanes, lane widths, and grades. Level-of-service (LOS), which is a measure of the degree of congestion, ranges from LOS “A” (free flowing) to LOS “F” (a congested, forced flow condition). LOS “C” is considered the minimum level of service for design and evaluation purposes. A description of each operational state for both signalized and unsignalized intersections, based on the Highway Capacity Manual, is presented in **Table 5**.

Table 5. Level of Service Thresholds

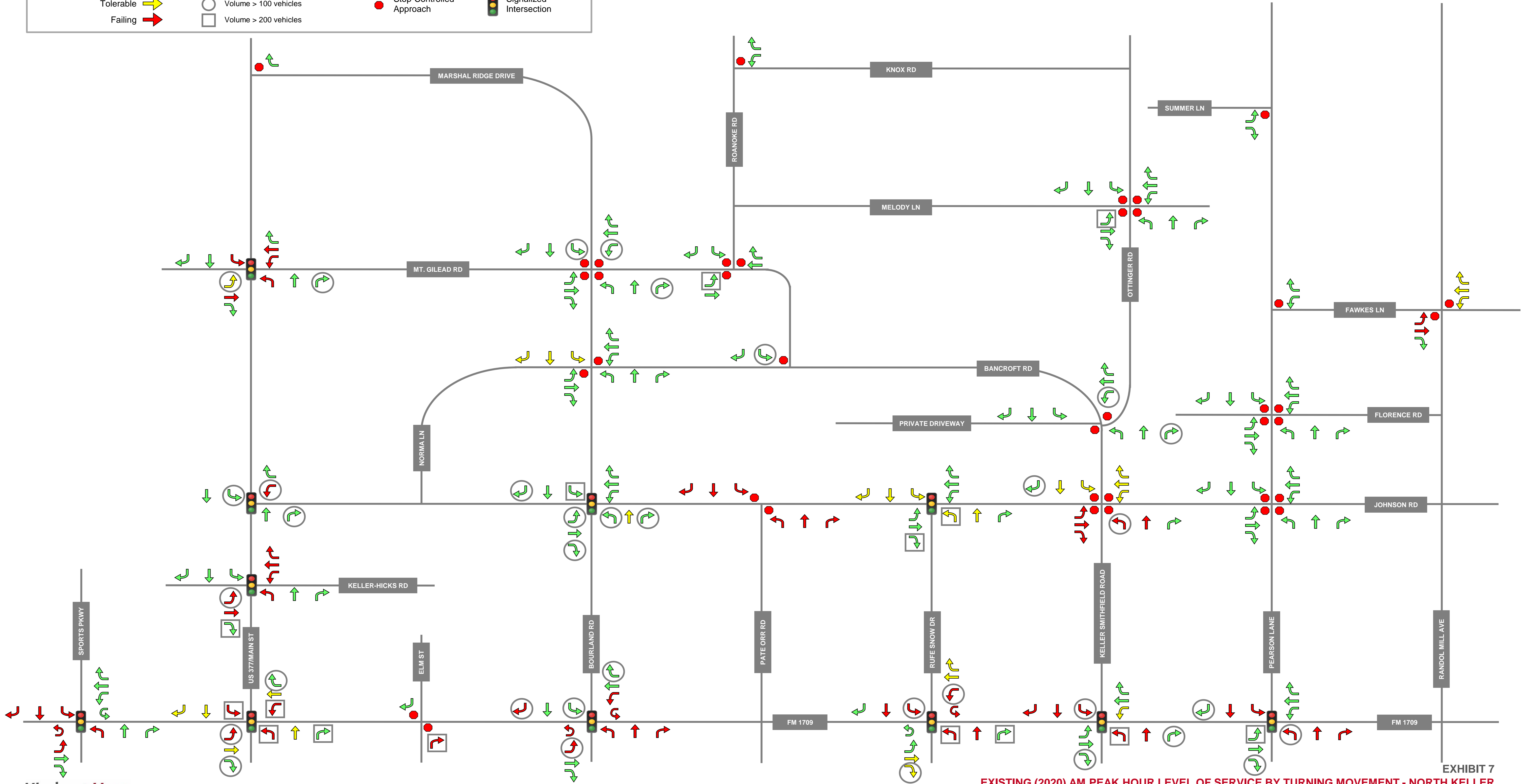
Level of Service	Stop-Controlled	Signalized	Intersection Rating
	Delay (average per veh)*	Delay (average per veh)*	
A	0-10 sec	0-10 sec	Acceptable
B	> 10-15 sec	> 10-20 sec	
C	> 15-25 sec	> 20-35 sec	
D	> 25-35 sec	> 35-55 sec	Tolerable
E	> 35-50 sec	> 55-80 sec	Failing
F	> 50 sec	> 80 sec	

The citywide traffic model considers many factors when calculating the level of service at each of the forty-five (45) intersections, including:

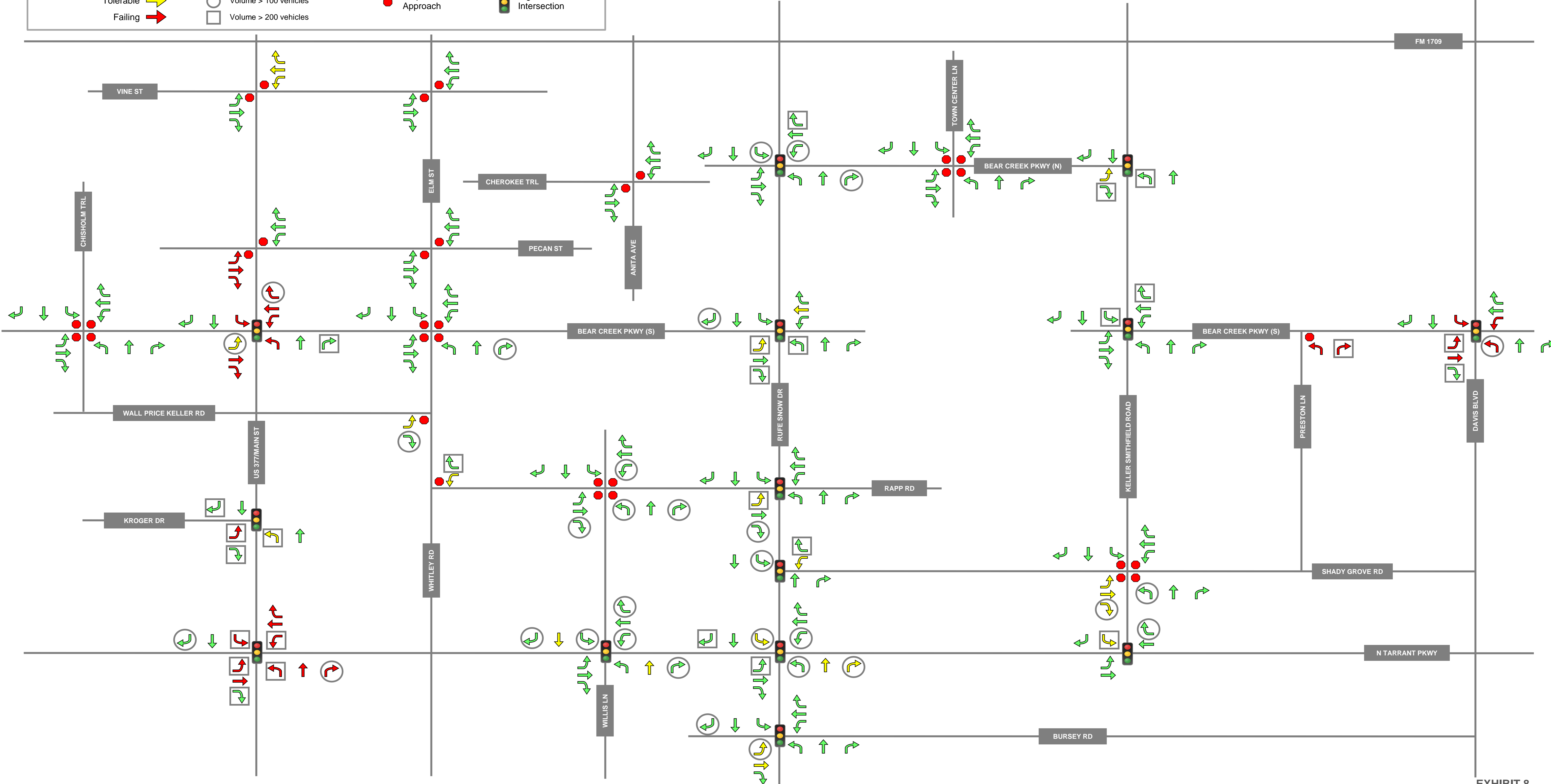
- posted speed limits;
- intersection control;
- signal timing; and
- lane configurations along arterials and at intersections.

Existing (2020) AM and PM peak hour level of service (LOS) results for each individual movement of all forty-five (45) major intersections in the City of Keller can be found on **Exhibits 7-10**. Also noted on the exhibits are specific turning movement volumes greater than 100 and 200 vehicles per hour. Recommendations based on the intersection capacity analysis can be found in the next section. Note the color correspondence between *Intersection Ratings* and *Level of Service* when reviewing the LOS exhibits.

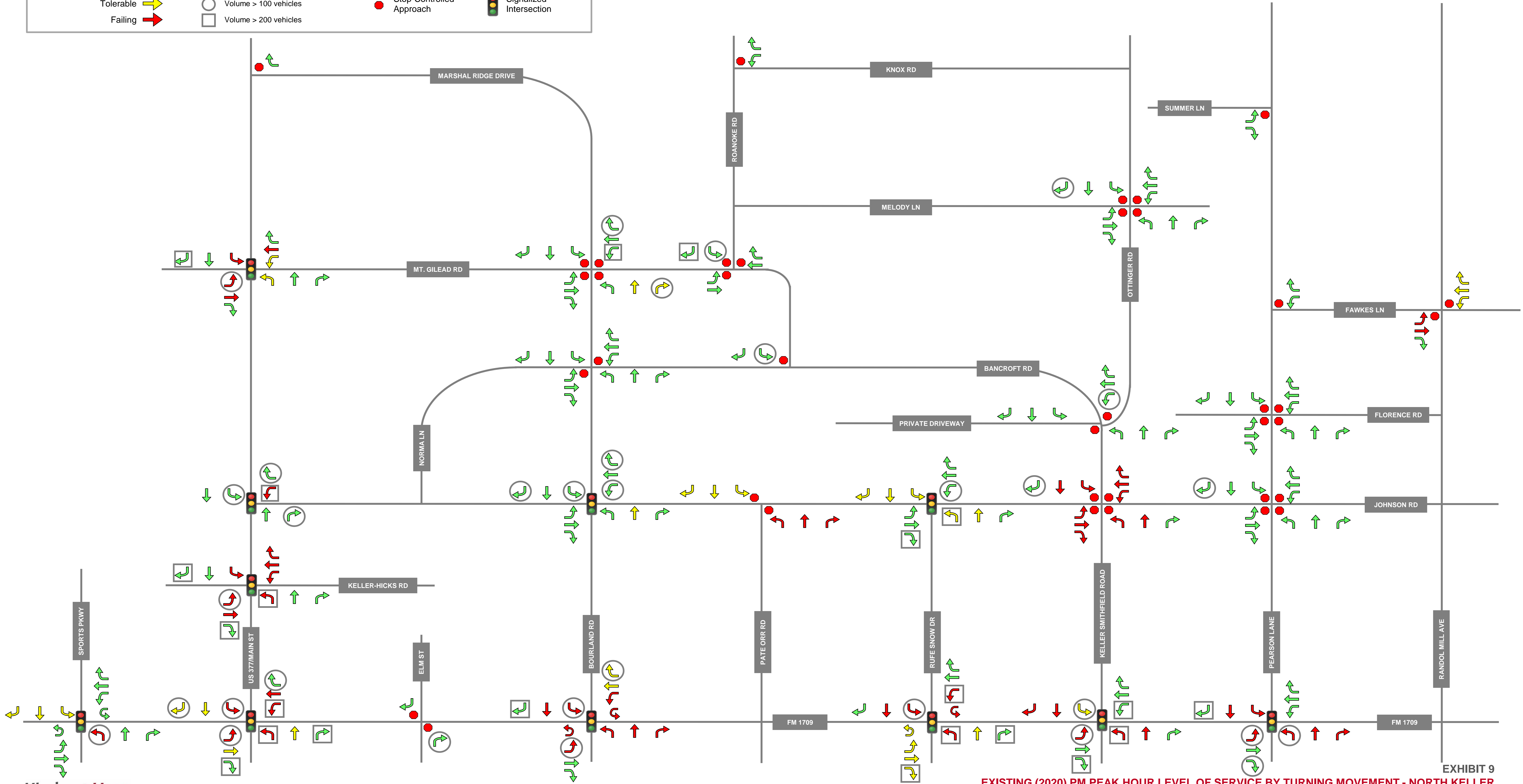
LEGEND			
LEVEL OF SERVICE		Existing Facility	
Acceptable	→	●	●
Tolerable	→	●	●
Failing	→	●	●
LEFT & RIGHT TURNING MOVEMENT VOLUMES			
○	Volume > 100 vehicles		
□	Volume > 200 vehicles		



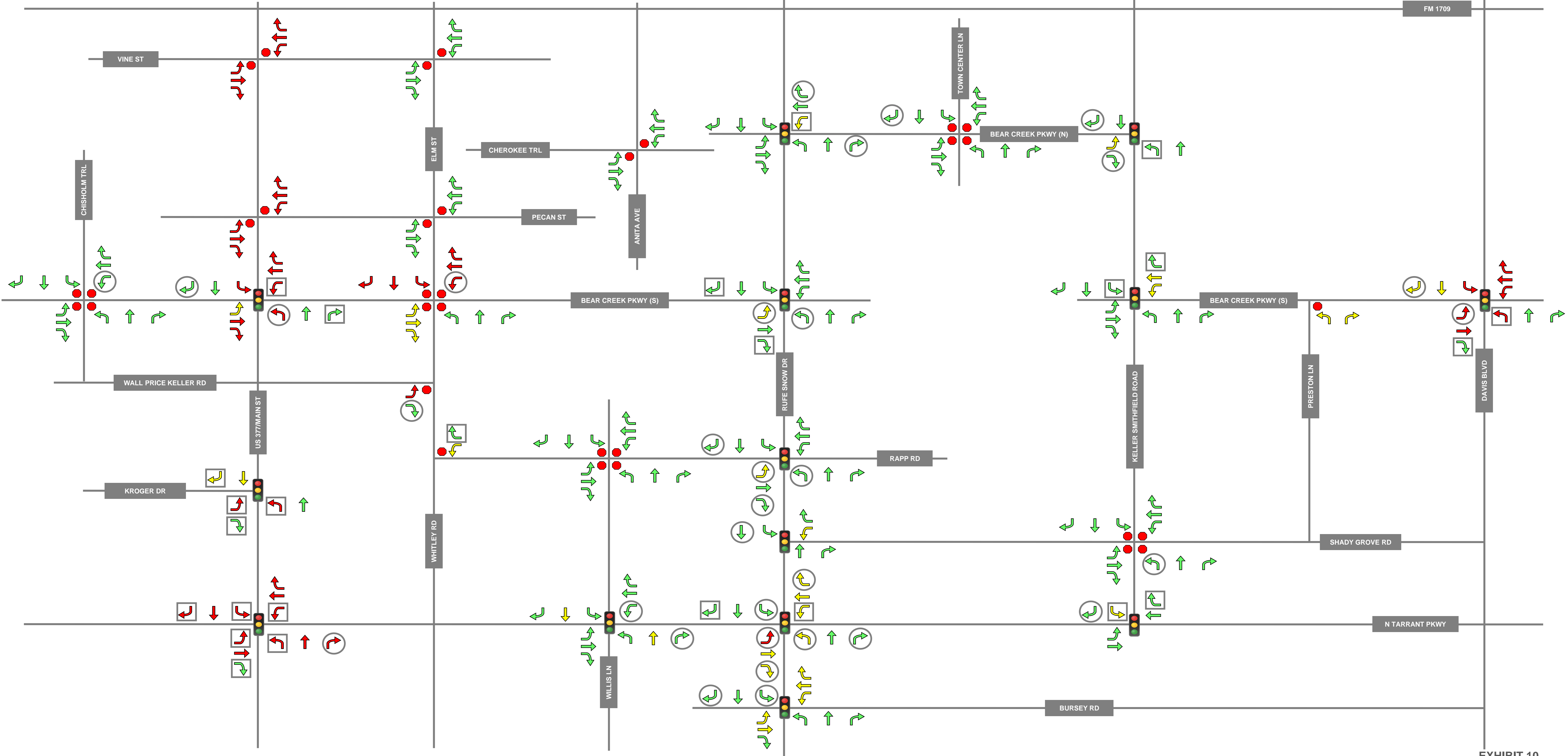
LEGEND		
LEVEL OF SERVICE		
Acceptable	→	
Tolerable	→	
Failing	→	
LEFT & RIGHT TURNING MOVEMENT VOLUMES		
○	Volume > 100 vehicles	
□	Volume > 200 vehicles	
Existing Facility		
●	Stop-Controlled Approach	
⬆	Signalized Intersection	



LEGEND			
LEVEL OF SERVICE		Existing Facility	
Acceptable	LEFT & RIGHT TURNING MOVEMENT VOLUMES ○ Volume > 100 vehicles □ Volume > 200 vehicles	Stop-Controlled Approach	Signalized Intersection
Tolerable			
Failing			



LEGEND		
LEVEL OF SERVICE		
Acceptable	→	
Tolerable	→	
Failing	→	
LEFT & RIGHT TURNING MOVEMENT VOLUMES		
○	Volume > 100 vehicles	
□	Volume > 200 vehicles	
Existing Facility		
●	Stop-Controlled Approach	
●	Signalized Intersection	



UPDATES TO THE THOROUGHFARE PLAN

The following section outlines the major updates that were considered and applied to a proposed updated thoroughfare plan for the City of Keller. These updates were determined based on comments provided by City staff, recommendations based on the citywide intersection evaluation, and proposed mitigations from the Tarrant County 2021 Transportation Bond Program Call for Projects. A discussion of these updates is provided below:

Roadway and Intersection Updates

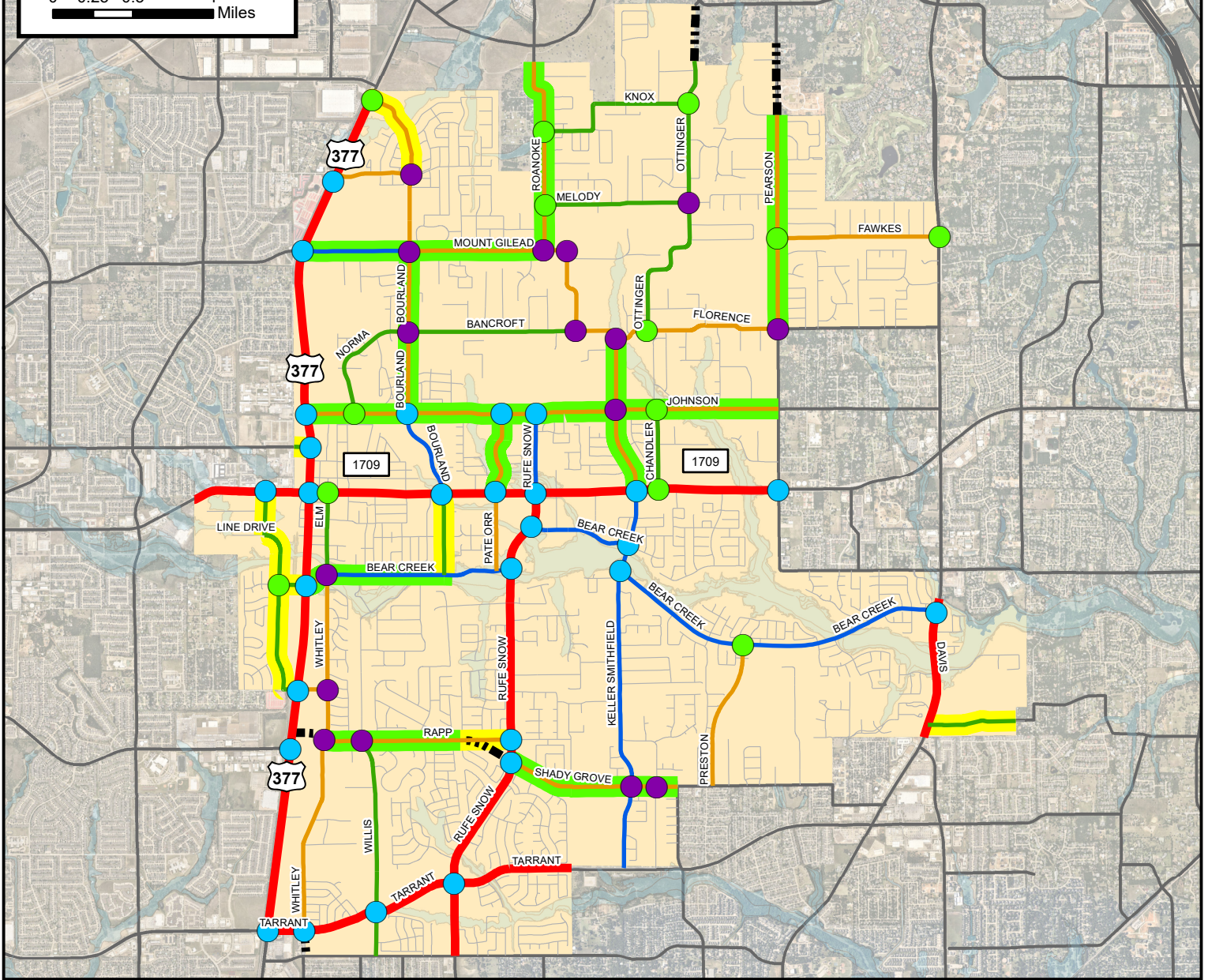
- The thoroughfare plan—currently referred to as the “Master” Thoroughfare Plan, is proposed to be **renamed to the Major Thoroughfare Plan** to maintain consistency with State language.
- Based on City input, **four-lane undivided collectors will no longer be defined on the thoroughfare plan.** All roads that have this designation in the 2012 Master Thoroughfare Plan have been reclassified to either a four-lane divided arterial or a three-lane undivided collector in the proposed update.
- In terms of the City’s intersections, the 2012 MTP only notes select signalized intersections between MTP thoroughfares. **The updated MTP proposal includes a total of fifty-eight (58) of the City’s major intersections, including existing and proposed signalized intersections, unsignalized intersections, and roundabouts.**
- The 2012 MTP proposed a diagonal extension of Rapp Road, planned to be constructed along an existing pedestrian trail and tying into the existing signalized intersection of Rufe Snow Drive and Shady Grove Road. **This proposed Rapp Road extension has been removed from the proposed update based on City input.**
 - An additional segment of Rapp Road—proposed to extend east to Whitley Road from US 377—was also included in the 2012 MTP. **Based on City input, this Rapp Road segment has also been removed from the updated thoroughfare plan.**
- The 2012 MTP also proposed a widening of Pearson Lane, planned at Florence Road and extending north to Dove Road in the City of Westlake. **The limits of this widening have been updated, with the northern boundary shifting south to Spring Drive in the City of Keller.**
- Shady Grove Road is currently denoted as a four-lane divided arterial on Keller’s 2012 MTP within the City limits. East of Smithfield Road, Shady Grove Road falls on the border of the City limits of both Keller and North Richland Hills. The City of North Richland Hills Vision 2030 Transportation Plan defines Shady Grove as a two-lane collector. **Based on recommendations from the Tarrant County 2021 Transportation Bond, the ultimate functional classification has been updated to apply a three-lane undivided configuration along the segments of Shady Grove Road that are not already fully built within the City limits of Keller.**
- **The following roadways are proposed for addition to the updated Major Thoroughfare Plan:**
 - 2 Lane Collectors (C2U)
 - i. Sports Parkway, FM 1709 to Apache Trail
 - ii. Chisholm Trail, Apache Trail to Wall Price Keller Road
 - iii. Bear Creek Parkway, Chisholm Trail to US 377
 - iv. Bourland Road/Anita Avenue, FM 1709 to Bear Creek Parkway
 - v. Keller Hicks Road, Western City Limits to FM 1709
 - vi. Bandit Trail, Davis Boulevard to Eastern City Limits
 - 3 Lane Collector (C3U)
 - i. Rapp Road, Muirfield Road to Rufe Snow Drive
 - ii. Marshall Ridge Parkway, US 377 to Ridge Point Parkway

A map outlining the proposed updates to the 2012 Master Thoroughfare Plan can be found in **Exhibit 11**, with a proposed updated 2021 Major Thoroughfare Plan presented in **Exhibit 12**.



0 0.25 0.5 1 Miles

Exhibit 11. 2021 Proposed Major Thoroughfare Plan Updates to the 2012 Plan City of Keller, TX September 2022 Kimley»Horn



Legend

2021 Thoroughfare Plan Designation

- 6 Lane Divided Arterial (A6D)
- 4 Lane Divided Arterial (A4D)
- 3 Lane Collector (C3U)
- 2 Lane Collector (C2U)

Intersection Status

- Unsignalized
- Signalized
- Roundabout

Updates from the 2012 Plan

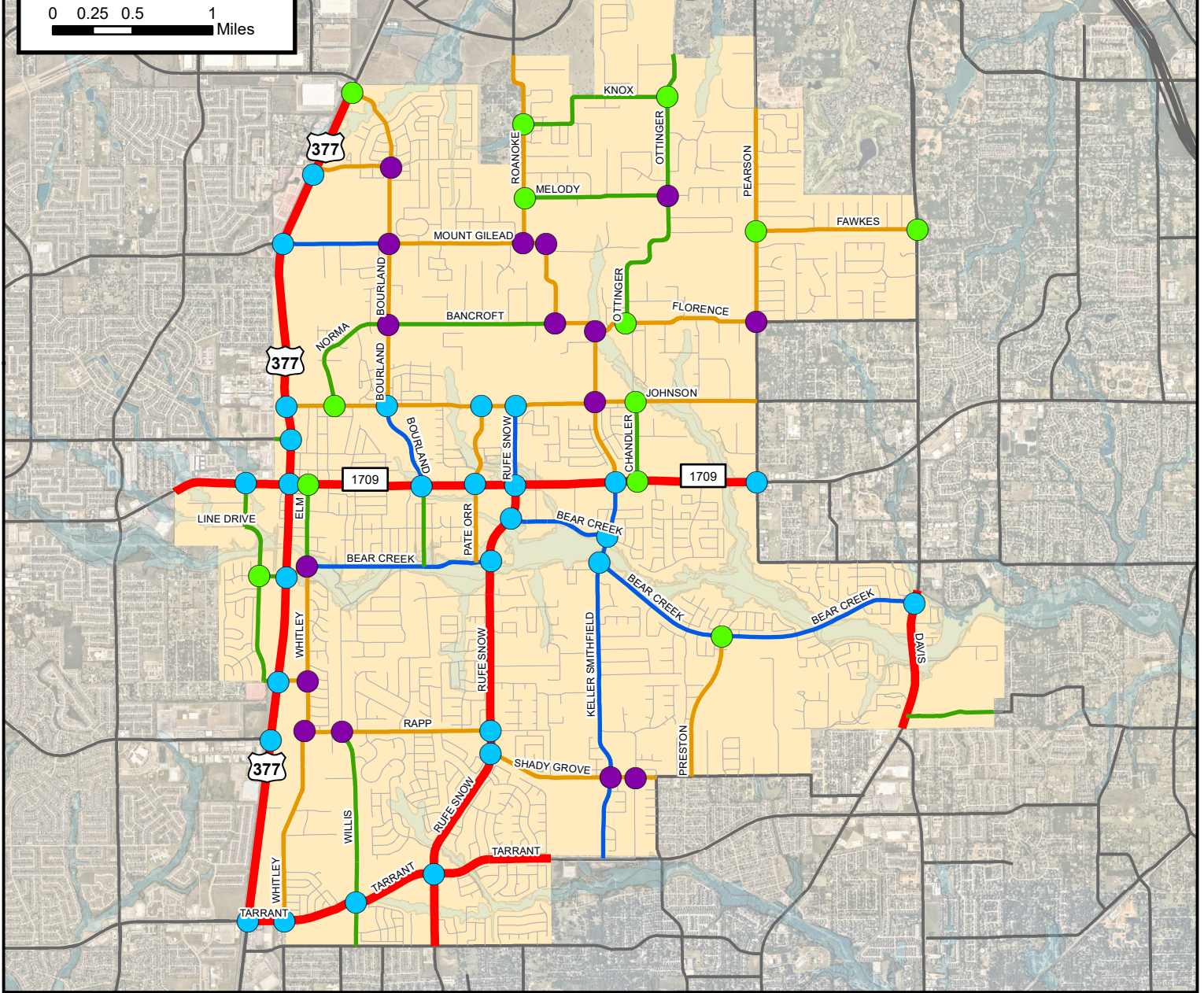
- Addition
- Class Change
- Proposed Removal

	A6D	A4D		C3U		C2U (PARKING)		C2U (LOCAL)		RURAL ^D
		SIDEWALK	TRAIL	SIDEWALK	TRAIL	SIDEWALK	TRAIL	SIDEWALK	TRAIL	
Number of Traffic Lanes	6	4	4	3	3	2	2	2	2	2
ROW Width (ft)	124	100	100	70	70	70	70	50	50	60
Lane Width (ft)										
Vehicle Lane	12	12	12	12	12	12	12	15	15	12
On-Street Parking Lane	---	---	---	---	---	8	8	---	---	---
Median	18 ^A	18	18	14 ^B	14 ^B	---	---	---	---	---
Sidewalk Width (ft)	6	6	10 ^C	5	10 ^C	5	10 ^C	5	8 ^C	---
Parkway Width (ft)	10	10	6	10	5	10	5	4	---	---
^A Includes 5' raised median + two 0.5' buffers + 12' center left-turn lane										
^B Two-Way Left-Turn Lane										
^C Trail										
^D Assuming an open bar ditch										



0 0.25 0.5 1 Miles

Exhibit 12. 2021 Proposed Major Thoroughfare Plan City of Keller, TX September 2022 Kimley»Horn



Legend

2021 Thoroughfare Plan Designation

- 6 Lane Divided Arterial (A6D)
- 4 Lane Divided Arterial (A4D)
- 3 Lane Collector (C3U)
- 2 Lane Collector (C2U)
- Adjacent City Thoroughfares

Intersection Status

- Unsignalized
- Signalized
- Roundabout

	A6D	A4D		C3U		C2U (PARKING)		C2U (LOCAL)		RURAL ^D
		SIDEWALK	TRAIL	SIDEWALK	TRAIL	SIDEWALK	TRAIL	SIDEWALK	TRAIL	
Number of Traffic Lanes	6	4	4	3	3	2	2	2	2	2
ROW Width (ft)	124	100	100	70	70	70	70	50	50	60
Lane Width (ft)										
<i>Vehicle Lane</i>	12	12	12	12	12	12	12	15	15	12
<i>On-Street Parking Lane</i>	---	---	---	---	---	8	8	---	---	---
<i>Median</i>	18 ^A	18	18	14 ^B	14 ^B	---	---	---	---	---
Sidewalk Width (ft)	6	6	10 ^C	5	10 ^C	5	10 ^C	5	8 ^C	---
Parkway Width (ft)	10	10	6	10	5	10	5	4	---	---

^AIncludes 5' raised median + two 0.5' buffers + 12' center left-turn lane

^BTwo-Way Left-Turn Lane

^CTrail

^DAssuming an open bar ditch

Proposed Cross Sections

In support of the update to the City's 2012 Master Thoroughfare Plan, Kimley-Horn was also asked to evaluate the City's current roadway cross section design standards and provide additional updates and recommendations. As discussed previously, four-lane undivided collectors will no longer be defined on the thoroughfare plan. With this consideration, proposed cross sections and associated recommended design elements were provided for seven roadway types based on guidelines outlined in the City's Subdivision Ordinance. Note that the MTP does not provide for any bike paths or shared lanes in the proposed cross section update. The roadway cross sections included in the proposed update are shown below in **Table 6** and **Figures 5-10**:

- 6-Lane Divided Arterials (A6D)
- 4-Lane Divided Arterials (A4D)
 - Sidewalk Option
 - Trail Option
- 3-Lane Undivided Collectors (C3U)
 - Sidewalk Option
 - Trail Option
- 2-Lane Undivided Collectors (C2U)
 - On-Street Parking Option
 - i. Sidewalk Option
 - ii. Trail Option
 - Local / Residential Option
 - i. Sidewalk Option
 - ii. Trail Option
- Rural / Unpaved Roads

Table 6. Proposed Roadway Cross Section Design Standards

	A6D	A4D		C3U		C2U (PARKING)		C2U (LOCAL)		RURAL ^D
		SIDEWALK	TRAIL	SIDEWALK	TRAIL	SIDEWALK	TRAIL	SIDEWALK	TRAIL	
Number of Traffic Lanes	6	4	4	3	3	2	2	2	2	2
ROW Width (ft)	124	100	100	70	70	70	70	50	50	60
Lane Width (ft)										
Vehicle Lane	12	12	12	12	12	12	12	15	15	12
On-Street Parking Lane	---	---	---	---	---	8	8	---	---	---
Median	18 ^A	18	18	14 ^B	14 ^B	---	---	---	---	---
Sidewalk Width (ft)	6	6	10 ^C	5	10 ^C	5	10 ^C	5	8 ^C	---
Parkway Width (ft)	10	10	6	10	5	10	5	4	---	---
^A Includes 5' raised median + two 0.5' buffers + 12' center left-turn lane										
^B Two-Way Left-Turn Lane										
^C Trail										
^D Assuming an open bar ditch										

The following measurement assumptions were applied to the determination of each proposed cross section:

- Each proposed cross section assumes a **one-foot gap between the edge of the available ROW and the edge of the associated sidewalk/sidepath** on either side of the facility.
- A **curb width of 0.5 feet is assumed within the measurement of each respective parkway** for all applicable cross sections. **Drive lane widths are measured between curb faces** and do not consider the width of the curb, itself.

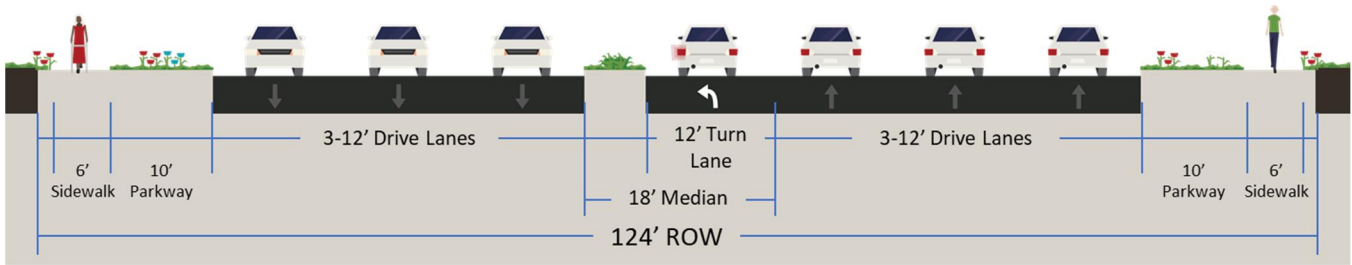


Figure 5. Proposed Cross Section: 6-Lane Divided Arterial

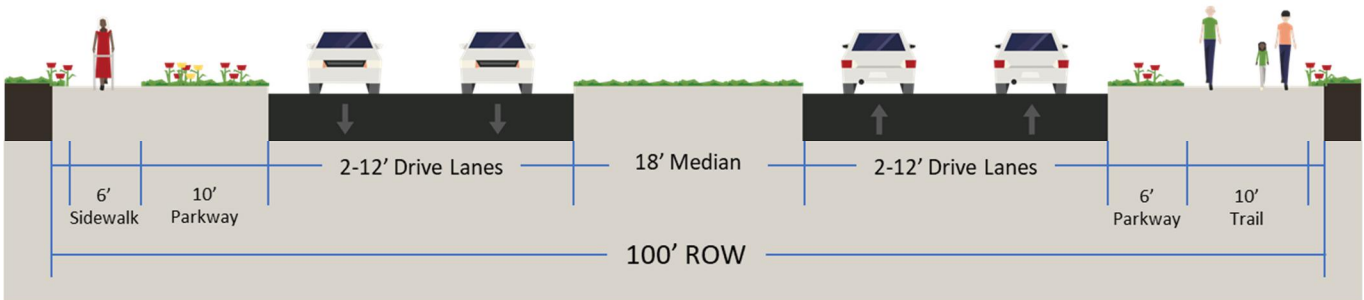


Figure 6. Proposed Cross Section: 4-Lane Divided Arterial – Sidewalk vs. Trail Option

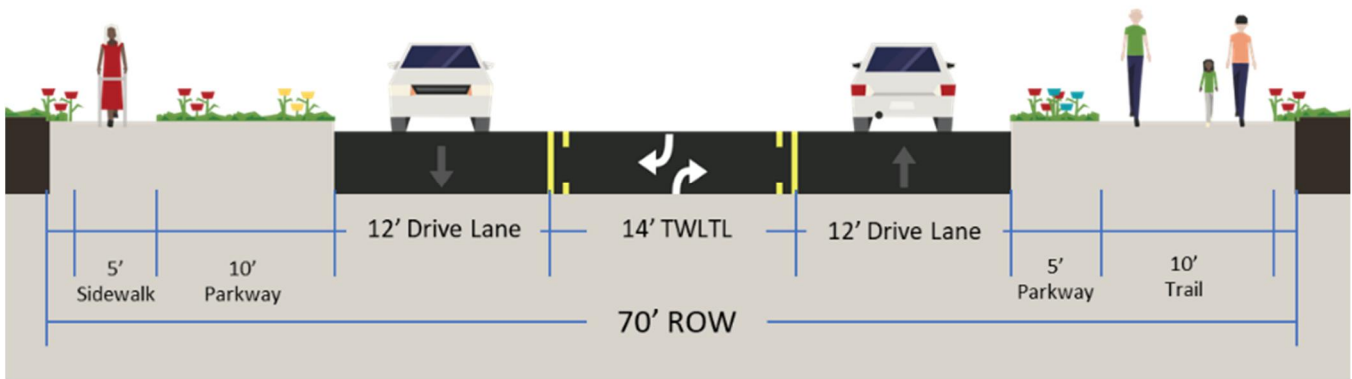


Figure 7. Proposed Cross Section: 3-Lane Undivided Collector – Sidewalk vs. Trail Option

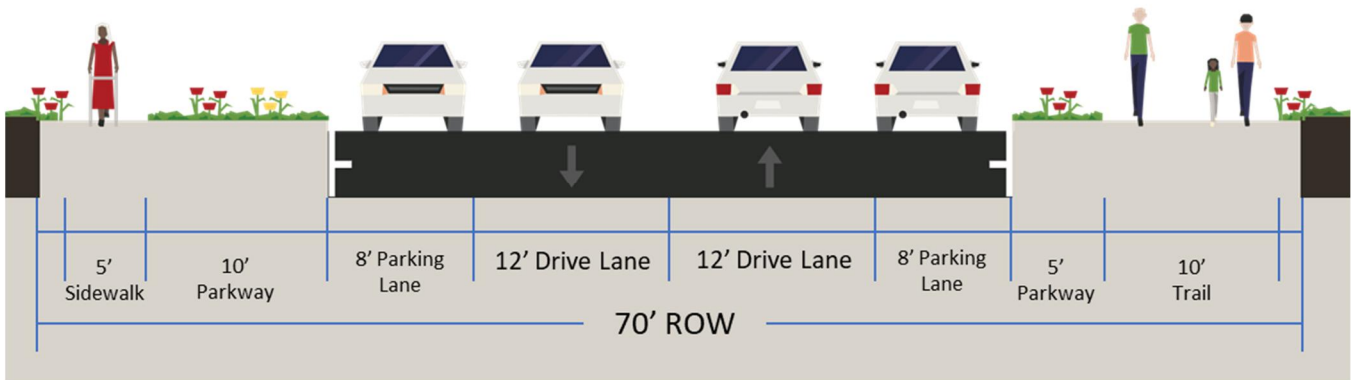


Figure 8. Proposed Cross Section: 2-Lane Undivided Collector (On-Street Parking) – Sidewalk vs. Trail Option

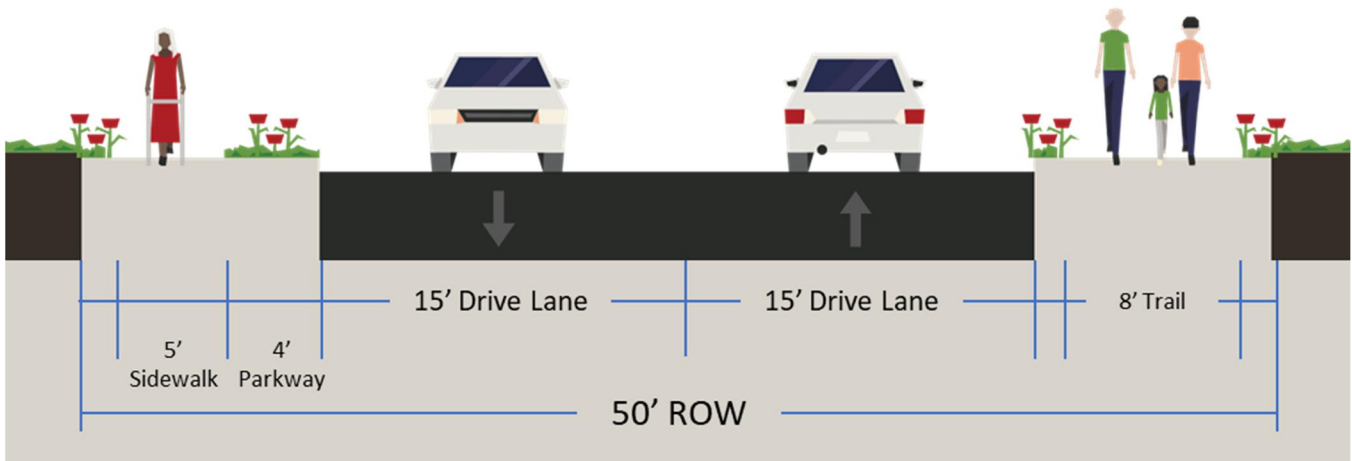


Figure 9. Proposed Cross Section: 2-Lane Undivided Collector (Local/Residential) – Sidewalk vs. Trail Option

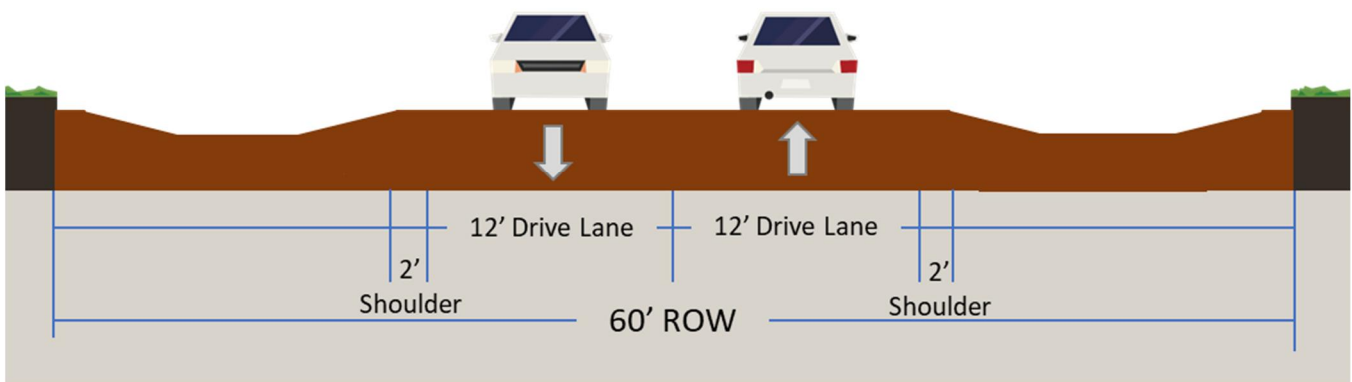


Figure 10. Proposed Cross Section: Rural Road (assuming an open bar ditch)

RECOMMENDATIONS

Based on the results of the field work, historical crash data, link LOS analysis, *Synchro 10TM* intersection capacity analysis, and input from the City, the following observations are provided regarding the following signalized and unsignalized major intersections in the City of Keller:

The following two (2) intersections feature two roadway facilities that **are not the responsibility of the City of Keller**; therefore, no recommendations were provided:

- US 377 & FM 1709
- US 377 & North Tarrant Parkway

Global Citywide Recommendations

Through field observations and commonalities in results between adjacent analysis intersections, the following global recommendations are offered for consideration throughout the City:

- Establish consistent signal timing and phasing along signalized corridors.
- Eliminate split phasing wherever possible by isolating lane movements at certain intersection approaches.
- Incorporate flashing yellow arrows (FYA) at signalized intersections that currently have (or potentially could have) a form of Protected/Permitted left turn phasing.
- Explore dual lefts at a potential enhancement in locations where opposing peak traffic are left turns are near or greater than 200 vehicles-per-hour (vph) on arterials and 150 vph or less collectors.
- Field observations indicate certain intersections with curb ramps that were in poor condition and may not be compliant with the best practices as defined by the Americans with Disabilities Act (ADA). It is recommended that all major signalized intersections have adequate ramps to serve all possible pedestrian crossing movements.

Intersection-Specific Recommendations

Based on the analysis procedures and City input, recommendations and observations were provided for seventeen (17) of the City's 58 MTP intersections, identifying critical movements and any problem areas, while considering factors such as increased turning movement volumes, thoroughfare capacity, and the effects of queueing on adjacent intersections and properties.

An overall map of prioritized intersection recommendations can be found on **Exhibit 13**, which also presents prioritized roadway recommendations, discussed previously. Intersection prioritization was based on factors such as LOS, turning volumes, queues, crash data, and field observations.

Following **Exhibit 13** are individualized recommendations sheets for each of the seventeen (17) intersections. Each intersection is given an overall conditional rating of Acceptable, Tolerable, or Failing based on both AM and PM peak hour LOS conditions:

Level of Service	Stop-Controlled	Signalized	Intersection Rating
	Delay (average per veh)*	Delay (average per veh)*	
A	0-10 sec	0-10 sec	Acceptable
B	> 10-15 sec	> 10-20 sec	
C	> 15-25 sec	> 20-35 sec	
D	> 25-35 sec	> 35-55 sec	Tolerable
E	> 35-50 sec	> 55-80 sec	Failing
F	> 50 sec	> 80 sec	

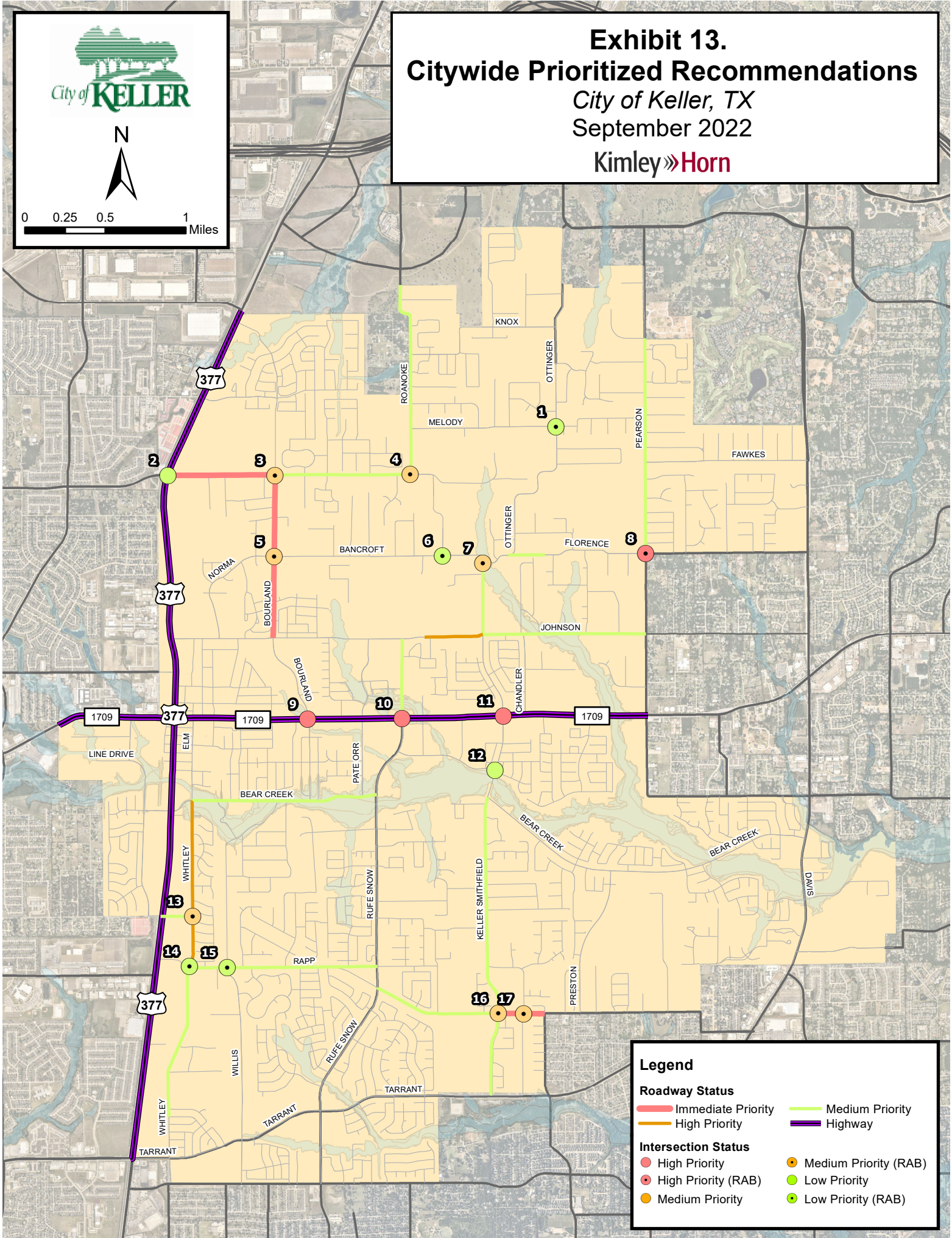
Individual recommendations and observations were provided for the following seventeen (17) intersections:

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Ottinger Road & Melody Lane 2. US 377 & Mount Gilead Road 3. Mount Gilead Road & Bourland Road 4. Mount Gilead Road & Roanoke Road 5. Bancroft Road & Bourland Road 6. Bancroft Road & Mount Gilead Road 7. Keller Smithfield Road & Ottinger Road 8. Pearson Lane & Florence Road 9. FM 1709 & Bourland Road | <ol style="list-style-type: none"> 10. FM 1709 & Rufe Snow Drive 11. FM 1709 & Keller Smithfield Road 12. Bear Creek Parkway (N) & Keller Smithfield Road 13. Whitley Road & Wall Price Keller Road 14. Whitley Road & Rapp Road 15. Willis Lane & Rapp Road 16. Shady Grove Road & Keller Smithfield Road 17. Shady Grove Road & Sarah Brooks Drive |
|--|--|



0 0.25 0.5 1 Miles

Exhibit 13. Citywide Prioritized Recommendations City of Keller, TX September 2022 Kimley»Horn



Legend

Roadway Status

- Immediate Priority
- High Priority
- Medium Priority
- Highway

Intersection Status

- High Priority
- High Priority (RAB)
- Medium Priority
- Medium Priority (RAB)
- Low Priority
- Low Priority (RAB)

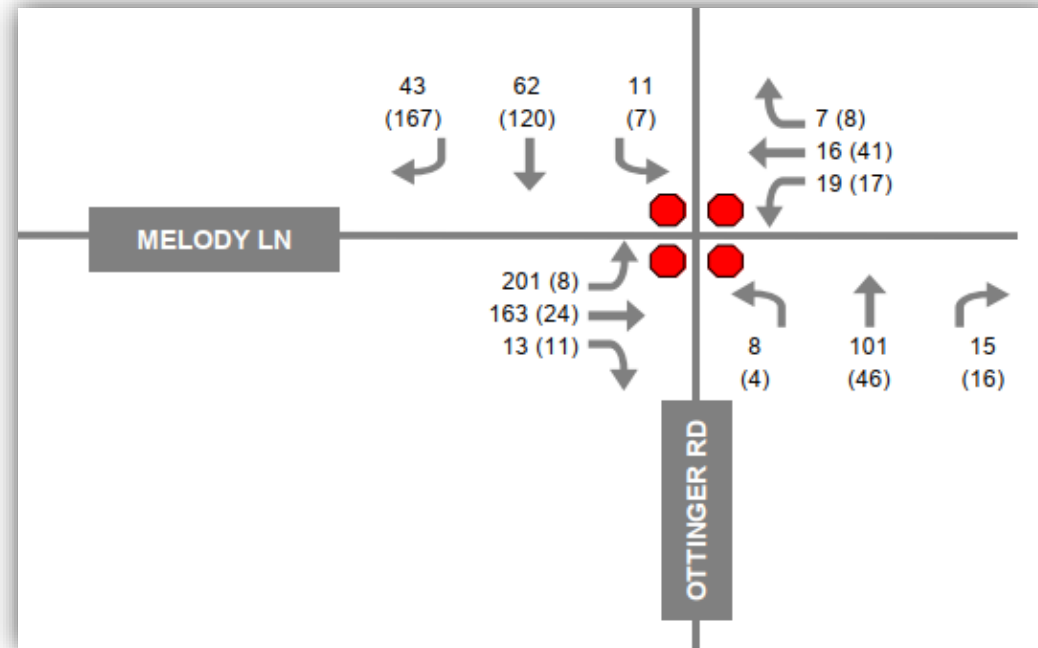
Citywide Intersection Analysis Recommendations:

1. Ottinger Road & Melody Lane



Overall Conditions

- AM: Acceptable
- PM: Acceptable



X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

Based on estimated 2020 traffic volumes

- Monitor current traffic conditions for the consideration of a future roundabout reconfiguration.

Citywide Intersection Analysis Recommendations:

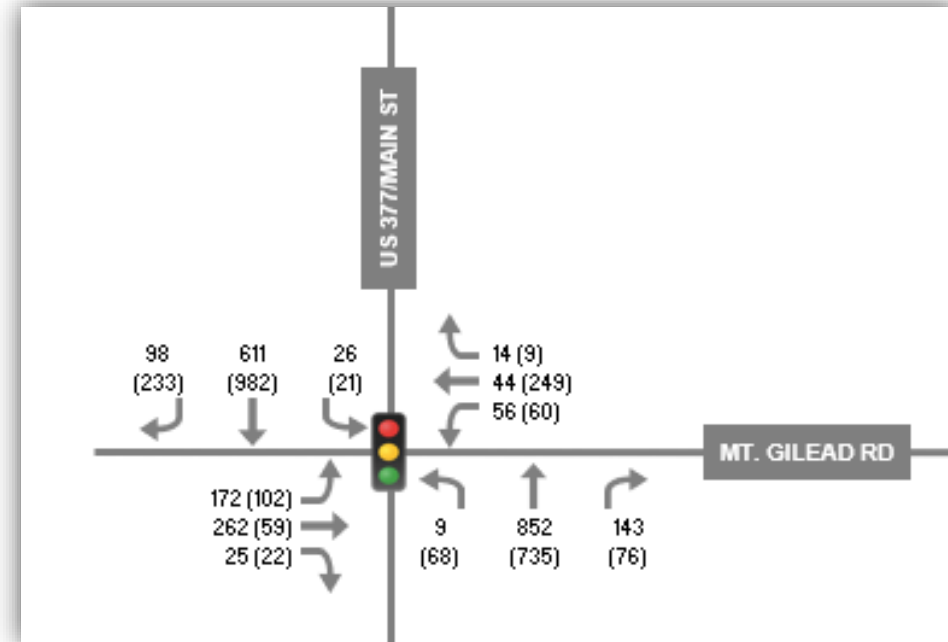
2. US 377 & Mount Gilead Road



Based on estimated
2020 traffic volumes

Overall
Conditions

- AM: Acceptable
- PM: Acceptable



X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

- **Install dual SB left turns** when Mount Gilead Road is widened to its ultimate configuration in the MTP.

Citywide Intersection Analysis Recommendations:

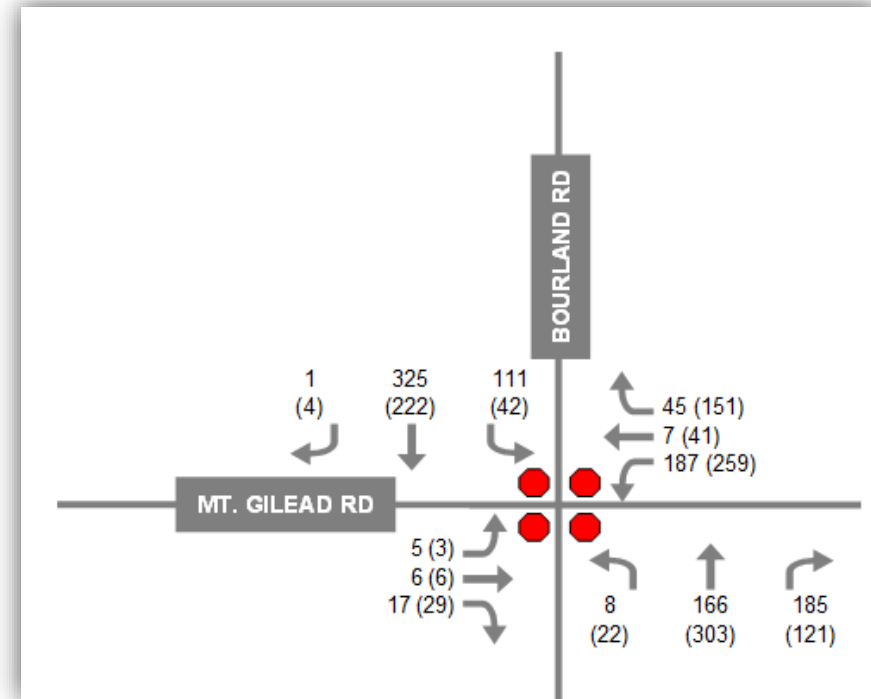
3. Mount Gilead Road & Bourland Road



Based on estimated
2020 traffic volumes

Overall
Conditions

- AM: Acceptable
- PM: Acceptable



X (Y)

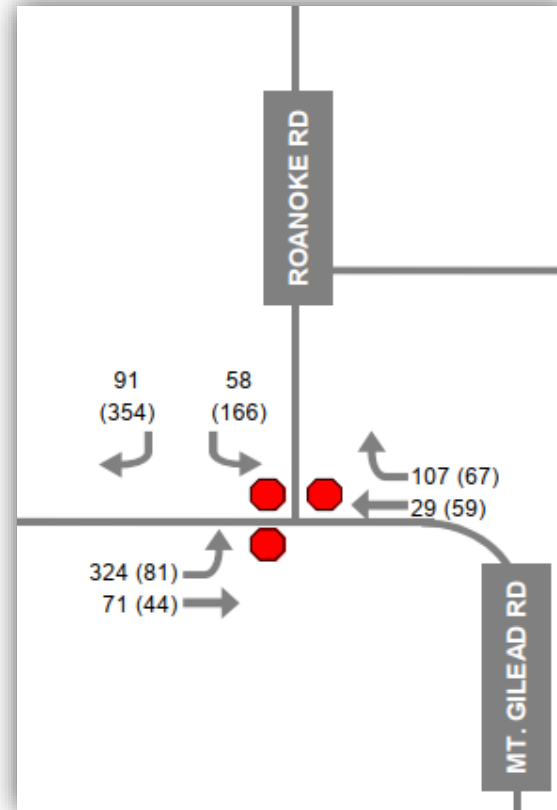
X = AM Peak Hour Turning Movements

Y = PM Peak Hour Turning Movements

- Consider reconfiguring the intersection into a **roundabout**. Be mindful of existing grading and elevation conditions.

Citywide Intersection Analysis Recommendations:

4. Mount Gilead Road & Roanoke Road



Overall Conditions

- AM: Acceptable
- PM: Acceptable

Based on estimated 2020 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

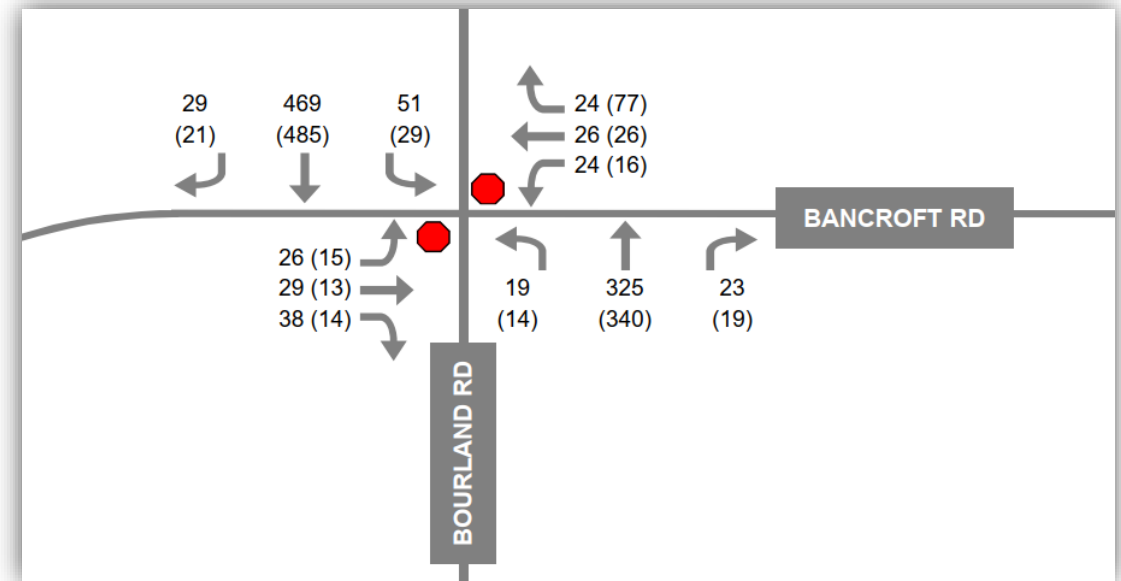
- Consider reconfiguring the intersection into a **roundabout**. Be mindful of existing grading and elevation conditions.

Citywide Intersection Analysis Recommendations:

5. Bancroft Road & Bourland Road

Overall Conditions

- AM: Acceptable
- PM: Acceptable



Based on estimated 2020 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

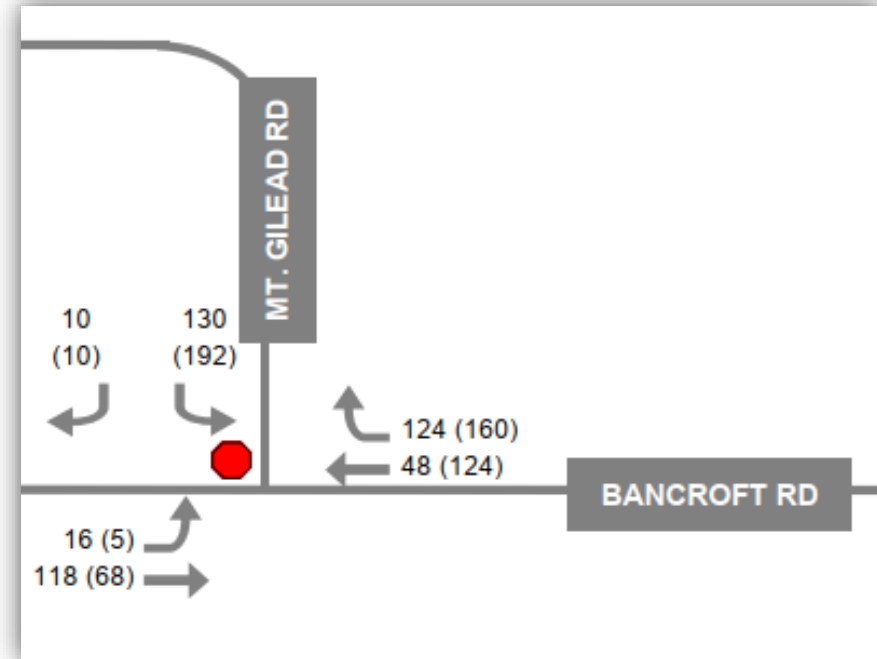
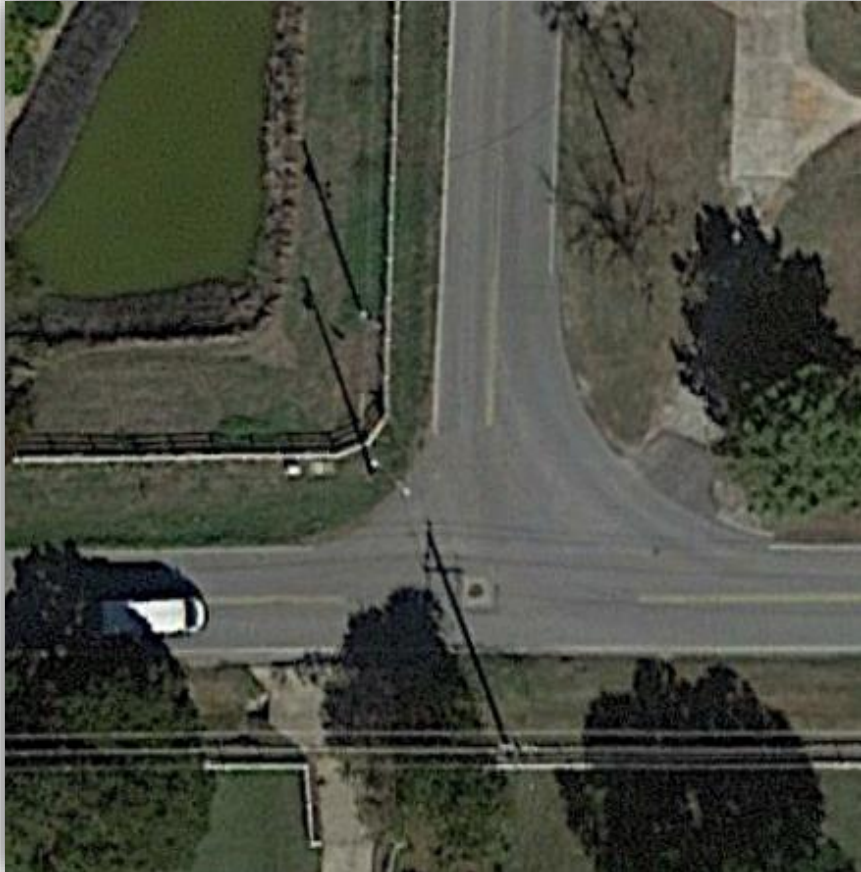
- Consider reconfiguring the intersection into a **roundabout** to improve traffic flow and reduce delay.

Citywide Intersection Analysis Recommendations:

6. Bancroft Road & Mount Gilead Road

Overall Conditions

- AM: Acceptable
- PM: Acceptable



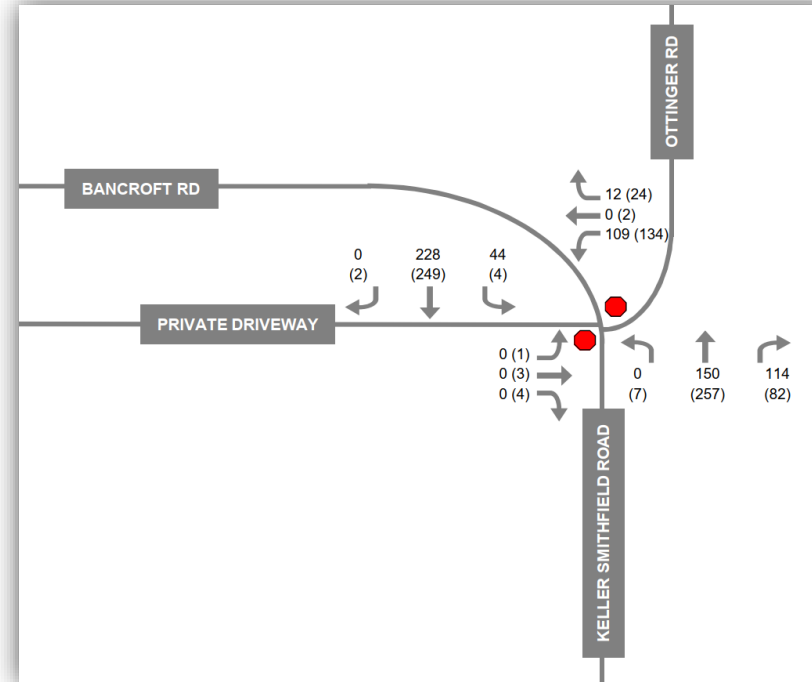
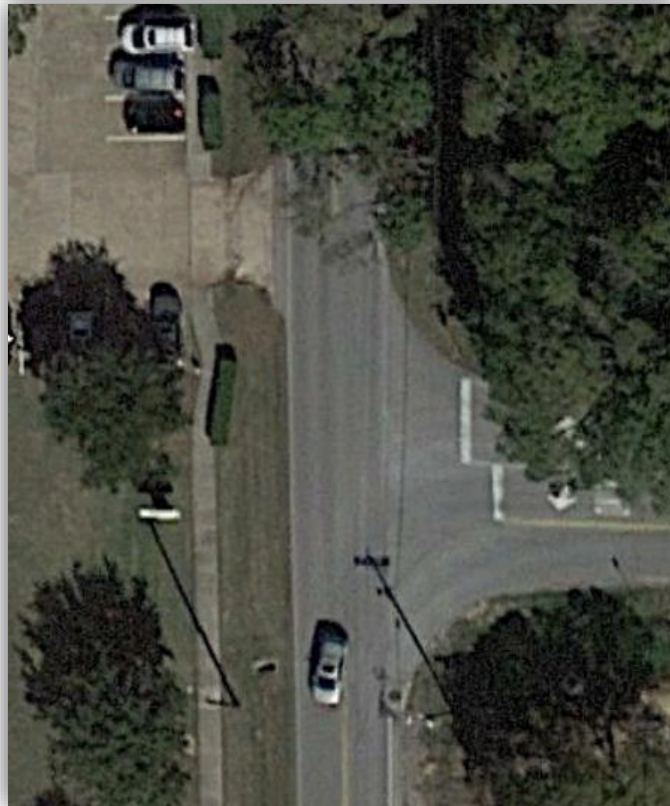
Based on estimated 2020 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

- Monitor current traffic conditions for the consideration of a future **roundabout reconfiguration** prior to the need for all-way stop control.

Citywide Intersection Analysis Recommendations:

7. Keller Smithfield Road & Ottinger Road



Overall Conditions

- AM: Acceptable
- PM: Acceptable

Based on estimated 2020 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

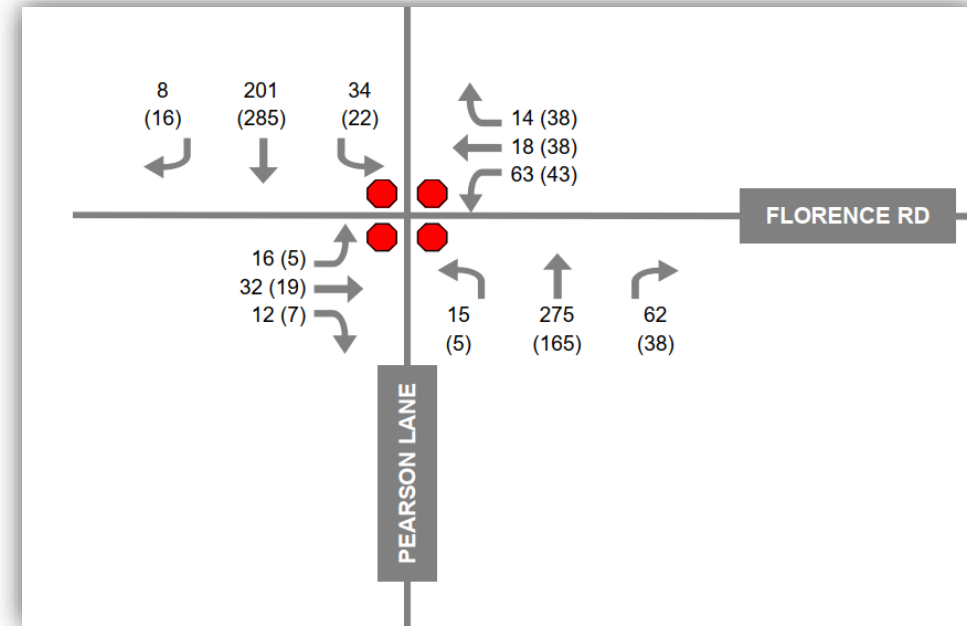
- Consider reconfiguring the intersection into a **roundabout**.
- **Install a 3-4' buffer** along the outside edge of the Keller Smithfield Road curve north of the intersection to **improve safety operations**.
- **Improve nighttime visibility** with additional lighting and reflective chevron signs.
- **Maintain vegetation** fronting the existing church to **improve sight distance conditions**.

Citywide Intersection Analysis Recommendations:

8. Pearson Lane & Florence Road

Overall Conditions

- AM: Acceptable
- PM: Acceptable



Based on estimated 2020 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

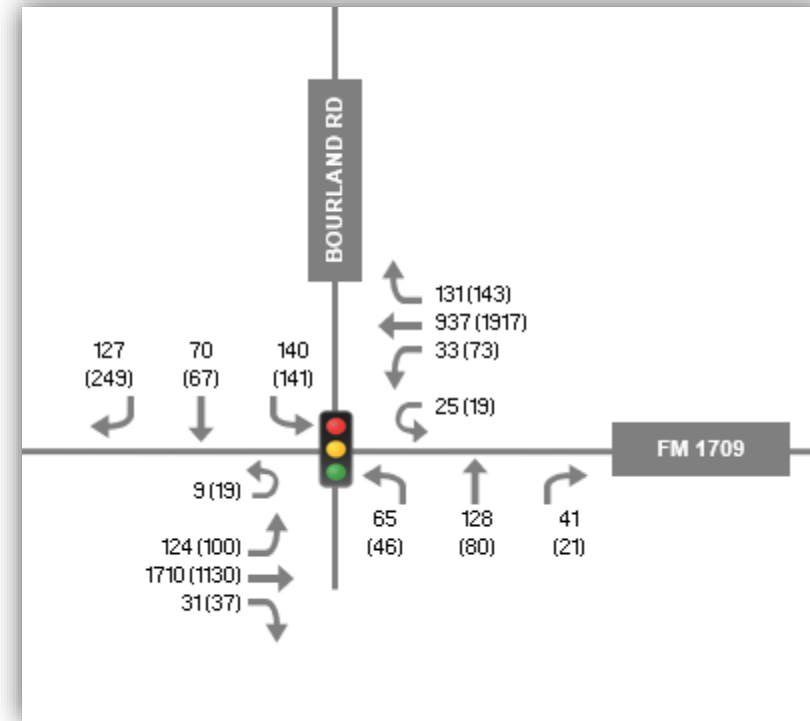
- Consider reconfiguring the intersection into a **roundabout** to improve traffic flow and reduce delay.

Citywide Intersection Analysis Recommendations:

9. FM 1709 & Bourland Road

Overall Conditions

- AM: Tolerable
- PM: Tolerable



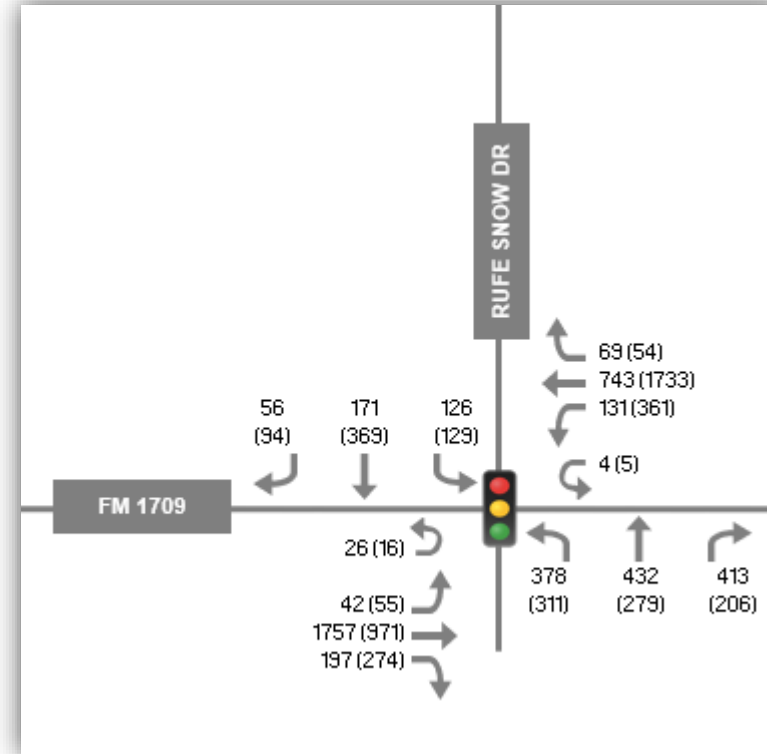
Based on estimated 2020 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

- **Reconfigure NB and SB approaches to feature one exclusive lane per movement** (with possibility for channelized rights). Be mindful of drainage issues along both approaches.
- **Remove split phasing and incorporate flashing yellow arrows.**
- **Install a northbound left-turn lane.**

Citywide Intersection Analysis Recommendations:

10. FM 1709 & Rufe Snow Drive



Overall Conditions

- AM: Failing
- PM: Tolerable

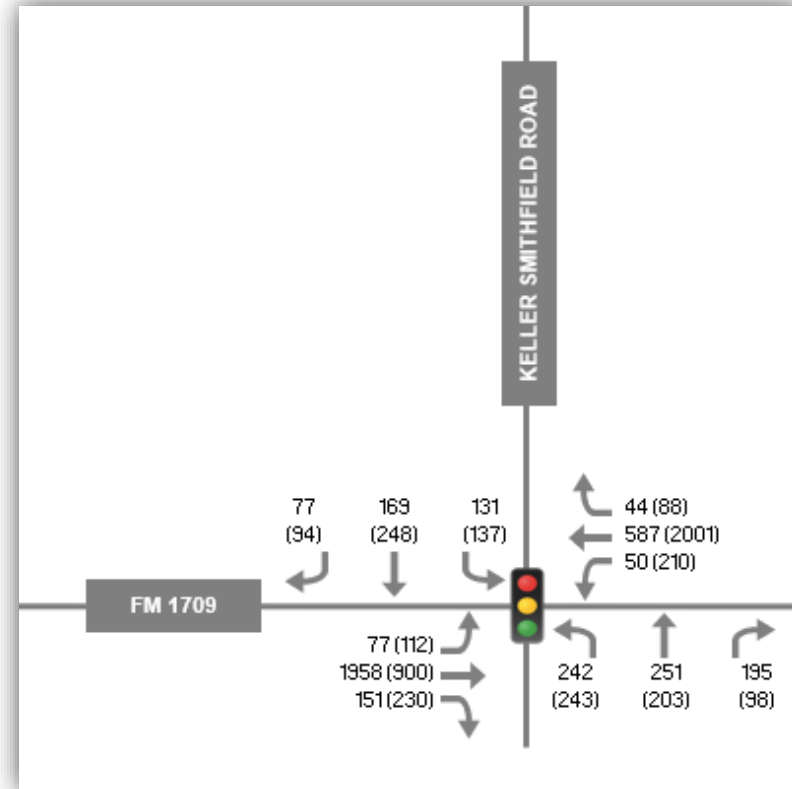
Based on estimated 2020 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

- Adjust signal with **Dallas Permitted plus Protected** phasing and flashing yellow arrows at the NB and SB approaches.

Citywide Intersection Analysis Recommendations:

11. FM 1709 & Keller Smithfield Road



Overall Conditions

- AM: Tolerable
- PM: Tolerable

Based on estimated 2020 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

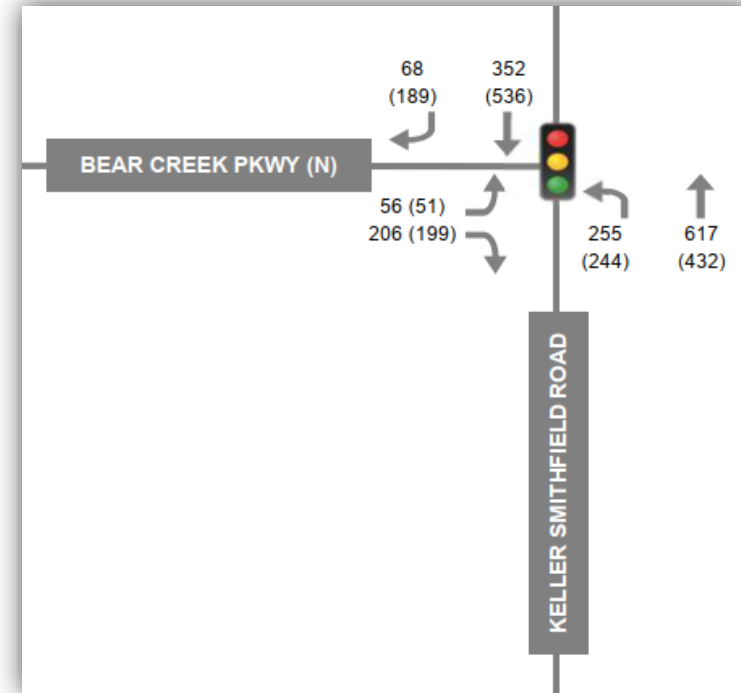
- Adjust signal with **Dallas Permitted plus Protected** phasing and flashing yellow arrows at the NB and SB approaches.

Citywide Intersection Analysis Recommendations:

12. Bear Creek Parkway (N) & Keller Smithfield Road

Overall
Conditions

- AM: Acceptable
- PM: Acceptable



Based on estimated
2020 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

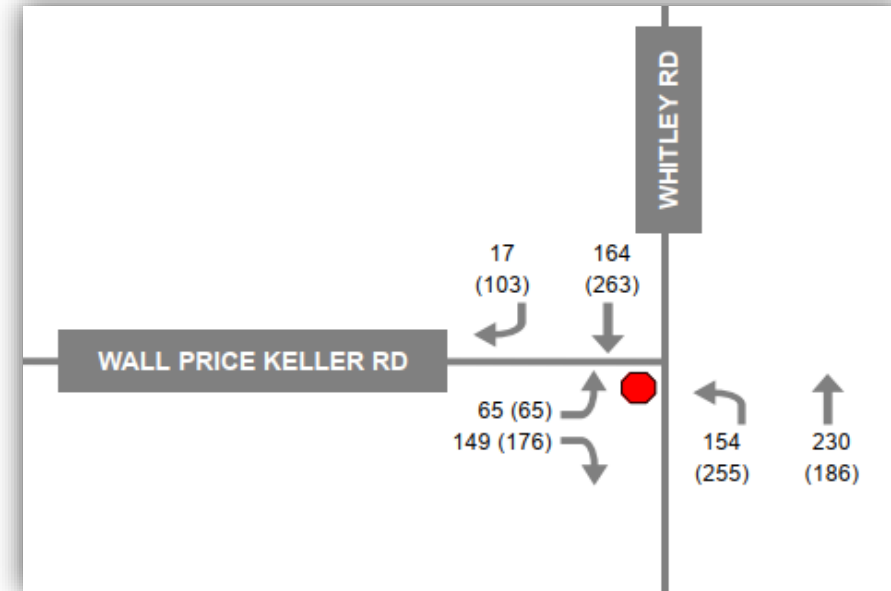
- The overall intersection currently operates acceptably. **Consider further mitigations** based on changes in **growing NB LT volumes**.

Citywide Intersection Analysis Recommendations:

13. Whitley Road & Wall Price Keller Road

Overall
Conditions

- AM: Tolerable
- PM: Tolerable



Based on estimated
2020 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

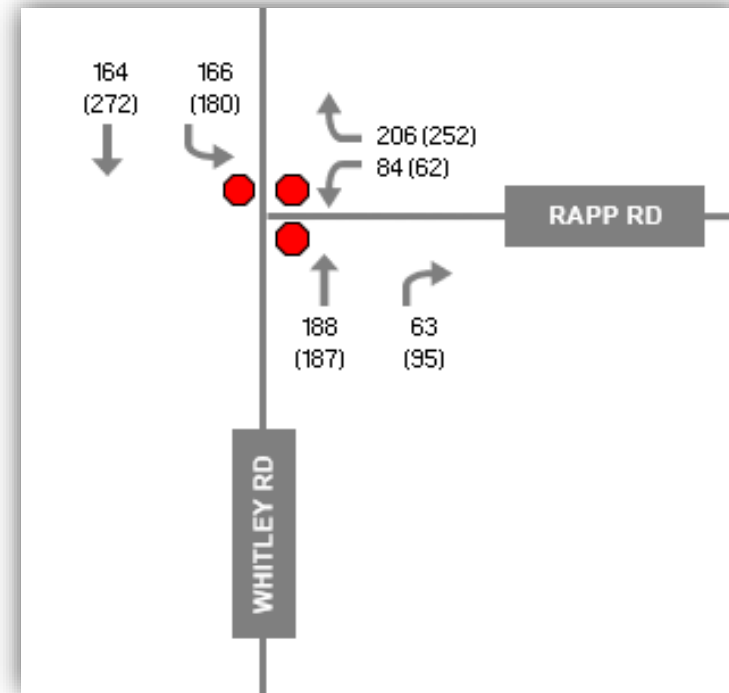
- Consider implementing a **roundabout** in the future based on changes in traffic patterns and LOS.

Citywide Intersection Analysis Recommendations:

14. Whitley Road & Rapp Road

Overall
Conditions

- AM: Acceptable
- PM: Acceptable



Based on estimated
2020 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

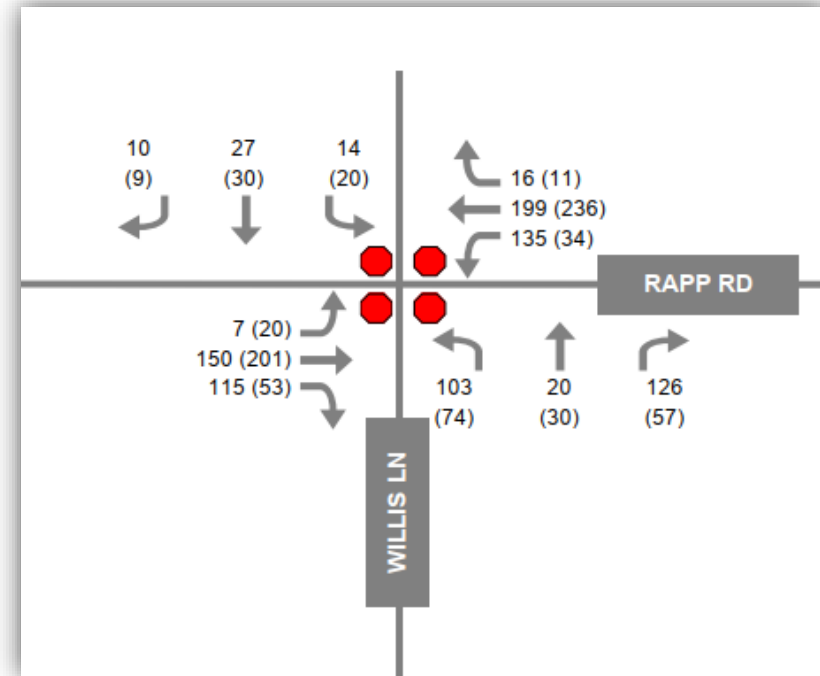
- Consider reconfiguring the intersection into a **roundabout**.
- **Examine impacts to the intersection** when Rapp Road is extended west of Whitley Road to US 377.

Citywide Intersection Analysis Recommendations:

15. Willis Lane & Rapp Road

Overall Conditions

- AM: Acceptable
- PM: Acceptable



Based on estimated 2020 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

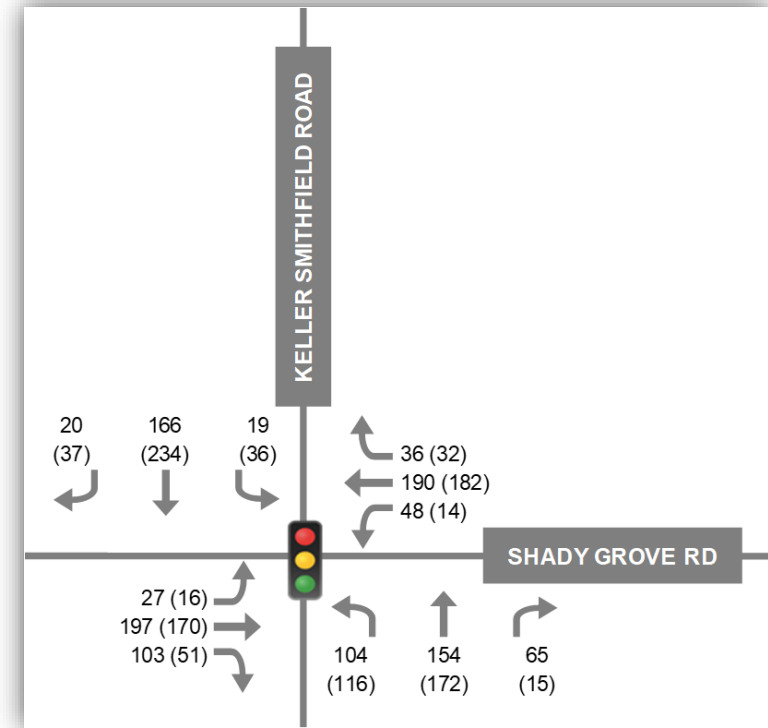
- Consider reconfiguring the intersection into a **roundabout**.

Citywide Intersection Analysis Recommendations:

16. Shady Grove Road & Keller Smithfield Road

Overall Conditions

- AM: Acceptable
- PM: Acceptable



Based on estimated 2020 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

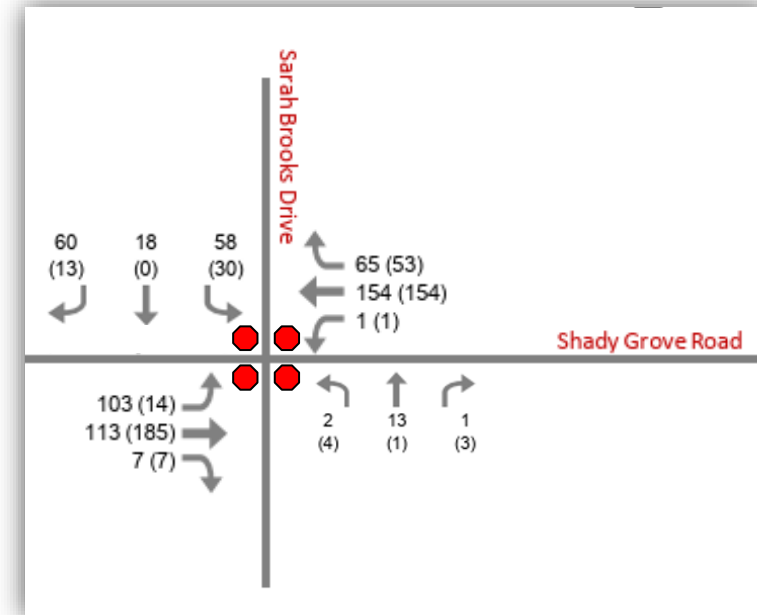
- The City is currently planning to reconfigure the intersection into a **roundabout**.

Citywide Intersection Analysis Recommendations:

17. Shady Grove Road & Sarah Brooks Drive

Overall
Conditions

- AM: Acceptable
- PM: Acceptable



Based on collected
2021 traffic volumes

X (Y)
X = AM Peak Hour Turning Movements
Y = PM Peak Hour Turning Movements

- The City is currently planning to reconfigure the intersection into a **roundabout**.