

Crossings Circle Transportation Study

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Kimley»Horn



Crossings Circle Transportation Study

PREPARED FOR:



The City of Spring Hill, Tennessee

PREPARED BY:

Kimley»»Horn
VOLKERT



Kimley-Horn and Associates, Inc.

Volkert, Inc.

Thomason and Associates

May 2015

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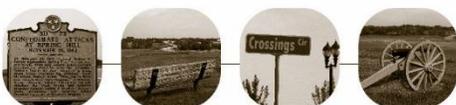
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1.0 INTRODUCTION

The City of Spring Hill issued a Request for Qualifications (RFQ) for the Crossings Circle Transportation Study on August 15, 2014. Among the Scope of Services included within this RFQ, there were two (2) areas of special emphasis:

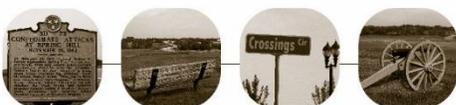
- “The primary purpose of this project is to establish an alignment for the extension of this roadway to establish connectivity by constructing a second entrance out of the Crossings development onto Kedron Road.”
- “The study segment includes a Civil War battlefield and stream crossings. Particular emphasis will be placed on developing an alignment and context sensitive treatments appropriate for historic preservation of a battlefield, as well as providing appropriate treatments for environmentally sensitive resources.”

The Crossings Circle Transportation Study focused on three (3) areas of emphasis, in no particular order: Multi-Modal Connectivity, Economic Development, and Historical Preservation.

1.1 *Multi-Modal Connectivity*

The Crossings of Spring Hill is a shopping center on 63 acres consisting of approximately 466,665 square feet (s.f.) of retail and restaurants. Currently, there is only one (1) roadway providing vehicle access to the shopping center – Crossings Boulevard is located at a traffic signal on Main Street (US-31 / SR-6), just north of the interchange with Saturn Parkway (SR-396). Within the shopping center, Crossings Circle intersects Crossings Boulevard at a circular intersection located approximately 300 feet east of Main Street (US-31 / SR-6).

The City has expressed concerns regarding only one (1) vehicle connection, specifically related to traffic congestion and safety. Within the shopping center, Crossings Boulevard and Crossings Circle both provide internal access to the various retail establishments and restaurants. Both of these roads have the potential for extension eastward to provide a connection with Kedron Road, which would be an alternative connection to the shopping center for several modes of transportation (vehicles, pedestrians, bicyclists).



1.2 Economic Development

The Crossings of Spring Hill has contributed to the sales tax revenue generated within the City. Additionally, additional development is currently under construction that will extend Crossings Circle by approximately 1,500 feet from its current western terminus. This additional development includes a Carmike Cinemas 12 movie theater. There is approximately 227 acres of undeveloped land located between the shopping center and Kedron Road, which is owned by two (2) individuals. Future development will likely increase property tax revenues and/or sales tax revenues. Additionally, if this land is developed, some form of transportation infrastructure will likely be provided to connect with the shopping center and Kedron Road.

1.3 Historical Preservation

The Battle of Spring Hill is a historical event that occurred during the Civil War over 150 years ago. In the land area bounded by Main Street (US-31 / SR-6), Saturn Parkway (SR-396), and Kedron Road, approximately 110 acres have been preserved to conserve the historical significance of the land. However, approximately 227 acres of additional land that is currently undeveloped were also the setting of significant events during this Civil War Battle. Any opportunity to construct transportation infrastructure between the shopping center and Kedron Road would require disruption of the terrain and construction of a roadway through land that, while not formally preserved, was the location of an important event in American history.

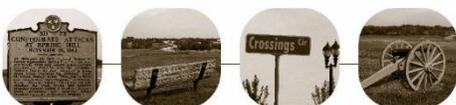
2.0 BATTLE OF SPRING HILL

The Battle of Spring Hill occurred on November 29, 1864 during the Civil War, and preceded the Battle of Franklin that occurred the following day. In the vicinity of where this battle occurred, approximately 110 acres have been preserved: a 90-acre parcel that is owned by the Association for the Preservation of Civil War Sites, Inc. (preserved Battlefield) and a 20-acre parcel that is owned by Maury County, Tennessee (Jerry Erwin Park).

The following websites provide more information on the events of the Battle of Spring Hill:

- <http://www.civilwar.org/battlefields/spring-hill.html>
- <http://www.springhilltn.org/index.aspx?NID=426>

More information on the Historic Context of the Battle of Spring Hill is provided in **Appendix A**.



3.0 DATA COLLECTION

3.1 Road Network

The study area includes five (5) existing intersections:

- Main Street (US-31 / SR-6) at Crossings Boulevard
- Main Street (US-31 / SR-6) at Kedron Road / Kedron Parkway
- Kedron Road at Reserve Boulevard
- Kedron Road at Saturn Parkway (SR-396) Westbound Ramps
- Kedron Road at Saturn Parkway (SR-396) Eastbound Ramps

Saturn Parkway (SR-396) is a 4-lane access controlled facility with a posted speed limit that varies between 55 and 70 miles per hour. The Tennessee Department of Transportation (TDOT) classifies this facility as 'Other Freeways and Expressways', and the City of Spring Hill's Major Thoroughfare Plan (MTP), dated October 2007, classifies this facility as 'Freeway'.

Main Street (US-31 / SR-6) is a 4-lane facility with a median on the southern portion and with a posted speed limit of 35 miles per hour. North of Kedron Road / Kedron Parkway, Main Street becomes a 3-lane facility with a center two-way left-turn lane. TDOT classifies this facility as 'Urban Principal Arterial', and the City's MTP classifies it as 'Arterial'.

Kedron Road is a 2-lane facility with a posted speed limit of 35 miles per hour. TDOT classifies this facility as 'Urban Collector', and the City's MTP classifies it as 'Collector'.

Reserve Boulevard is a 3-lane facility with a center two-way left-turn lane and a posted speed limit of 30 miles per hour. TDOT does not classify this facility, and the City MTP classifies it as a 'Collector' when it was proposed as Project Number P10.

The Project Map is illustrated in **Figure 1**, and the Aerial Exhibit is illustrated in **Figure 2**.





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Aerial
Exhibit

Figure
2

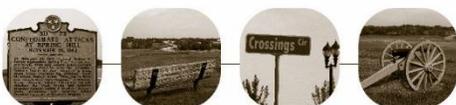
3.2 Traffic Data

The Tennessee Department of Transportation (TDOT) collects traffic data along specific locations throughout Tennessee’s roadway network. **Table 1** shows the Annual Average Daily Traffic (AADT) based on TDOT counts from the Year 2013.

Table 1 – Annual Average Daily Traffic (AADT) from TDOT		
Roadway	Approximate Location	AADT (2013)
Main Street (US-31 / SR-6)	South of Crossings Boulevard	19,490
Saturn Parkway (SR-396)	West of Kedron Road	23,466
Saturn Parkway (SR-396)	East of Kedron Road	25,083
Kedron Road	East of Main Street (US-31 / SR-6)	5,192

The City of Spring Hill collects traffic data along specific locations throughout the City’s roadway network. **Table 2** shows the Annual Average Daily Traffic (AADT) based on the City’s counts from the Year 2013.

Table 2 – Annual Average Daily Traffic (AADT) from the City of Spring Hill		
Roadway	Approximate Location	AADT (2013)
Main Street (US-31 / SR-6)	North of Crossings Boulevard	24,781
Kedron Road	East of Main Street (US-31 / SR-6)	8,762



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Additional tube counts were obtained to collect bi-directional traffic counts along Kedron Road, north of Reserve Boulevard. Traffic volumes were obtained during November 13-15, 2014 (Thursday, Friday, and Saturday). **Table 3** summarizes this traffic data along Kedron Road.

Table 3 – Tube Count Volumes along Kedron Road			
Day	24-Hour Traffic Count	Peak Hour #1	Peak Hour #2
Thursday, November 13, 2014	8,382	761 (4:30 PM – 5:30 PM)	587 (7:00 AM – 8:00 AM)
Friday, November 14, 2014	9,045	819 (5:00 PM – 6:00 PM)	569 (7:00 AM – 8:00 AM)
Saturday, November 15, 2014	7,499	646 (12:15 PM – 1:15 PM)	625 (2:30 PM – 3:30 PM)
Average	8,312		

Vehicle turning movement counts were performed by Quality Counts at the three (3) study intersections along Kedron Road. The traffic data collection occurred on Thursday, November 13, 2014 and Saturday, November 15, 2014 at the study intersections. The volumes were collected in 15-minute intervals to determine the weekday AM peak hour, weekday PM peak hour, and Saturday peak hour volumes as well as the peak hour factors.



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Vehicle turning movement counts were previously collected by Quality Counts at the two (2) study intersections along Main Street. This traffic data collection occurred on Tuesday, May 6, 2014 and Saturday, May 10, 2014 as part of the U.S. Route 31 Signal Timing Optimization Study. Intersection peak hours are summarized in **Table 4**.

Table 4 – Intersection Peak Hours			
Intersection	Weekday AM Peak Hour	Weekday PM Peak Hour	Saturday Peak Hour
Main Street (US-31 / SR-6) at Crossings Boulevard	7:15 AM – 8:15 AM	4:30 PM – 5:30 PM	1:45 PM – 2:45 PM
Main Street (US-31 / SR-6) at Kedron Road / Kedron Parkway	7:15 AM – 8:15 AM	4:30 PM – 5:30 PM	12:15 PM – 1:15 PM
Kedron Road at Reserve Boulevard	7:00 AM – 8:00 AM	4:30 PM – 5:30 PM	12:15 PM – 1:15 PM
Kedron Road at Saturn Parkway (SR-396) Westbound Ramps	7:00 AM – 8:00 AM	4:45 PM – 5:45 PM	12:15 PM – 1:15 PM
Kedron Road at Saturn Parkway (SR-396) Eastbound Ramps	7:00 AM – 8:00 AM	4:45 PM – 5:45 PM	1:00 PM – 2:00 PM

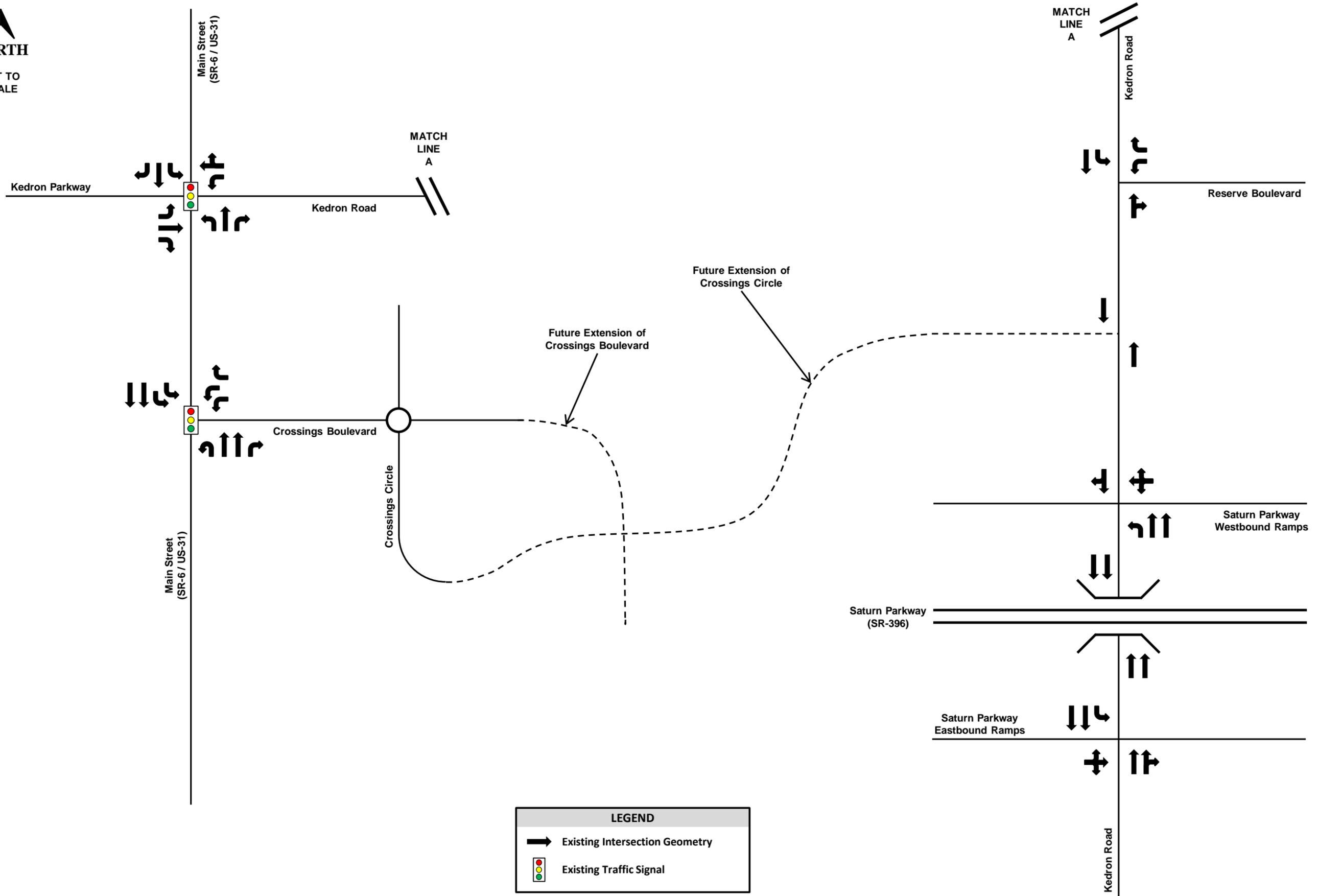
The Existing 2014 Intersection Geometry is illustrated in **Figure 3**, and the Existing 2014 Traffic Volumes are illustrated in **Figures 4A, 4B, 4C, and 4D**.

The traffic data are provided in **Appendix B**.





NOT TO SCALE



LEGEND

- Existing Intersection Geometry
- Existing Traffic Signal

Figure 3

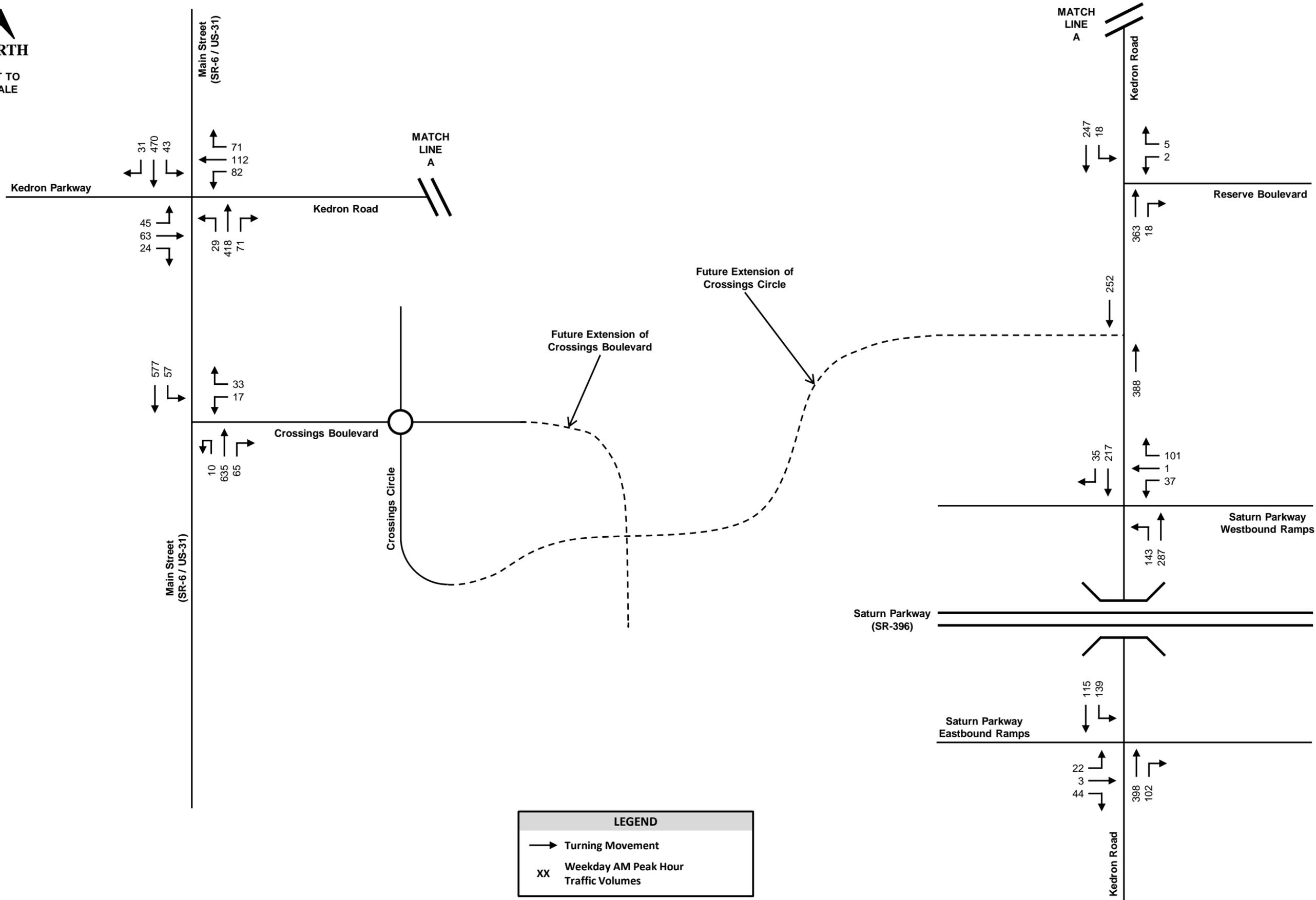
Existing 2014 Intersection Geometry

Crossings Circle Transportation Study





NOT TO SCALE



LEGEND

- Turning Movement
- XX Weekday AM Peak Hour Traffic Volumes

Figure 4A

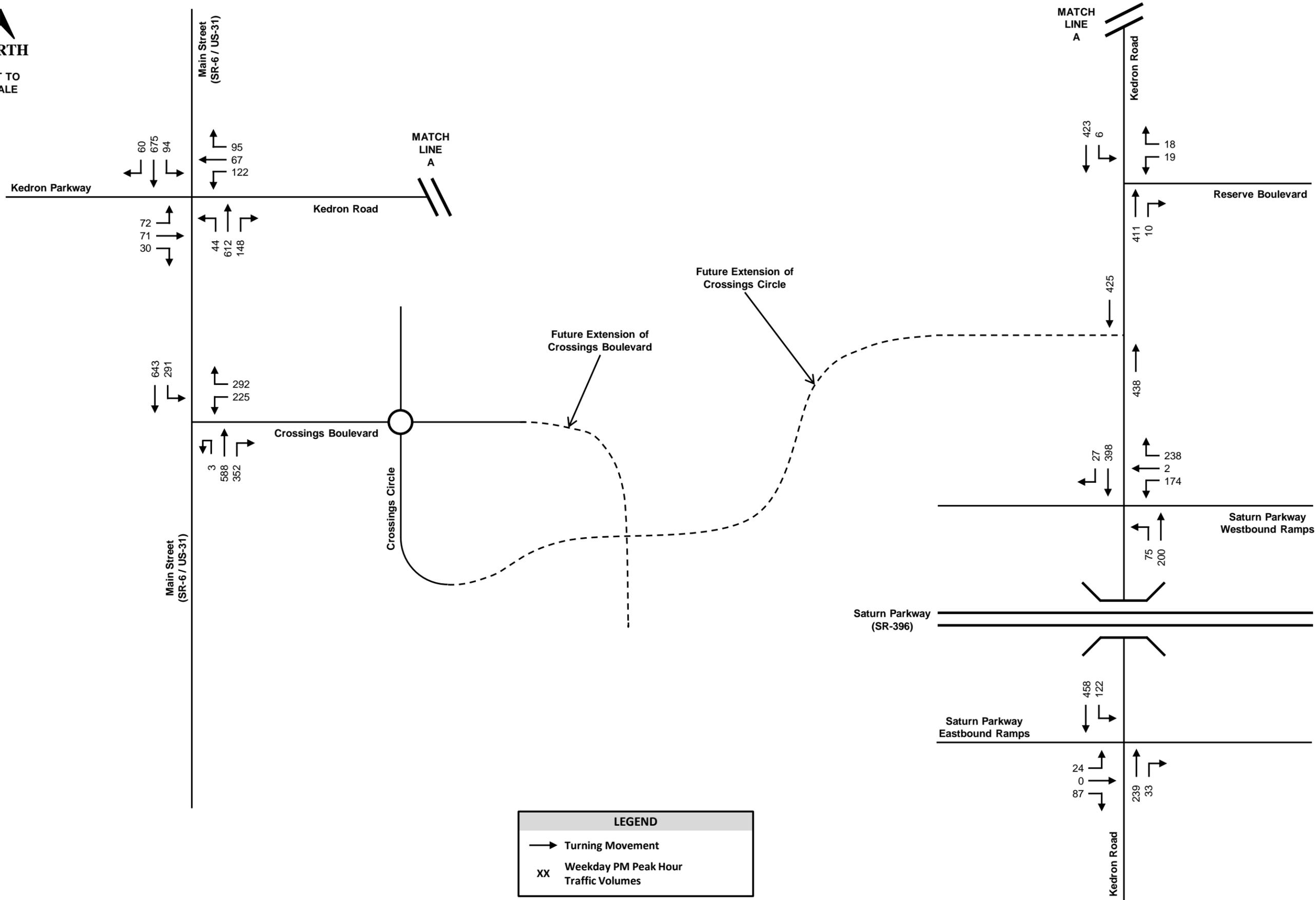
Existing 2014 Weekday AM Peak Hour Traffic Volumes

Crossings Circle Transportation Study





NOT TO SCALE



LEGEND

- Turning Movement
- XX Weekday PM Peak Hour Traffic Volumes

Figure 4B

Existing 2014 Weekday PM Peak Hour Traffic Volumes

Crossings Circle Transportation Study





NOT TO SCALE

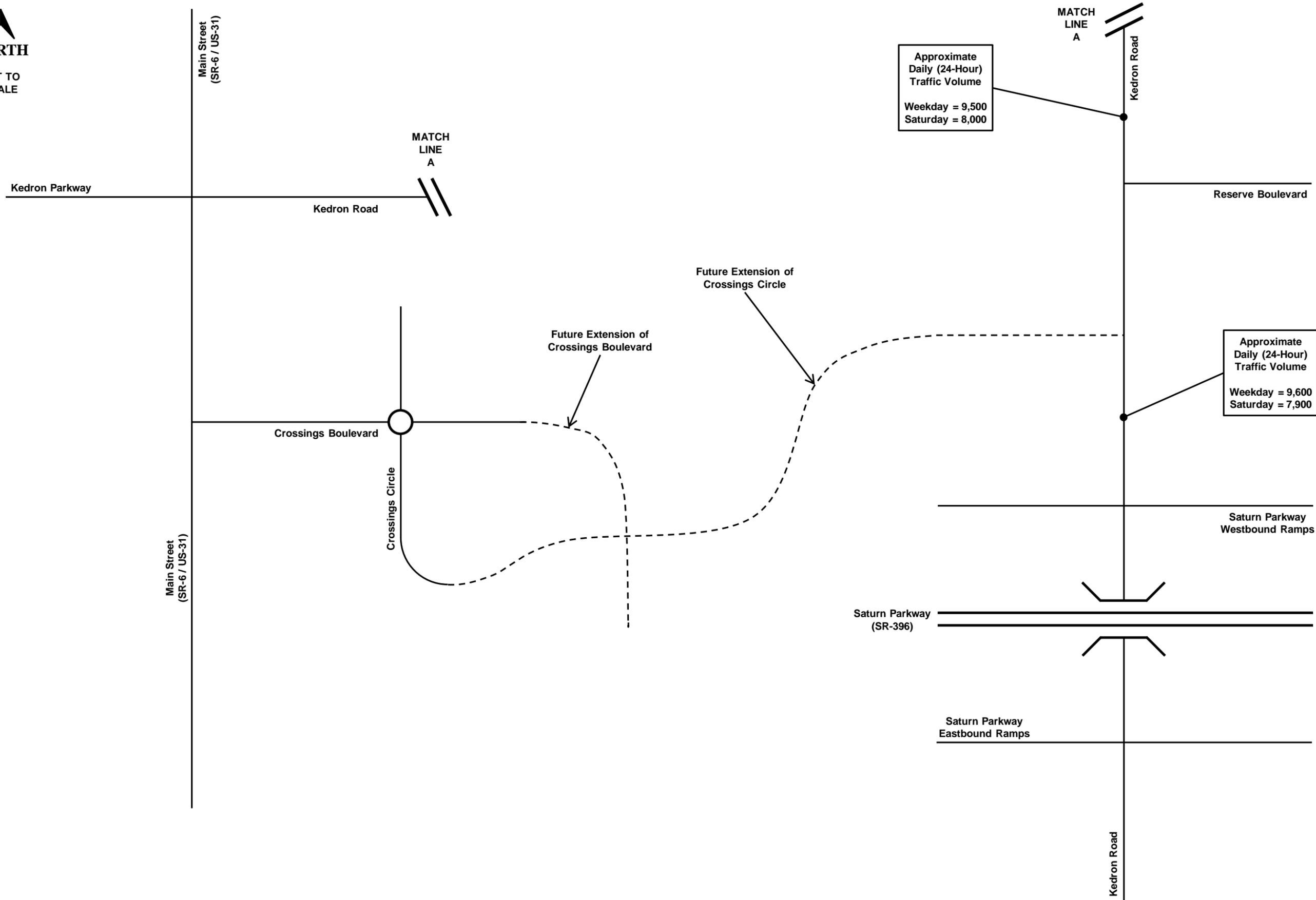


Figure 4D

Existing 2014 Daily (24-Hour) Traffic Volumes

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4.0 ALIGNMENT ALTERNATIVES

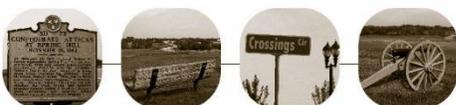
Two (2) typical sections and three (3) alignment alternatives were considered for the Future Crossings Circle and Future Crossings Boulevard.

4.1 Typical Section

The typical sections for Future Crossings Circle and Future Crossings Boulevard were developed through coordination with the City. Two (2) roadway typical sections were generated: a 2-lane divided facility with a right-of-way of 95 feet, and a 4-lane divided facility with a right-of-way of 105 feet.

The roadway would consist of:

- Two (2) 11-foot travel lanes, or Four (4) 11-foot travel lanes
- A raised, landscaped median with a width of approximately 15 feet
- 5-foot bicycle lanes in each direction
- 2-foot curb and gutter on each side
- 5-foot grass strip between the curb and gutter and the sidewalk
- 5-foot sidewalk on each side
- 1-foot grass strip outside of the sidewalk
- Varying additional width to the edge of the right-of-way boundary



Crossings Circle Transportation Study

Daily traffic volumes were estimated for the existing and future roads within the study network. These estimated daily traffic volumes along Future Crossings Circle, Future Crossings Boulevard, and Kedron Road are summarized in **Table 5**.

Table 5 – Daily Traffic Volume Estimates			
Location	Existing 2014	Future 2034 (50% Build-Out)	Future 2034 (100% Build-Out)
WEEKDAY			
Kedron Road north of Reserve Boulevard	9,500	21,500	28,100
Kedron Road south of Future Crossings Circle	9,600	25,300	35,900
Future Crossings Boulevard north of Future Crossings Circle	---	5,000	8,400
Future Crossings Circle west of Future Crossings Boulevard	---	3,600	6,300
Future Crossings Circle east of Future Crossings Boulevard	---	7,200	12,200
SATURDAY			
Kedron Road north of Reserve Boulevard	8,000	21,000	30,300
Kedron Road south of Future Crossings Circle	7,900	24,800	38,900
Future Crossings Boulevard north of Future Crossings Circle	---	6,800	11,700
Future Crossings Circle west of Future Crossings Boulevard	---	4,600	8,700
Future Crossings Circle east of Future Crossings Boulevard	---	10,800	18,400



4.2 *Alternative A*

The proposed Alternative A alignment for Future Crossings Circle would extend toward Kedron Road through the southern portions of the Adams parcel and Wolff parcel, adjacent to Saturn Parkway. Closer to Kedron Road, the alignment would significantly turn northward to intersect Kedron Road approximately 700 feet south of Reserve Boulevard and approximately 600 feet north of the Saturn Parkway Westbound Ramps.

Advantages:

- More land area would remain contiguous to the currently preserved Battlefield.
- The roadway would not be constructed on any portion of the existing Civil War Trust property.

Disadvantages:

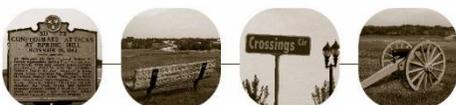
- Development could potentially occur along the north side of the roadway, directly adjacent to the currently preserved Battlefield. Additionally, potential development would likely position the building frontage towards the roadway – thus, the back of the building would face the currently preserved Battlefield.
- At its intersection with Kedron Road, the roadway would not align directly across from Reserve Boulevard. Instead of one (1) 4-leg intersection, this will result in two (2) 3-leg intersections that are spaced approximately 700 feet apart from each other.

4.3 *Alternative B*

The proposed Alternative B alignment for Future Crossings Circle would extend toward Kedron Road through the middle portion of the Adams parcel and the northern portion of the Wolff parcel, further away from Saturn Parkway. Approaching Kedron Road, the alignment would slightly turn northward to intersect Kedron Road approximately 700 feet south of Reserve Boulevard and approximately 600 feet north of the Saturn Parkway Westbound Ramps.

Advantages:

- The roadway would act as a buffer between potential development and the currently preserved Battlefield. Additionally, potential development would likely position the building frontage towards the roadway – thus, the front of the building would face the currently preserved Battlefield.
- The roadway would not be constructed on any portion of the existing Civil War Trust property.



Disadvantages:

- The roadway would be located closer to the existing Civil War Trust property, resulting in less land area that would remain contiguous to the currently preserved Battlefield.
- At its intersection with Kedron Road, the roadway would not align directly across from Reserve Boulevard. Instead of one (1) 4-leg intersection, this will result in two (2) 3-leg intersections that are spaced approximately 700 feet apart from each other.

4.4 *Alternative C*

The proposed Alternative C alignment for Future Crossings Circle would extend toward Kedron Road through the middle portion of the Adams parcel and the northern portion of the Wolff parcel, further away from Saturn Parkway. Approximately 900 feet west of Kedron Road, the alignment would turn northward through the use of a modern roundabout. The alignment would travel through the Battlefield property that is currently preserved by the Civil War Trust, and then turn eastward to intersect Kedron Road directly across from Reserve Boulevard (approximately 1,300 feet north of the Saturn Parkway Westbound Ramps).

Advantages:

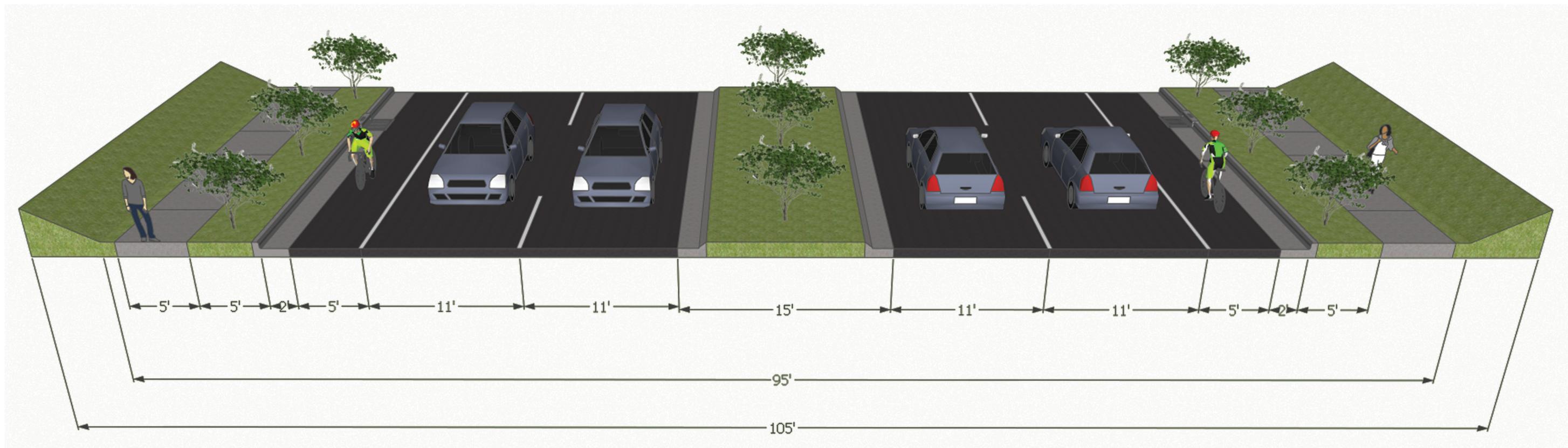
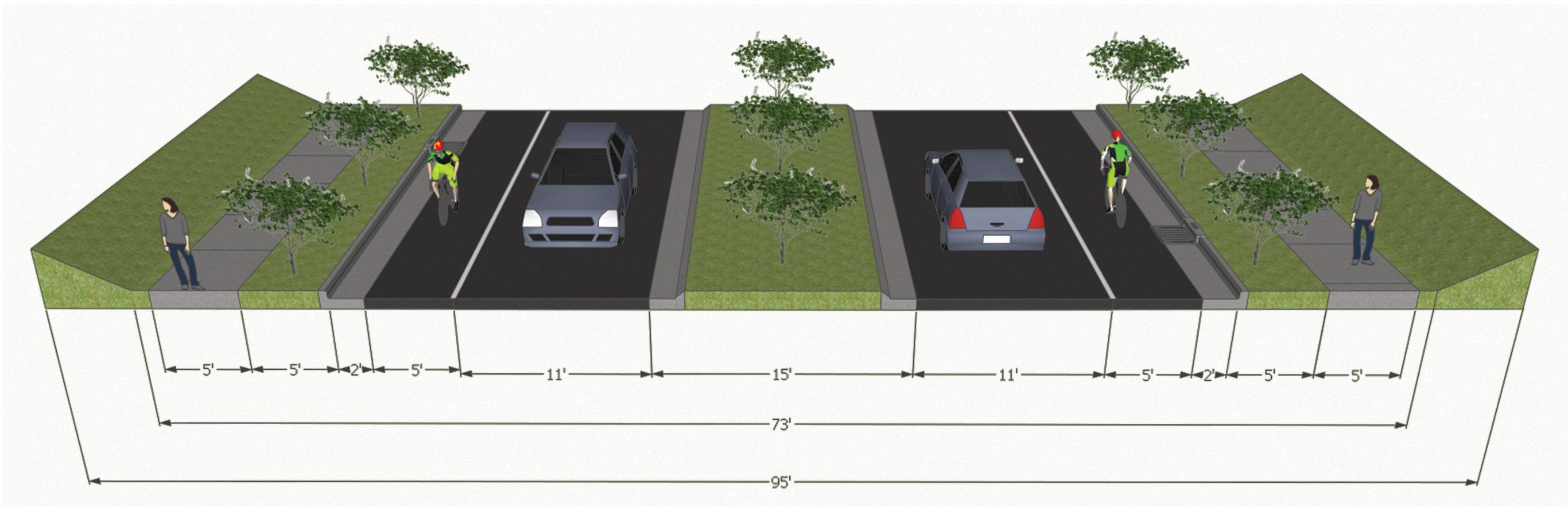
- The roadway would act as a buffer between potential development and the currently preserved Battlefield. Additionally, potential development would likely position the building frontage towards the roadway – thus, the front of the building would face the currently preserved Battlefield.
- At its intersection with Kedron Road, the roadway would align directly across from Reserve Boulevard. This would create one (1) 4-leg intersection, instead of two (2) 3-leg intersections that are separated.

Disadvantages:

- The roadway would be constructed on a portion of the existing Civil War Trust property. Based on correspondence that has occurred with representatives from the Civil War Trust, constructing a roadway through the currently preserved Battlefield would require approval from the United States Secretary of the Interior.

The typical section and functional exhibits for Alternatives A, B, and C are illustrated in the following **Exhibits**.





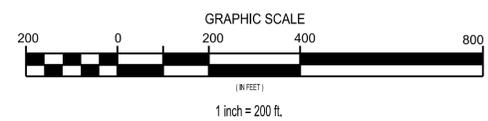


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CROSSINGS CIRCLE SOUTH EXTENSION

ALTERNATIVE A



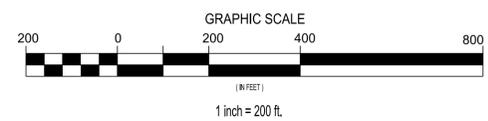


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CROSSINGS CIRCLE SOUTH EXTENSION

ALTERNATIVE B

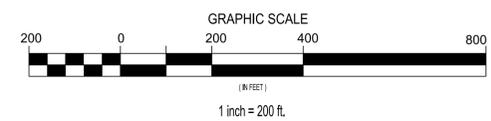




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CROSSINGS CIRCLE SOUTH EXTENSION
ALTERNATIVE C



5.0 TRAFFIC FORECASTING

5.1 *Development Potential*

The City of Spring Hill identified fourteen (14) parcels to be considered within the study area. There are generally three (3) categories of parcels:

- Partially-developed parcels that are currently generating traffic but anticipate future expansion (e.g. The Crossings, TriStar Emergency Room)
- Parcels in the process of being developed but are not currently generating traffic (e.g. Carmike Cinemas, Adams South)
- Parcels that have not begun the process of being developed, but have the potential for development in the future

These fourteen (14) parcels were considered for potential development, and possible land uses and densities were generated for the purposes of traffic forecasting. The selected parcels are summarized in **Table 6**.

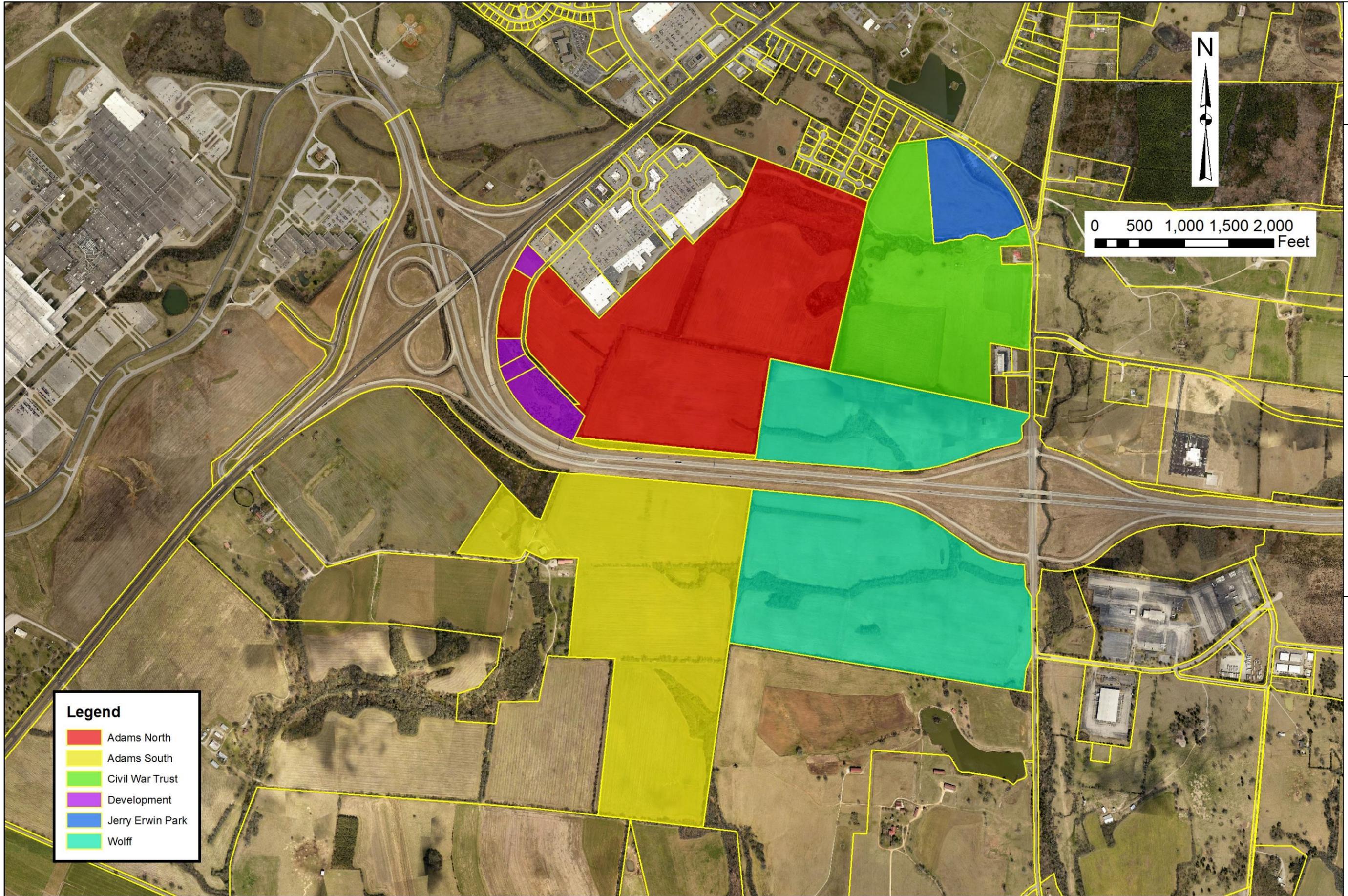


Table 6 – Study Parcels for Development Potential

Parcel ID	Property Owner	Parcel Size (acres)
A	The Crossings (remaining)	2.2
B	Carmike Cinemas 12, et al	13.2
C	Adams North	169
D	Wolff North	58
E	Adams South	153
F	Wolff South	127
G	Ingram	149
H	Southeastern Holdings	40
I	H&P Properties	12
J	Fitts Land Partners	137
K	Spring Hill Hospital	120
L	Maher John Builders	96
M	Jenkins	53
N	KTA Realty	22
TOTAL		1,151.4

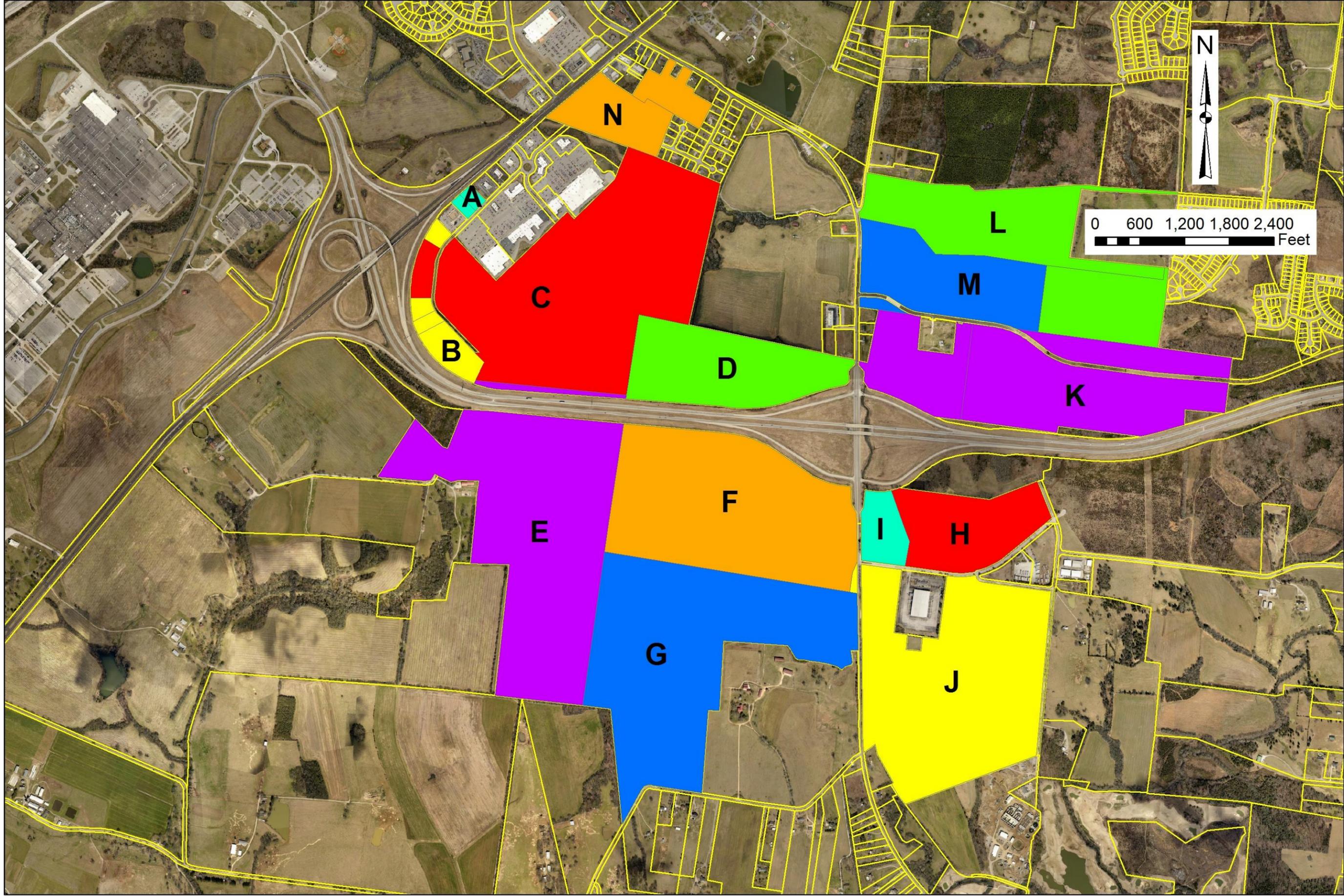
The Civil War Battlefield Parcels of Interest are illustrated in **Figure 5**, and the Study Parcels for Development Potential are illustrated in **Figure 6**.





Legend

- Adams North
- Adams South
- Civil War Trust
- Development
- Jerry Erwin Park
- Wolff



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Transportation Study

Study Parcels for
Development Potential

Figure
6

5.2 Trip Generation

Traffic expected to be generated by these fourteen (14) parcels was calculated using equations provided in the *Trip Generation Manual, 9th Edition*, published by the Institute of Transportation Engineers (ITE). These calculations result in the gross trips generated by potential development, prior to considering any reductions resulting from mixed-use development.

Internal capture (or mixed-use) represents the concept that trips generated by individual land uses within a site may remain internal to the site. Mixed-use vehicle trip reductions were taken according to the *ITE Trip Generation Handbook, 3rd Edition*. These internal capture reductions were considered in two (2) concepts:

1. A mixture of land uses within a development will reduce the number of trips, both along the immediate public roadway network and beyond the study area.
2. A mixture of land uses between adjacent or proximate developments may not reduce the number of trips along the immediate public roadway network, but will reduce the number of trips beyond the study area.

Internal capture calculations were performed using three (3) different techniques to estimate the trip interaction between parcels within the study area:

1. All fourteen (14) parcels were evaluated together as one large development, with the assumption that 'internal capture' trips would remain within the study area.
2. The four (4) quadrants of the Saturn Parkway (SR-396) at Kedron Road interchange were evaluated independently, with the assumption that these 'internal capture' trips must utilize the public roadway network (e.g. Kedron Road) between the origin and destination.
3. Each of the fourteen (14) parcels was evaluated separately, with the assumption that these 'internal capture' trips would not need to utilize the public roadway network.

This process resulted in a traffic forecast for the new trips generated by potential development within the study area. Additionally, this process quantified a traffic forecast for new trips along Kedron Road between parcels as well as the extensions of Crossings Circle and Crossings Boulevard.

Using this methodology, trip generation was calculated for the entire study area consisting of the fourteen (14) parcels. The traffic projections of potential development for Weekday Daily, Weekday AM Peak Hour, Weekday PM Peak Hour, Saturday Daily, and Saturday Peak Hour are summarized in **Table 7**.

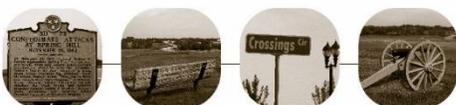


Table 7 – Trip Generation for Entire Study Area

Land Use	ITE Code	Weekday			Saturday	
		Daily	AM Peak Hour	PM Peak Hour	Daily	Peak Hour
400 dwelling units Single-Family Detached Housing	210	3,760	289	366	3,685	365
825 dwelling units Residential Condominium/Townhouse	230	4,811	365	432	4,698	409
400 dwelling units Senior Adult Housing – Detached	251	1,624	98	127	1,092	92
500 rooms Hotel	310	2,983	265	300	3,630	362
12 screens Multiplex Movie Theater	445	1,442	0	164	3,859	175
275 beds Hospital	610	4,230	363	391	2,718	275
600,000 square feet General Office Building	710	6,644	996	908	1,313	258
150,000 square feet Medical-Dental Office Building	720	5,919	358	420	1,344	544
1,475,000 square feet Shopping Center	820	37,393	547	3,674	56,729	5,533
35,000 square feet High-Turnover (Sit-Down) Restaurant	932	4,451	378	344	5,544	493
10,000 square feet Fast-Food Restaurant with Drive-Through	934	4,961	455	327	7,220	590
300 dealer parking spaces Auto Auction	n/a	900	30	90	2,400	240
Gross Trips		79,118	4,144	7,543	94,232	9,336
<i>Internal Capture (Mixed-Use) Reduction</i>		- 26,726	- 1,208	- 2,372	- 25,406	- 2,730
New Trips		52,392	2,936	5,171	68,826	6,606



Crossings Circle Transportation Study

The Weekday and Saturday trip generation potential for each of the fourteen (14) parcels are summarized in **Table 8**.

Table 8 – Trip Generation for Each Parcel				
Parcel ID	Property Owner	Parcel Size (acres)	Weekday Trip Generation Potential	Saturday Trip Generation Potential
A	The Crossings (remaining)	2.2	388	572
B	Carmike Cinemas 12, et al	13.2	1,963	4,251
C	Adams North	169	6,057	7,481
D	Wolff North	58	4,153	7,040
E	Adams South	153	987	636
F	Wolff South	127	8,585	14,840
G	Ingram	149	2,286	2,147
H	Southeastern Holdings	40	677	2,058
I	H&P Properties	12	2,240	3,622
J	Fitts Land Partners	137	7,446	9,286
K	Spring Hill Hospital	120	11,975	8,182
L	Maher John Builders	96	868	777
M	Jenkins	53	475	513
N	KTA Realty	22	4,292	7,421
TOTAL		1,151.4	52,392	68,826



A background growth of 1.0% per year for twenty (20) years was applied to the existing traffic volumes. This accommodates additional traffic growth that may occur due to activity beyond the fourteen (14) parcels within the study area.

Three (3) parcels were assumed to have no future development:

- Currently-Preserved Battlefield, Civil War Preservation Trust (90 Acres)
- Jerry Erwin Park, Maury County (20 Acres)
- Oaklawn Plantation, Shuff (86 Acres)

5.3 Trip Distribution and Assignment

Trip distribution was prepared for the fourteen (14) parcels within the study area. The trip distribution was applied to the trip generation potential of new trips to develop individual turning movement volumes at the study intersections.

- 35% to/from the east along Saturn Parkway and Reserve Boulevard
- 25% to/from the north along Main Street (US-31 / SR-6) and Old Kedron Road
- 15% to/from the south along Main Street (US-31 / SR-6)
- 15% to/from the south along Kedron Road
- 10% to/from the west along Kedron Parkway and Beechcroft Road (SR-247)

For a scenario where the Future Crossings Circle and Reserve Boulevard do not intersect with Kedron Road directly across from each other:

- The Future 2034 (50% Build-Out) Traffic Volumes are illustrated in **Figures 7A, 7B, 7C, and 7D**; the Future 2034 (100% Build-Out) Traffic Volumes are illustrated in **Figures 8A, 8B, 8C, and 8D**.

For a scenario where the Future Crossings Circle and Reserve Boulevard do intersect with Kedron Road directly across from each other:

- The Future 2034 (50% Build-Out) Traffic Volumes are illustrated in **Figures 9A, 9B, 9C, and 9D**; the Future 2034 (100% Build-Out) Traffic Volumes are illustrated in **Figures 10A, 10B, 10C, and 10D**.

The calculations and analysis used for the traffic forecasting are provided in **Appendix C** (for 50% Build-Out) and **Appendix D** (for 100% Build-Out).





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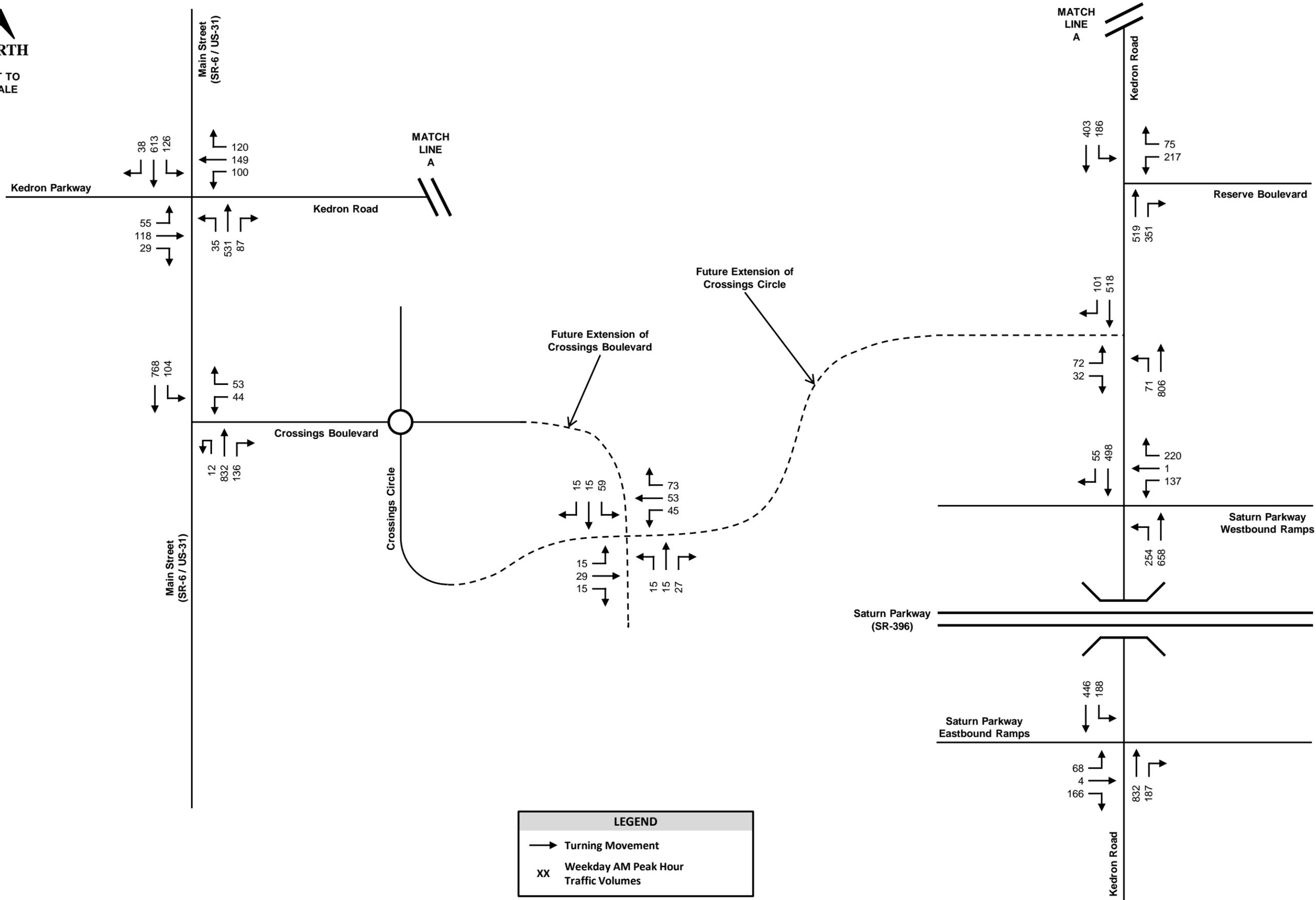


Figure 7A

Future 2034 (50% Build-Out) Weekday AM Peak Hour Traffic Volumes

Crossings Circle Transportation Study





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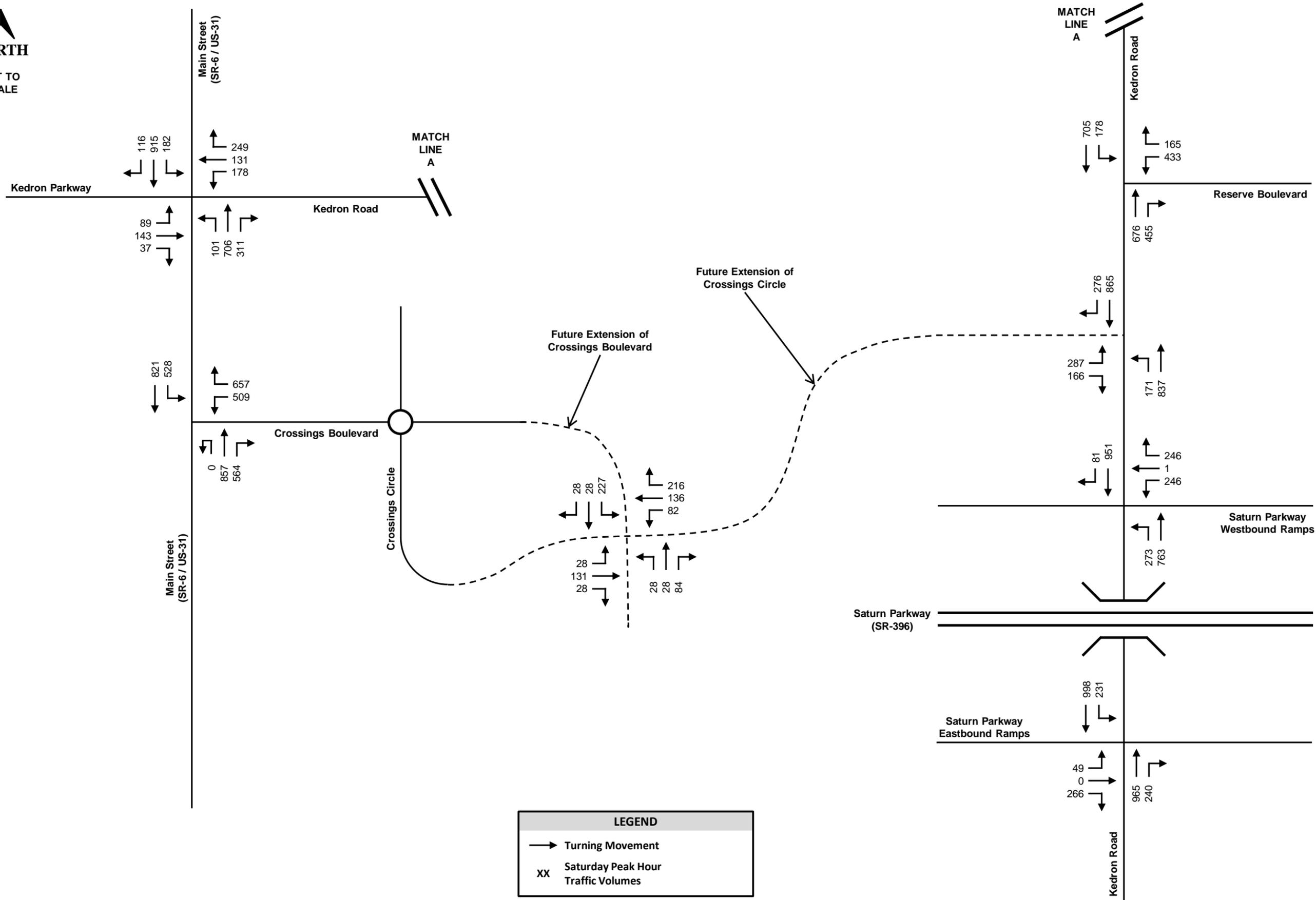


Figure 7C

Future 2034 (50% Build-Out) Saturday Peak Hour Traffic Volumes

Crossings Circle Transportation Study





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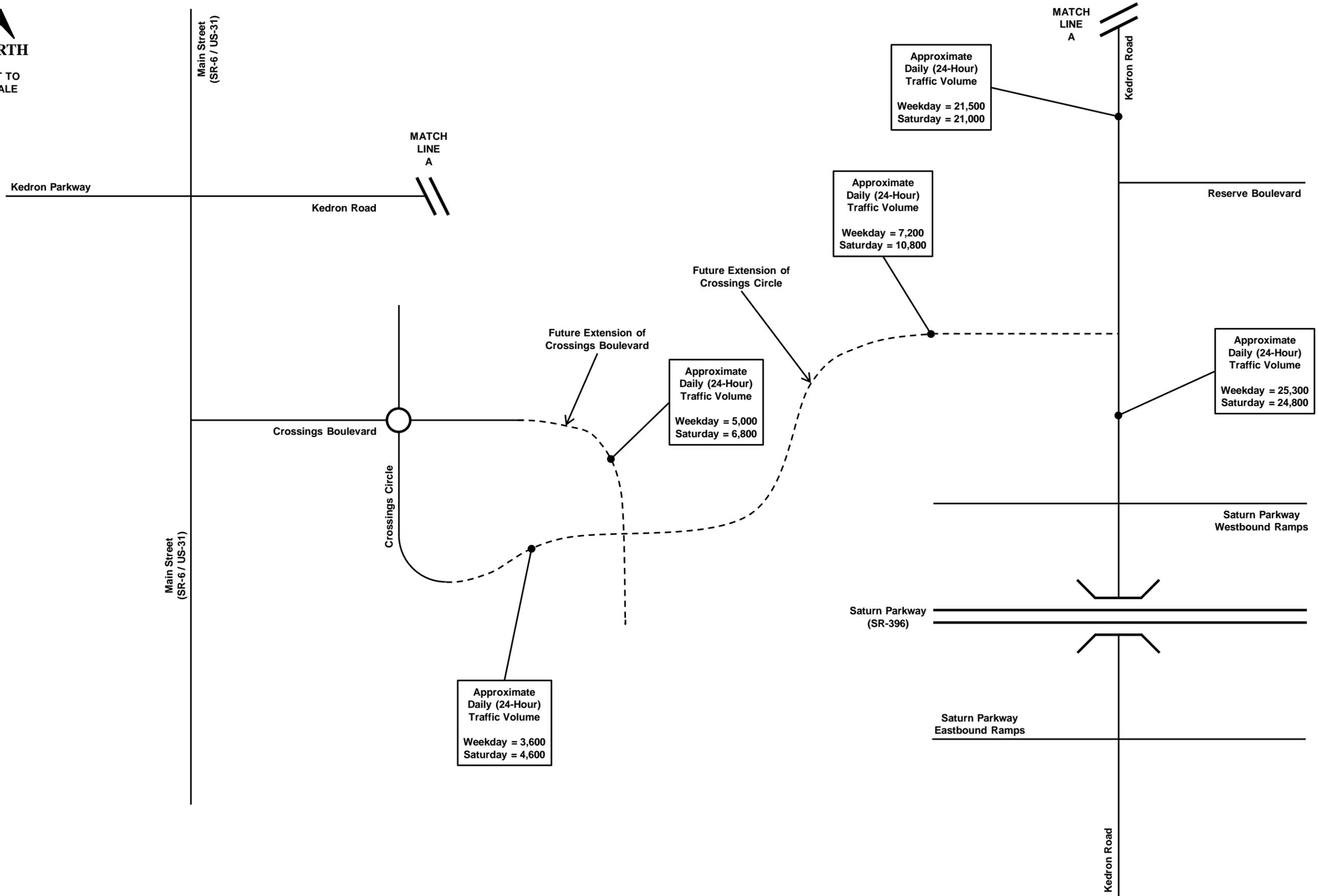


Figure 7D

Future 2034 (50% Build-Out) Daily (24-Hour) Traffic Volumes

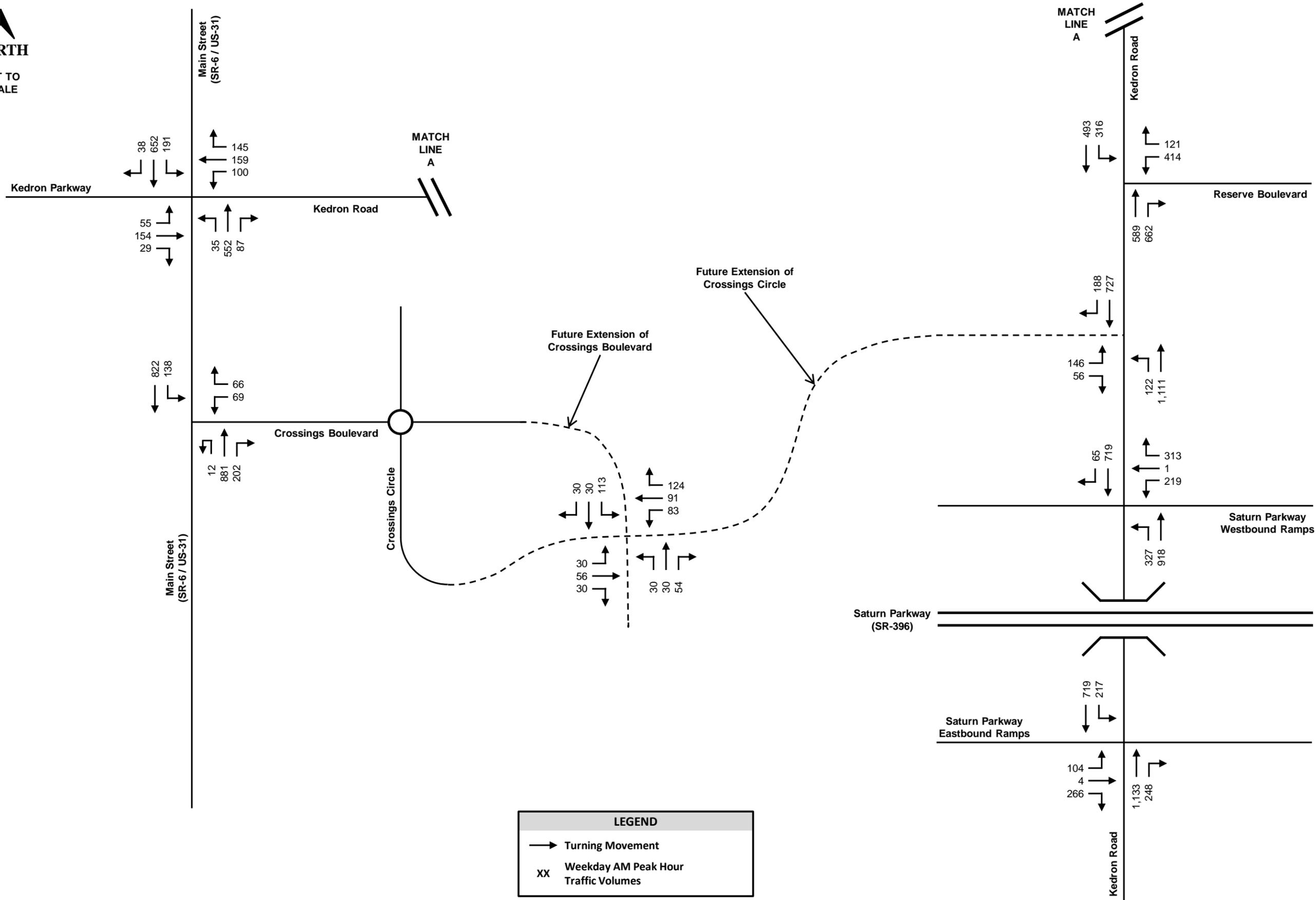
Crossings Circle Transportation Study

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Future 2034 (100% Build-Out) Weekday AM Peak Hour Traffic Volumes

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Figure 8A



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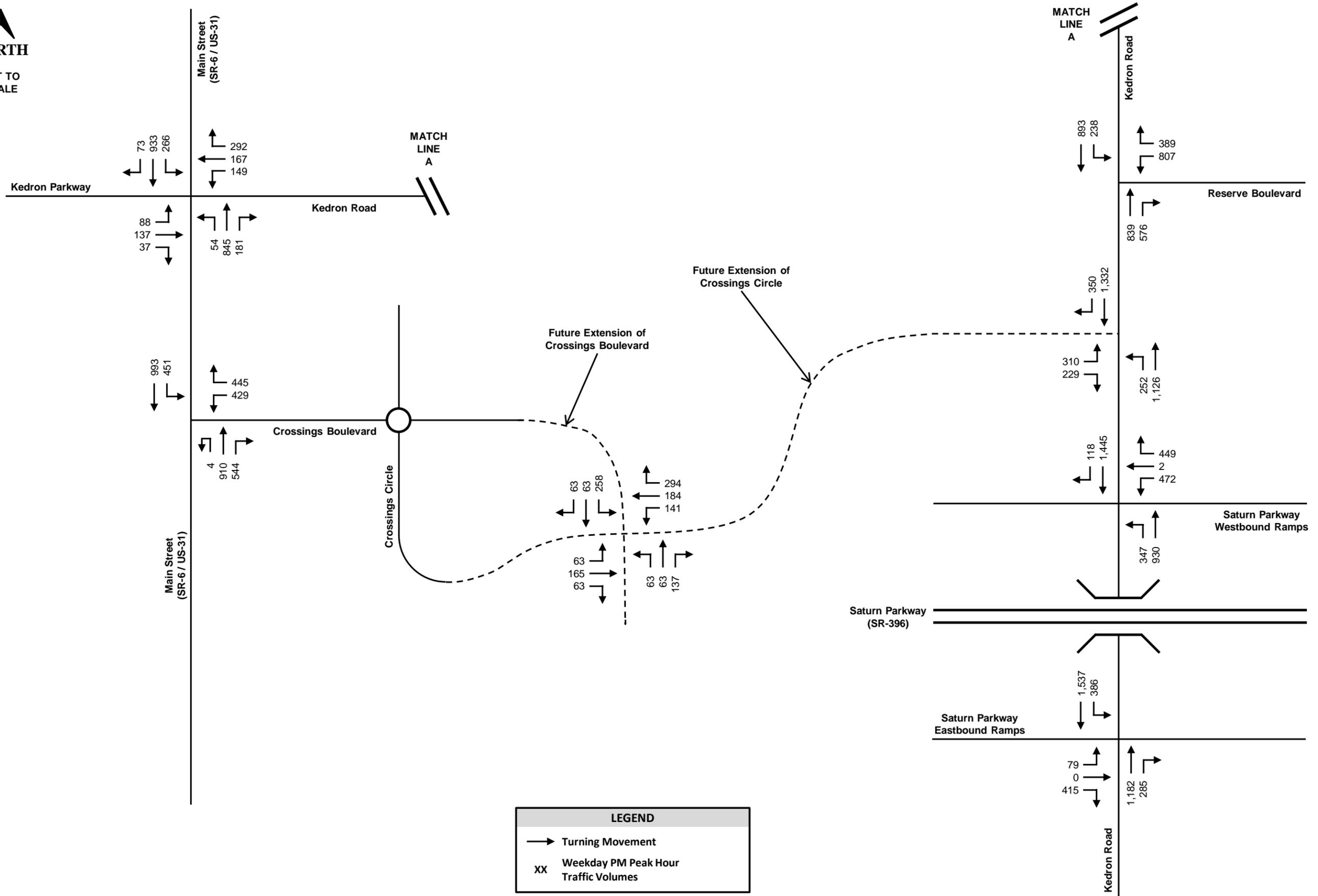


Figure 8B

Future 2034 (100% Build-Out) Weekday PM Peak Hour Traffic Volumes

Crossings Circle Transportation Study





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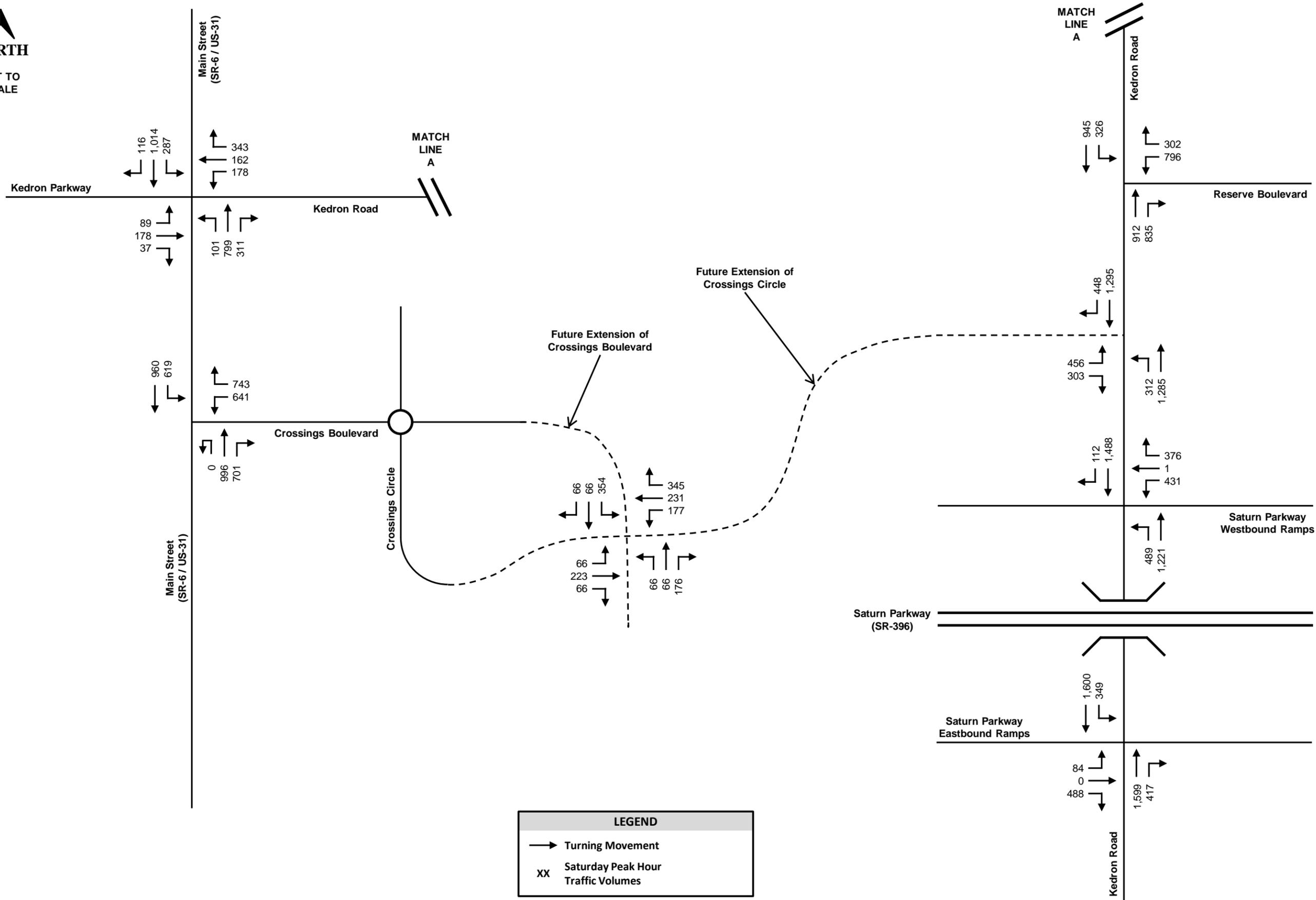


Figure 8C

Future 2034 (100% Build-Out) Saturday Peak Hour Traffic Volumes

Crossings Circle Transportation Study



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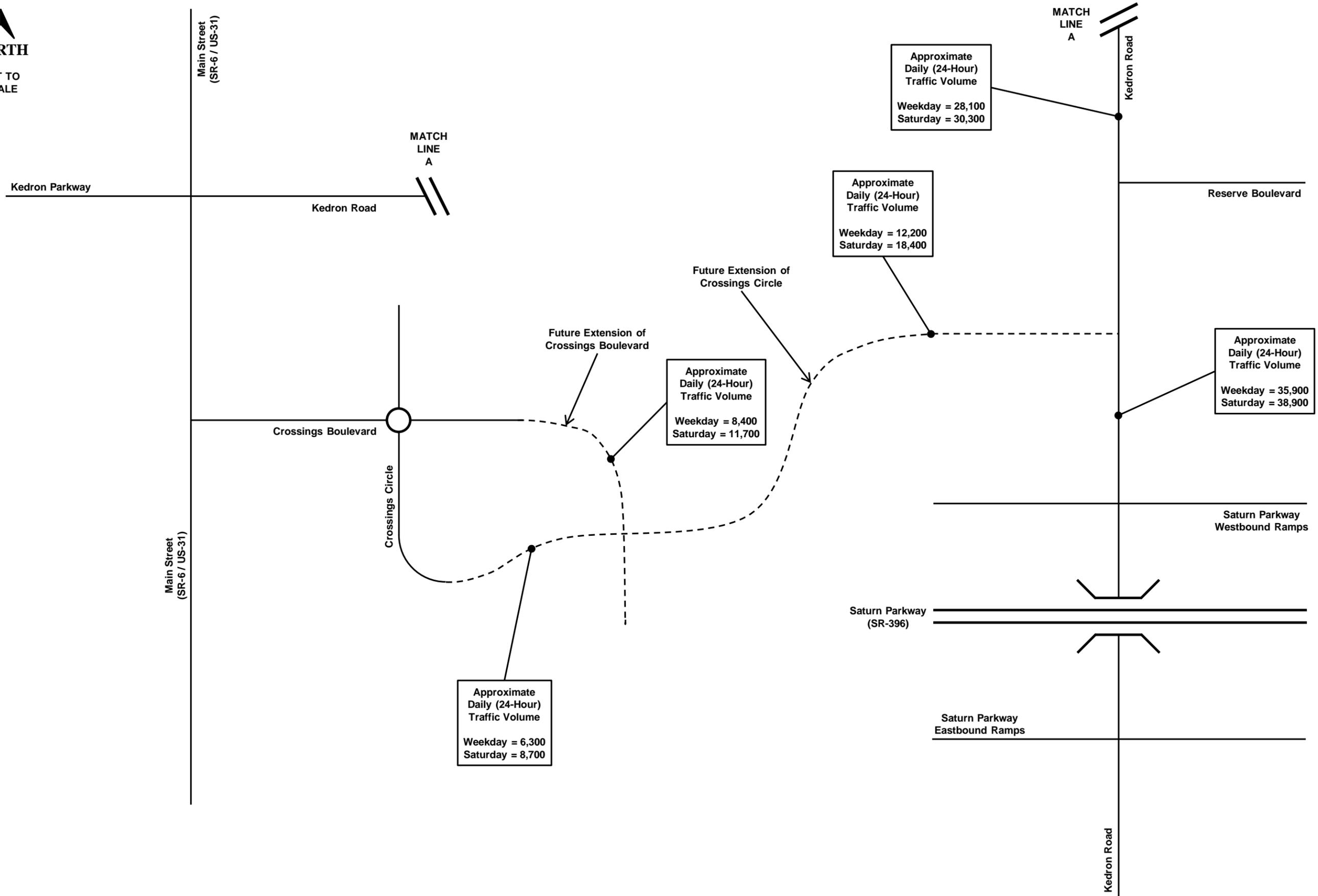


Figure 8D

Future 2034 (100% Build-Out) Daily (24-Hour) Traffic Volumes

Crossings Circle Transportation Study





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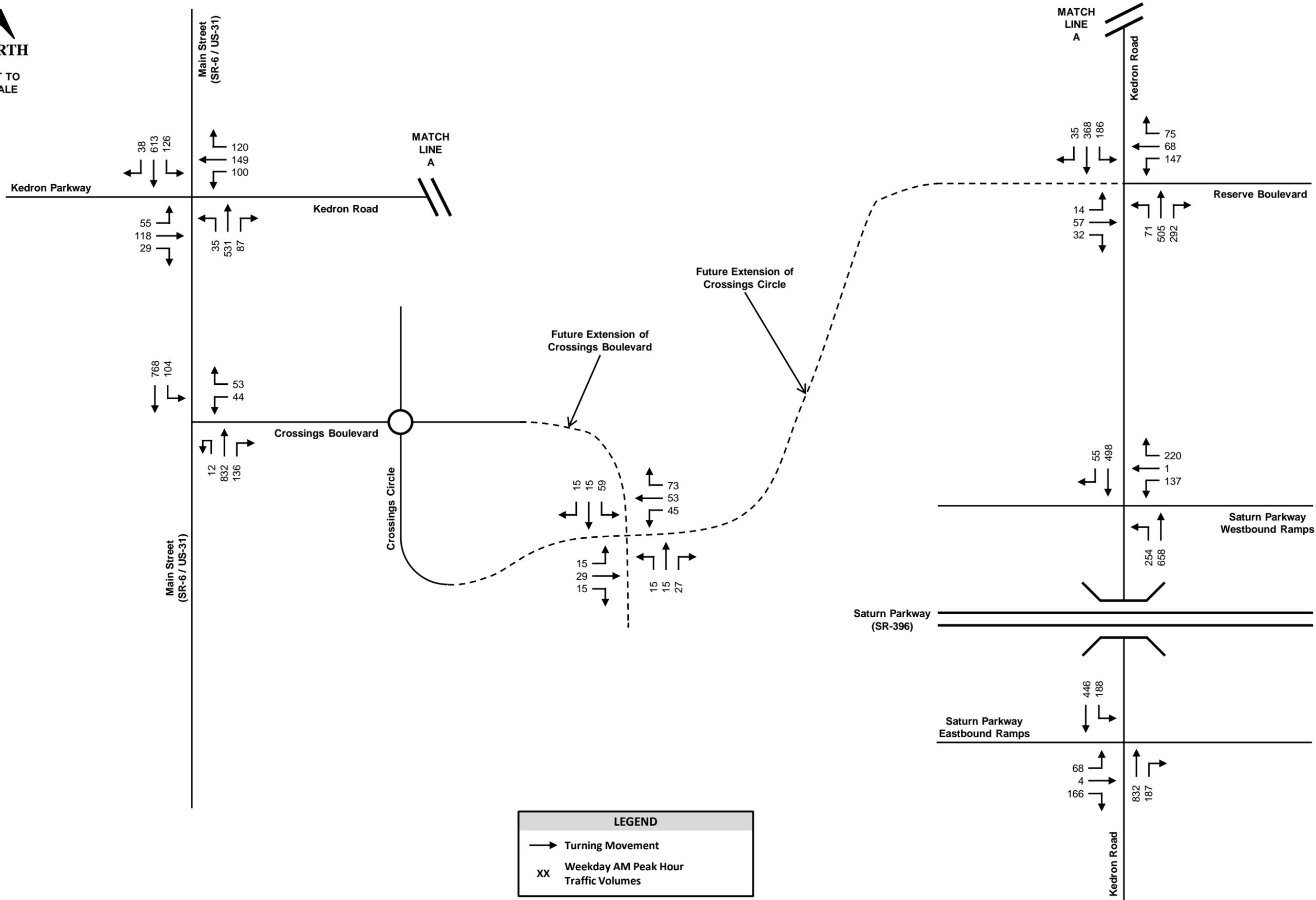


Figure 9A

Future 2034 (50% Build-Out) Weekday AM Peak Hour Traffic Volumes

Crossings Circle Transportation Study





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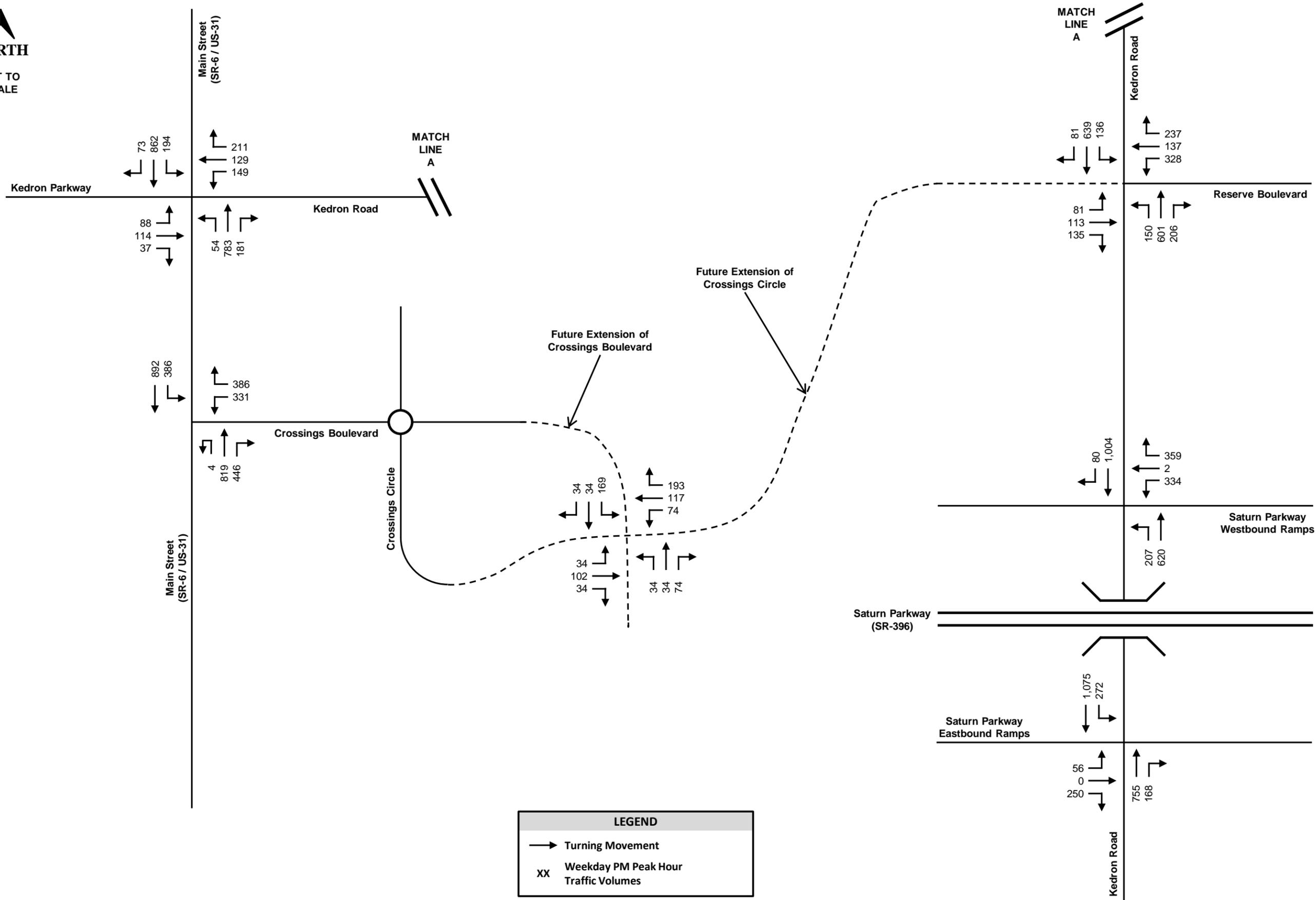


Figure 9B

Future 2034 (50% Build-Out) Weekday PM Peak Hour Traffic Volumes

Crossings Circle Transportation Study





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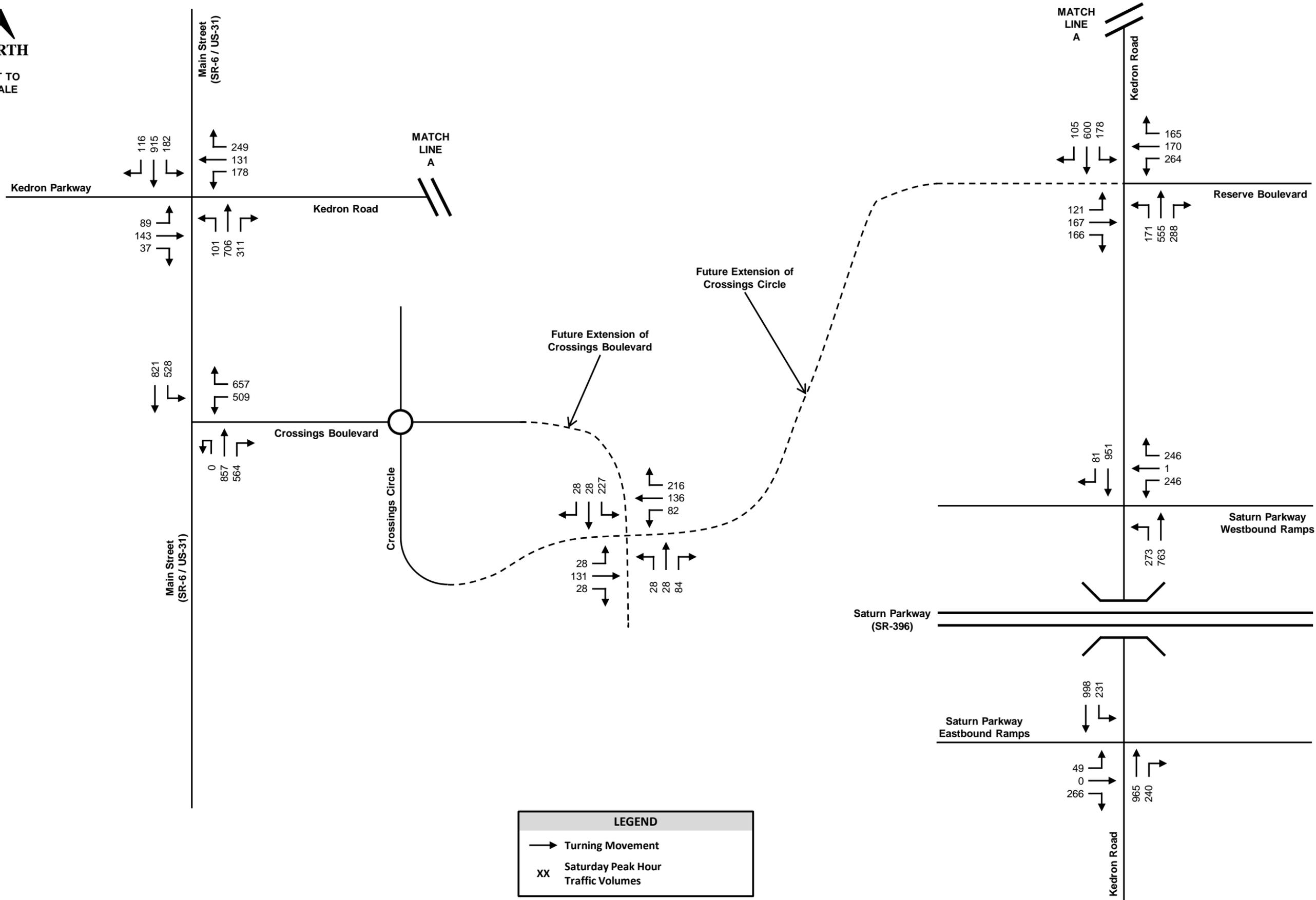


Figure
9C

Future 2034 (50% Build-Out)
Saturday Peak Hour
Traffic Volumes

Crossings Circle
Transportation Study

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NORTH
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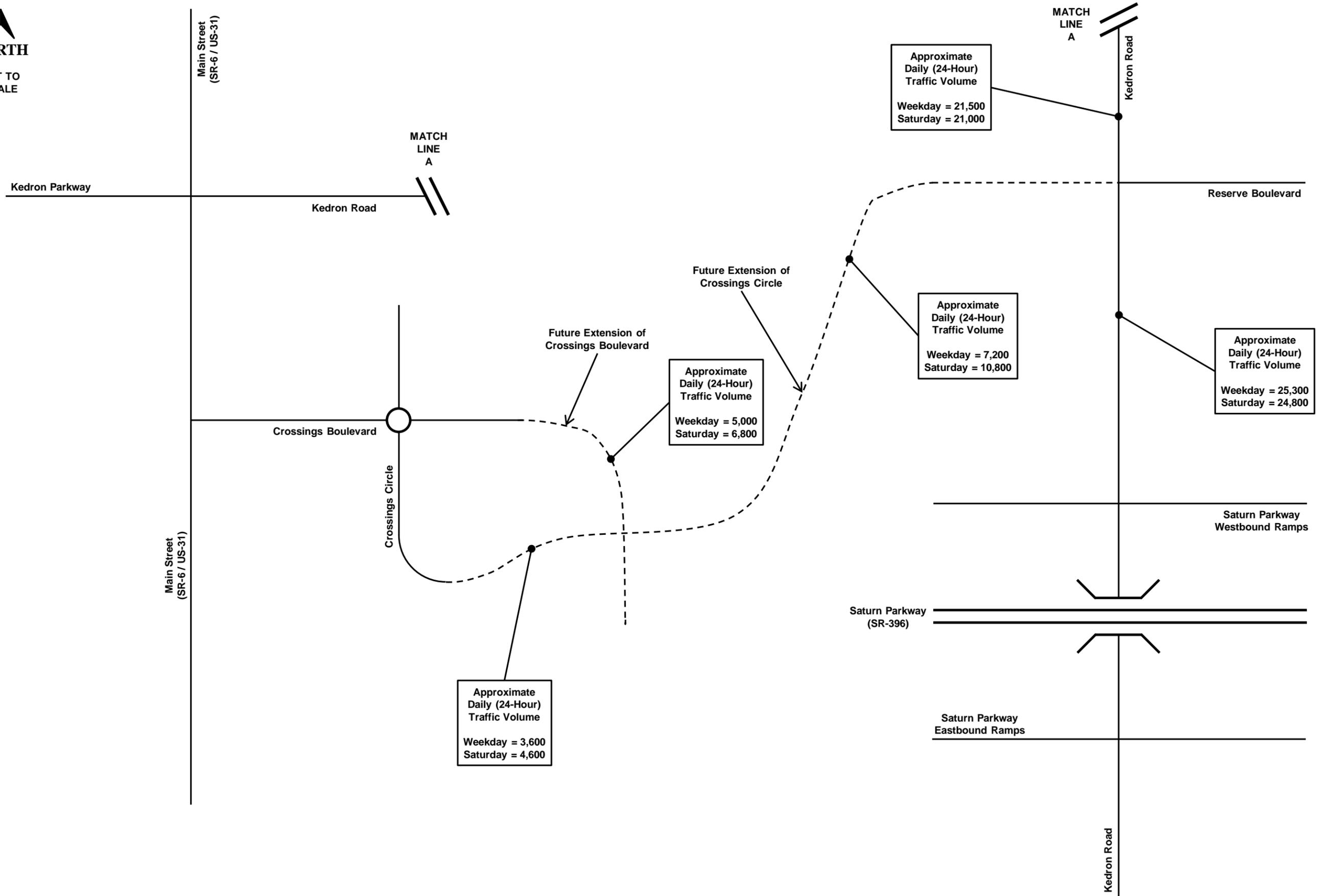


Figure 9D

Future 2034 (50% Build-Out) Daily (24-Hour) Traffic Volumes

Crossings Circle Transportation Study

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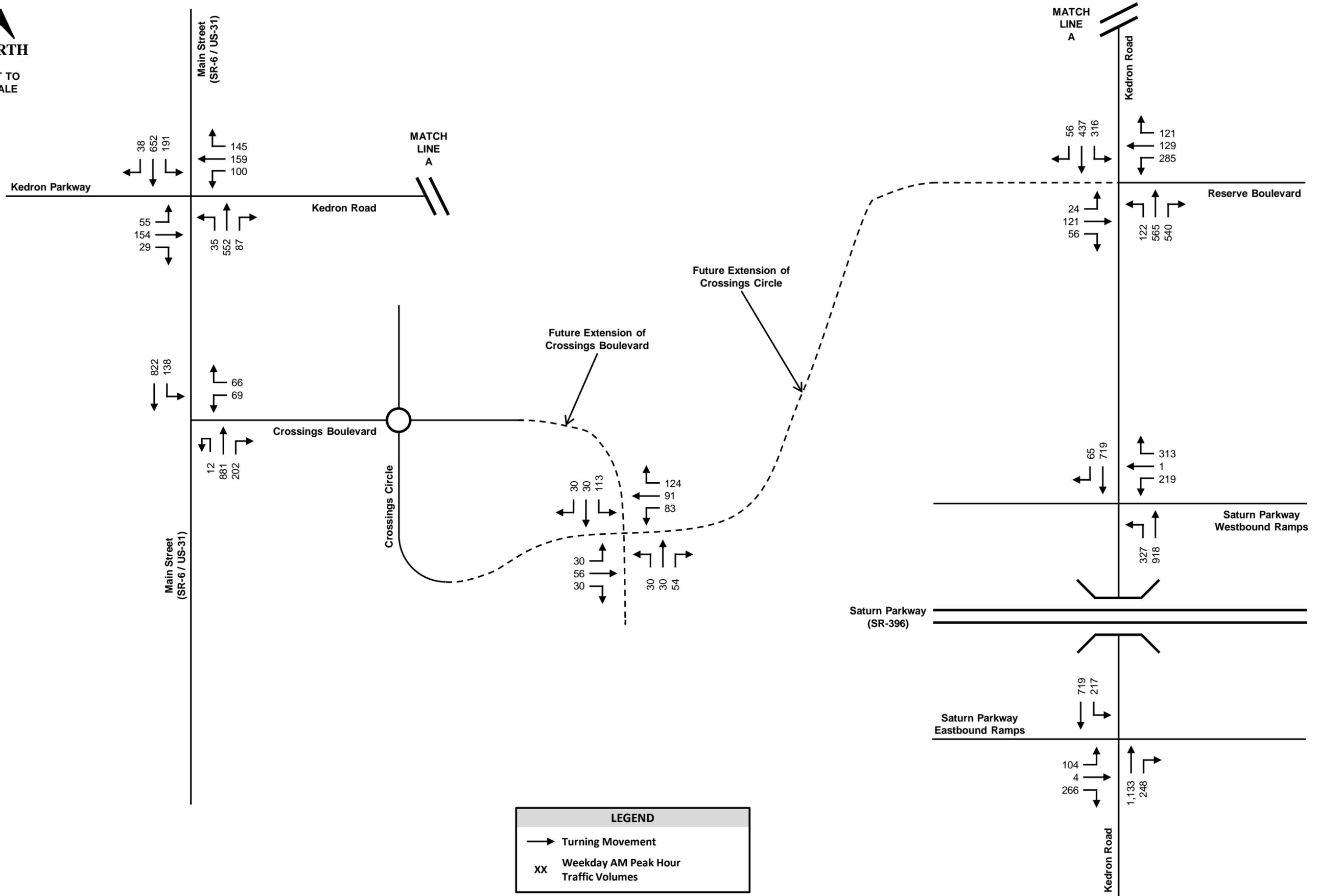


Figure 10A

Future 2034 (100% Build-Out) Weekday AM Peak Hour Traffic Volumes

Crossings Circle Transportation Study

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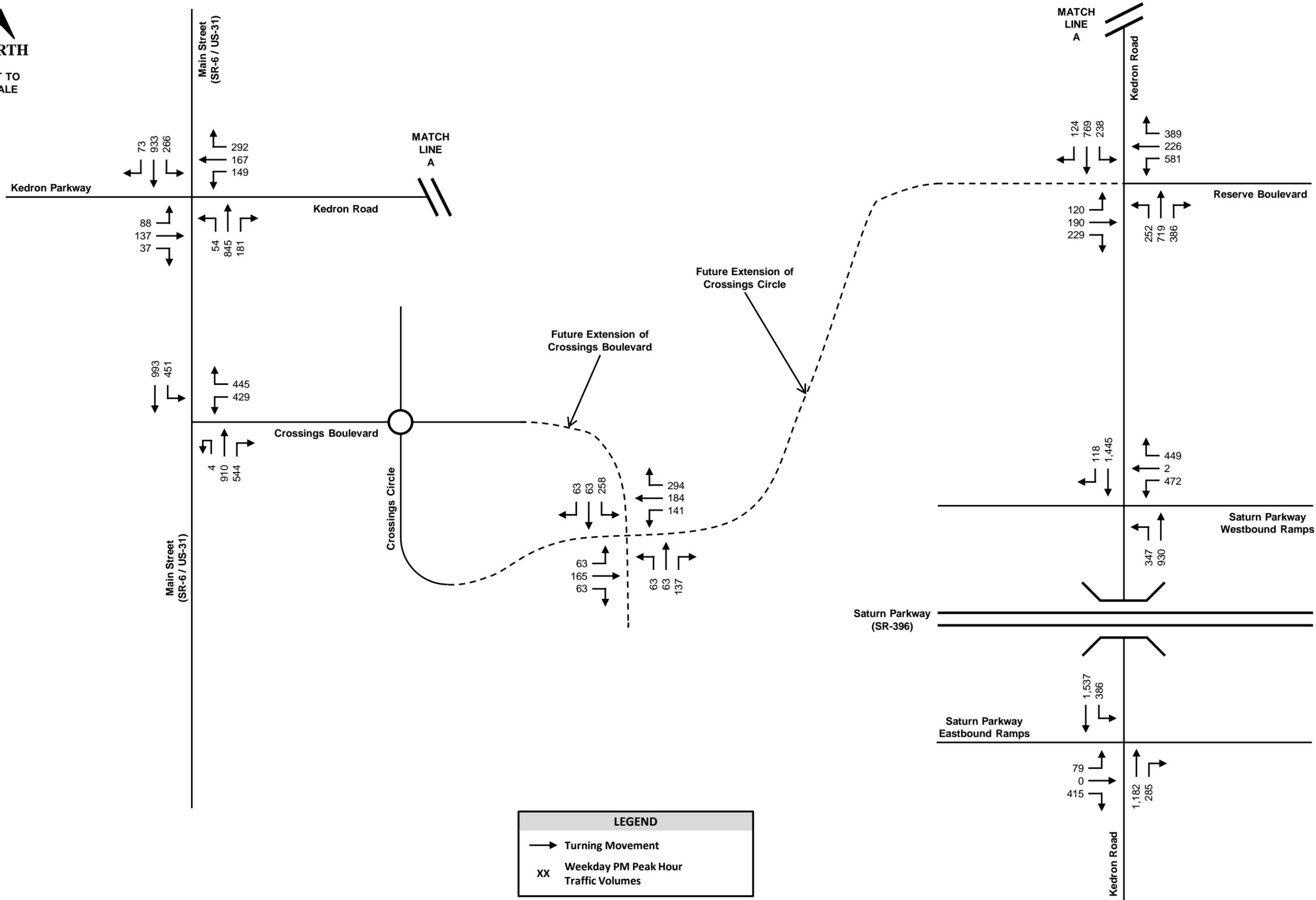


Figure 10B

Future 2034 (100% Build-Out) Weekday PM Peak Hour Traffic Volumes

Crossings Circle Transportation Study





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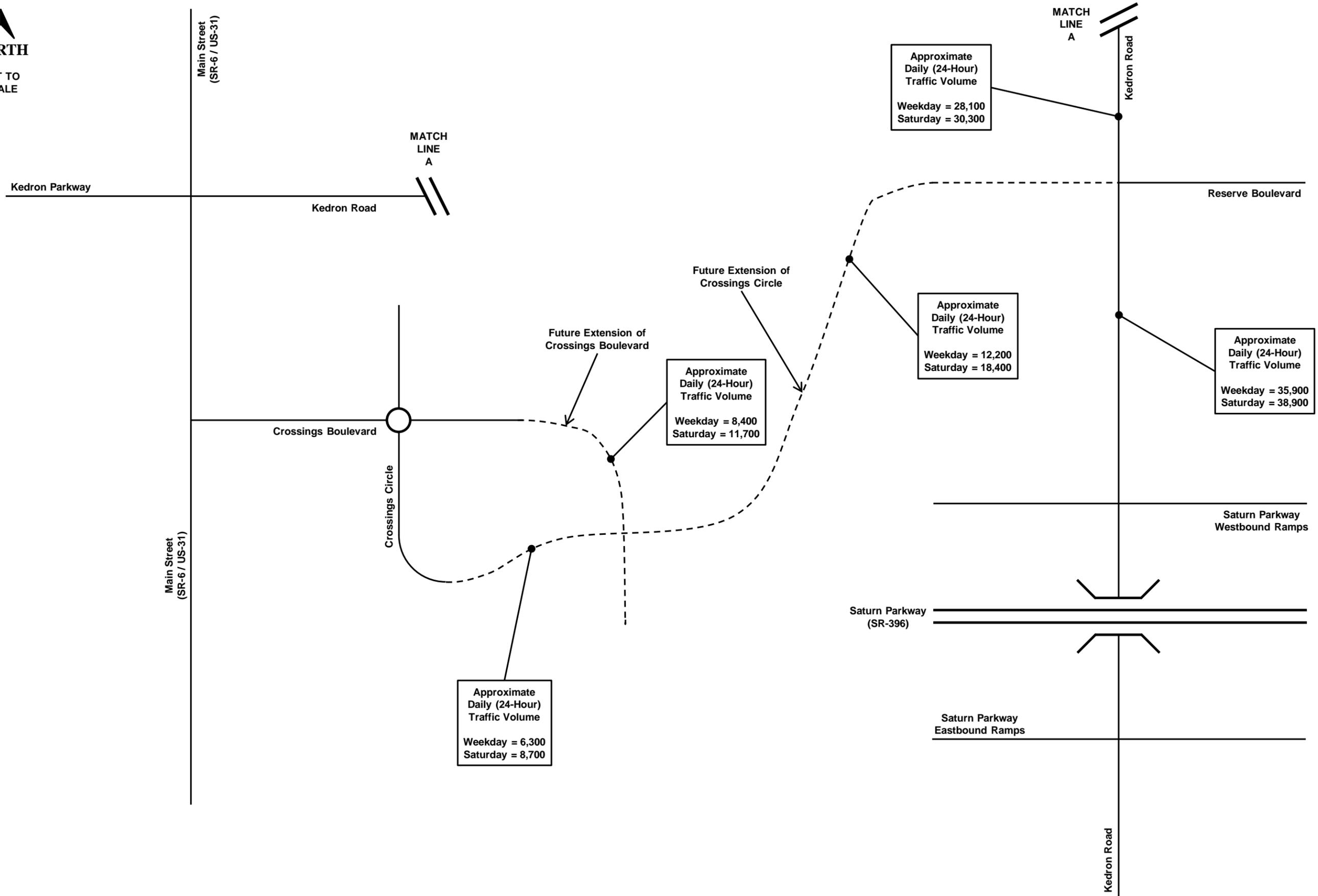


Figure 10D

Future 2034 (100% Build-Out) Daily (24-Hour) Traffic Volumes

Crossings Circle Transportation Study



6.0 CAPACITY ANALYSIS

6.1 Highway Capacity Manual (HCM)

The *Highway Capacity Manual (HCM) 2010* provides insight and guidance on control delay, level of service (LOS), signalized intersection LOS, and unsignalized intersection LOS.

Control Delay:

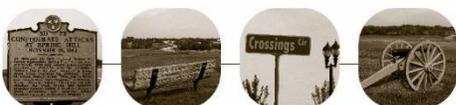
“Control delay – the delay brought about by the presence of a traffic control device – is the principal service measure in the HCM for evaluating LOS at signalized and unsignalized intersections. Control delay includes delay associated with vehicles slowing in advance of an intersection, the time spent stopped on an intersection approach, the time spent as vehicles move up in the queue, and the time needed for vehicles to accelerate to their desired speed.” (Source: *Highway Capacity Manual 2010*, Chapter 4)

LOS:

“LOS is a quantitative stratification of a performance measure or measures that represent quality of service. The measures used to determine LOS for transportation system elements are called service measures. The HCM defines six levels of service, ranging from A to F, for each service measure, or for the output from a mathematical model based on multiple performance measures. LOS A represents the best operating conditions from the traveler’s perspective and LOS F the worst. For cost, environmental impact, and other reasons, roadways are not typically designed to provide LOS A conditions during peak periods, but rather some lower LOS that reflects a balance between the individual travelers’ desires and society’s desires and financial resources. Nevertheless, during low-volume periods of the day, a system element may operate at LOS A.” (Source: *Highway Capacity Manual 2010*, Chapter 5)

Signalized Intersection LOS:

- Control delay alone is used to characterize LOS for the entire intersection or an approach
- Control delay and volume-to-capacity ratio are used to characterize LOS for a lane group.
- Delay quantifies the increase in travel time due to traffic signal control. It is also a surrogate measure of driver discomfort and fuel consumption.



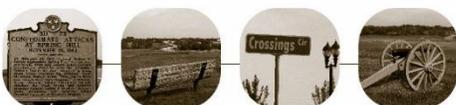
The LOS criteria for signalized intersections are summarized in **Table 9**.

Table 9 – Signalized Intersection Level of Service		
LOS	Control Delay (seconds/vehicle)	Comments
A	≤ 10	Volume-to-capacity ratio is low and either progression is exceptionally favorable or the cycle length is very short. If it is due to favorable progression, most vehicles arrive during the green indication and travel through the intersection without stopping.
B	> 10 – 20	Volume-to-capacity ratio is low and either progression is highly favorable or the cycle length is short. More vehicles stop than with LOS A.
C	> 20 – 35	Progression is favorable or the cycle length is moderate. Individual cycle failures (i.e., one or more queued vehicles are not able to depart as a result of insufficient capacity during the cycle) may begin to appear at this level. The number of vehicles stopping is significant, although many vehicles still pass through the intersection without stopping.
D	> 35 – 55	Volume-to-capacity ratio is high and either progression is ineffective or the cycle length is long. Many vehicles stop and individual cycle failures are noticeable.
E	> 55 – 80	Volume-to-capacity ratio is high, progression is unfavorable, and the cycle length is long. Individual cycle failures are frequent.
F	> 80	Volume-to-capacity ratio is very high, progression is very poor, and the cycle length is long. Most cycles fail to clear the queue.

Source: *Highway Capacity Manual 2010*, Chapter 18

Unsignalized (two-way stop-controlled) intersection LOS:

- For motor vehicles, LOS is determined for each minor-street movement (or shared movement) as well as the major-street left turns...LOS is not defined for the intersection as a whole or for major-street approaches
- The LOS criteria for unsignalized intersections are somewhat different from the criteria for signalized intersections, primarily because user perceptions differ among transportation facility types. The expectation is that a signalized intersection is designed to carry higher traffic volumes and will present greater delay than an unsignalized intersection. Unsignalized intersections are also associated with more uncertainty for users, as delays are less predictable than they are at signals, which can reduce users' delay tolerance.



The LOS criteria for unsignalized intersections are summarized in **Table 9**.

Table 9 – Unsignalized Intersection Level of Service		
LOS	Control Delay (seconds/vehicle)	Comments
A	0 – 10	Usually no conflicting traffic
B	> 10 – 15	Occasionally some delay due to conflicting traffic
C	> 15 – 25	Delay noticeable to vehicles, but not inconveniencing
D	> 25 – 35	Delay noticeable and irritating, increased likelihood of risk taking
E	> 35 – 50	Delay approaches tolerance level, risk-taking behavior likely
F	> 50	Delay exceeds tolerance level, high likelihood of vehicle risk taking

Source: *Highway Capacity Manual 2010*, Chapter 19

The Synchro 8 software is a complete software package for modeling, optimizing, managing, and simulating traffic systems. Synchro was used to analyze intersections using methodology contained within the *Highway Capacity Manual 2000*.

6.2 SIDRA

The Sidra Intersection software is an advanced lane-based micro-analytical tool for design and evaluation of individual intersections and networks of intersections. It provides estimates of capacity, level of service, and a wide range of performance measures including delay, queue length and stops for vehicles and pedestrians. This software was used to analyze roundabout intersections using the SIDRA Standard capacity model, which is sensitive to many parameters related to roundabout geometry.

SIDRA Standard capacity model:

“The SIDRA Standard capacity model for roundabouts is sensitive to many parameters related to roundabout geometry, namely roundabout diameter, entry radius, entry angle, entry lane width, circulating lane width, number of entry lanes and circulating lanes, short lanes for approach flaring and other geometric parameters. However, the HCM 2010 model is only sensitive to the number of entry and circulating lanes.”

(Source: Sidra Solutions website)



6.3 Intersection Analysis

The following intersections were analyzed:

- For Alignment Alternatives A, B, and C
 - Main Street (US-31 / SR-6) at Crossings Boulevard
 - Main Street (US-31 / SR-6) at Kedron Road / Kedron Parkway
 - Kedron Road at Saturn Parkway (SR-396) Westbound Ramps
 - Kedron Road at Saturn Parkway (SR-396) Eastbound Ramps
 - Future Crossings Circle at Future Crossings Boulevard
- For Alignment Alternatives A and B
 - Kedron Road at Reserve Boulevard
 - Kedron Road at Future Crossings Circle
- For Alignment Alternative C
 - Kedron Road at Reserve Boulevard / Future Crossings Circle

Intersection capacity analyses were conducted for the following conditions within the study area:

- Existing 2014 Conditions
- Future 2034 Conditions with 50% Build-Out of Development Potential
- Future 2034 Conditions with 100% Build-Out of Development Potential

A summary of the capacity analyses for the Weekday AM peak hour, Weekday PM peak hour, and Saturday peak hour is provided in **Table 10**, **Table 11**, and **Table 12**, respectively.

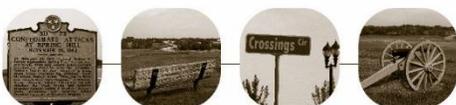


Table 10 – Intersection Capacity Analysis Results – Weekday AM Peak Hour					
Intersection	Existing 2014	Future 2034 (50% Build-Out)		Future 2034 (100% Build-Out)	
		Base	Improved	Base	Improved
Alignment Alternatives A, B, and C					
Main Street (US-31 / SR-6) at Crossings Boulevard	B (10.2)	B (11.8)	B (11.7)	B (13.0)	B (12.2)
Main Street (US-31 / SR-6) at Kedron Road / Kedron Parkway	C (25.4)	C (32.2)	C (24.0)	D (36.6)	C (25.2)
Kedron Road at Saturn Parkway (SR-396) Westbound Ramps	C (16.0)	F ***	B (12.2)	F ***	B (15.4)
Kedron Road at Saturn Parkway (SR-396) Eastbound Ramps	B (12.8)	F (197.5)	C (23.8)	F ***	B (18.3)
Future Crossings Circle at Future Crossings Boulevard	---	B (11.7)	B (13.3)	C (20.8)	B (14.9)
Alignment Alternatives A and B					
Kedron Road at Reserve Boulevard	B (11.7)	F (692.1)	B (14.8)	F (7743.6)	C (33.7)
Kedron Road at Future Crossings Circle	---	A (6.6)	---	A (7.3)	---
Alignment Alternative C					
Kedron Road at Reserve Boulevard / Future Crossings Circle	---	---	B (18.2)	---	C (26.6)

*** Excessive Delay



Table 11 – Intersection Capacity Analysis Results – Weekday PM Peak Hour					
Intersection	Existing 2014	Future 2034 (50% Build-Out)		Future 2034 (100% Build-Out)	
		Base	Improved	Base	Improved
Alignment Alternatives A, B, and C					
Main Street (US-31 / SR-6) at Crossings Boulevard	C (20.0)	C (22.9)	C (22.7)	C (24.7)	C (25.0)
Main Street (US-31 / SR-6) at Kedron Road / Kedron Parkway	C (26.6)	E (66.8)	D (35.1)	F (121.7)	D (35.2)
Kedron Road at Saturn Parkway (SR-396) Westbound Ramps	F (90.3)	F ***	D (48.2)	F ***	D (36.3)
Kedron Road at Saturn Parkway (SR-396) Eastbound Ramps	B (14.8)	F ***	C (23.4)	F ***	C (24.7)
Future Crossings Circle at Future Crossings Boulevard	---	A (7.7)	---	B (10.2)	---
Alignment Alternatives A and B					
Kedron Road at Reserve Boulevard	B (14.7)	F (6648.4)	C (31.8)	F (6903.0)	C (34.9)
Kedron Road at Future Crossings Circle	---	F ***	C (23.0)	F ***	C (23.3)
Alignment Alternative C					
Kedron Road at Reserve Boulevard / Future Crossings Circle	---	---	C (34.2)	---	D (37.8)

*** Excessive Delay



Table 12 – Intersection Capacity Analysis Results – Saturday Peak Hour					
Intersection	Existing 2014	Future 2034 (50% Build-Out)		Future 2034 (100% Build-Out)	
		Base	Improved	Base	Improved
Alignment Alternatives A, B, and C					
Main Street (US-31 / SR-6) at Crossings Boulevard	C (23.8)	C (28.8)	C (29.3)	C (34.7)	C (34.8)
Main Street (US-31 / SR-6) at Kedron Road / Kedron Parkway	C (30.2)	E (70.8)	D (41.3)	F (133.0)	C (27.3)
Kedron Road at Saturn Parkway (SR-396) Westbound Ramps	C (16.1)	F ***	D (35.0)	F ***	D (48.4)
Kedron Road at Saturn Parkway (SR-396) Eastbound Ramps	B (11.0)	F ***	C (25.4)	F ***	D (35.4)
Future Crossings Circle at Future Crossings Boulevard	---	A (8.1)	---	B (16.0)	---
Alignment Alternatives A and B					
Kedron Road at Reserve Boulevard	B (11.1)	F (7249.2)	C (32.4)	F ***	C (30.7)
Kedron Road at Future Crossings Circle	---	F ***	C (27.7)	F ***	D (44.0)
Alignment Alternative C					
Kedron Road at Reserve Boulevard / Future Crossings Circle	---	---	C (31.2)	---	D (48.0)

*** Excessive Delay



For a scenario where the Future Crossings Circle and Reserve Boulevard do not intersect with Kedron Road directly across from each other:

- The Future 2034 (50% Build-Out) Intersection Geometry is illustrated in **Figure 11**, and the Future 2034 (100% Build-Out) Intersection Geometry is illustrated in **Figure 12**.

For a scenario where the Future Crossings Circle and Reserve Boulevard do intersect with Kedron Road directly across from each other:

- The Future 2034 (50% Build-Out) Intersection Geometry is illustrated in **Figure 13**, and the Future 2034 (100% Build-Out) Intersection Geometry is illustrated in **Figure 14**.

The results of the capacity analyses are provided in **Appendix E**.





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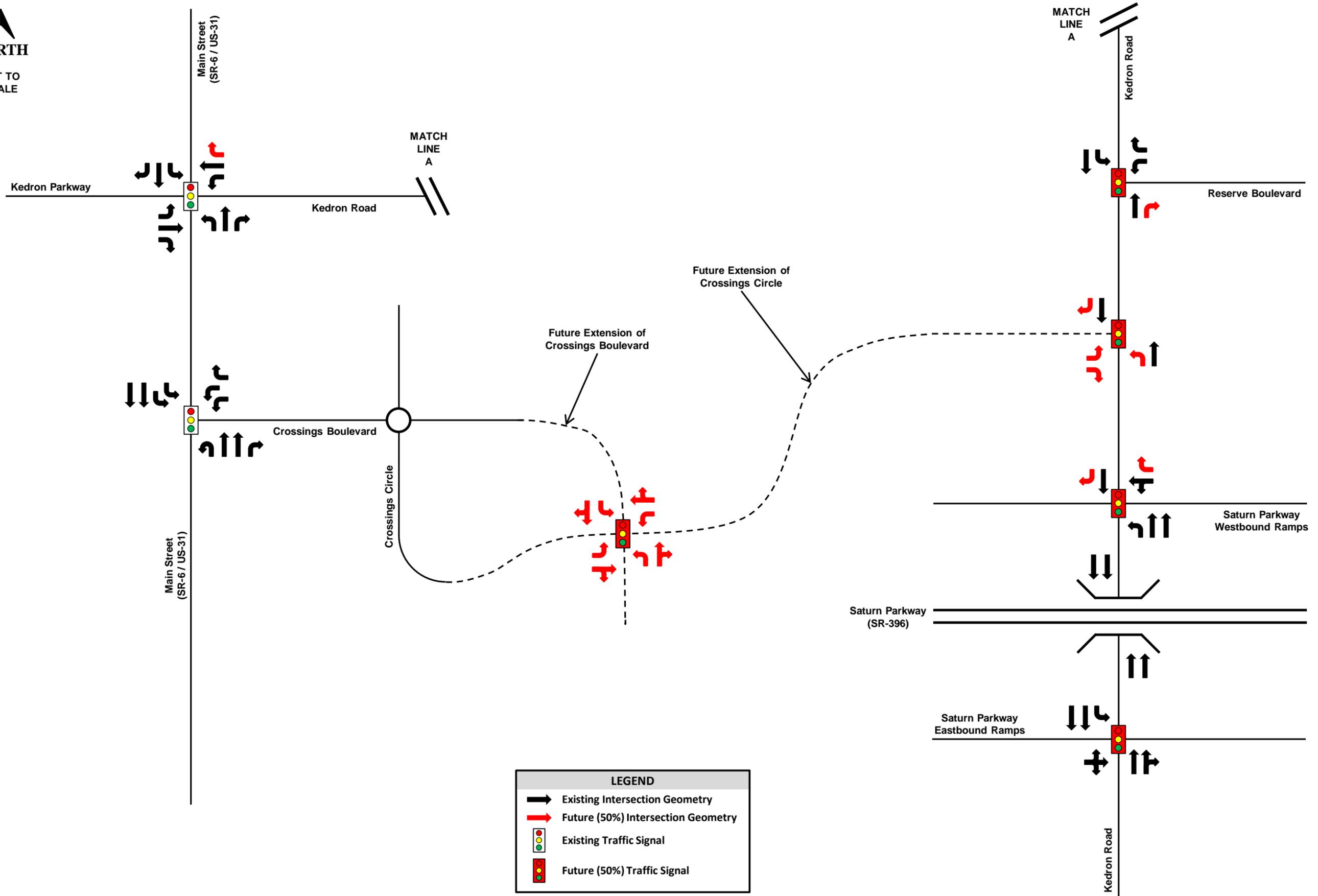


Figure 11

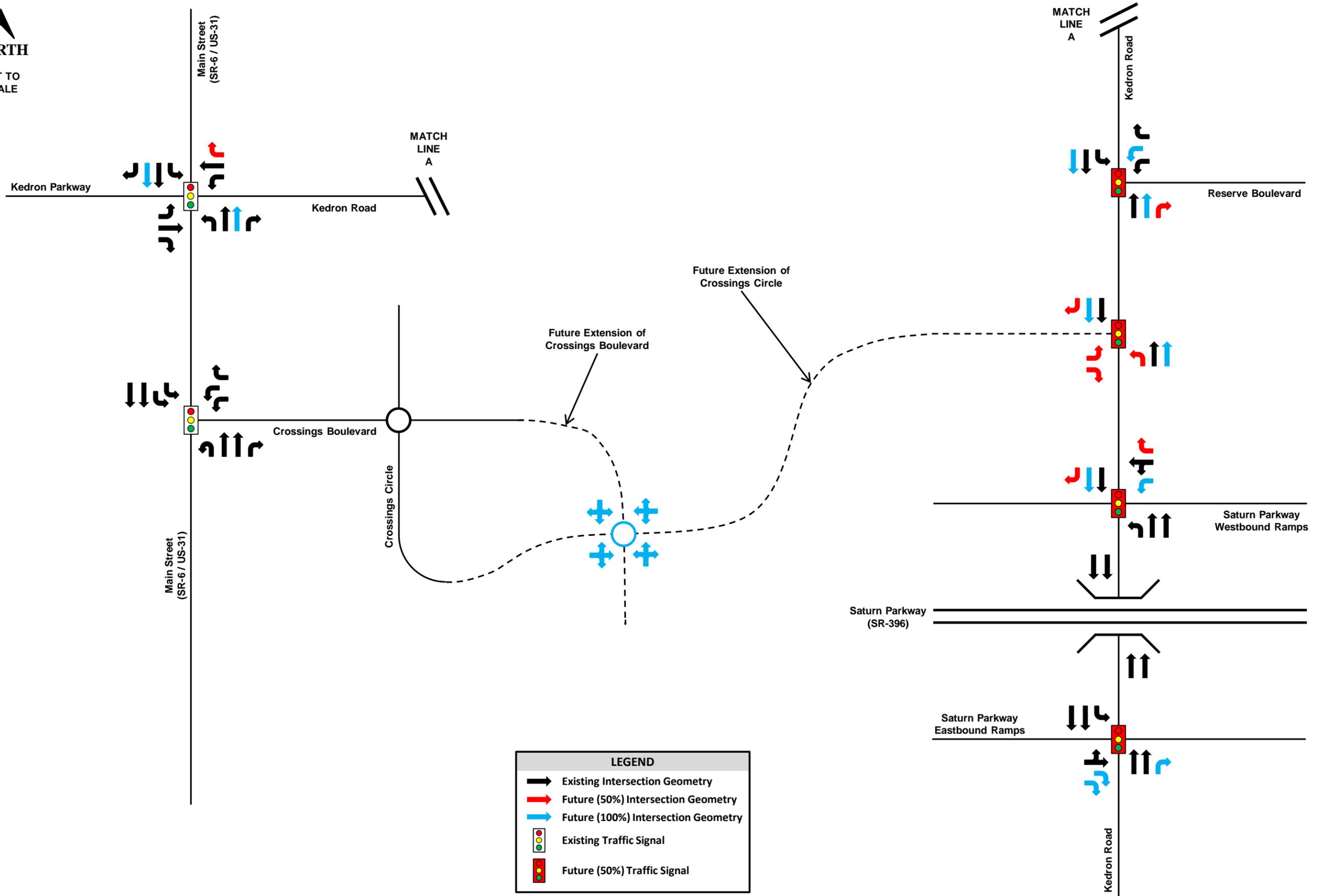
Future 2034 (50% Build-Out) Intersection Geometry

Crossings Circle Transportation Study





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LEGEND	
	Existing Intersection Geometry
	Future (50%) Intersection Geometry
	Future (100%) Intersection Geometry
	Existing Traffic Signal
	Future (50%) Traffic Signal



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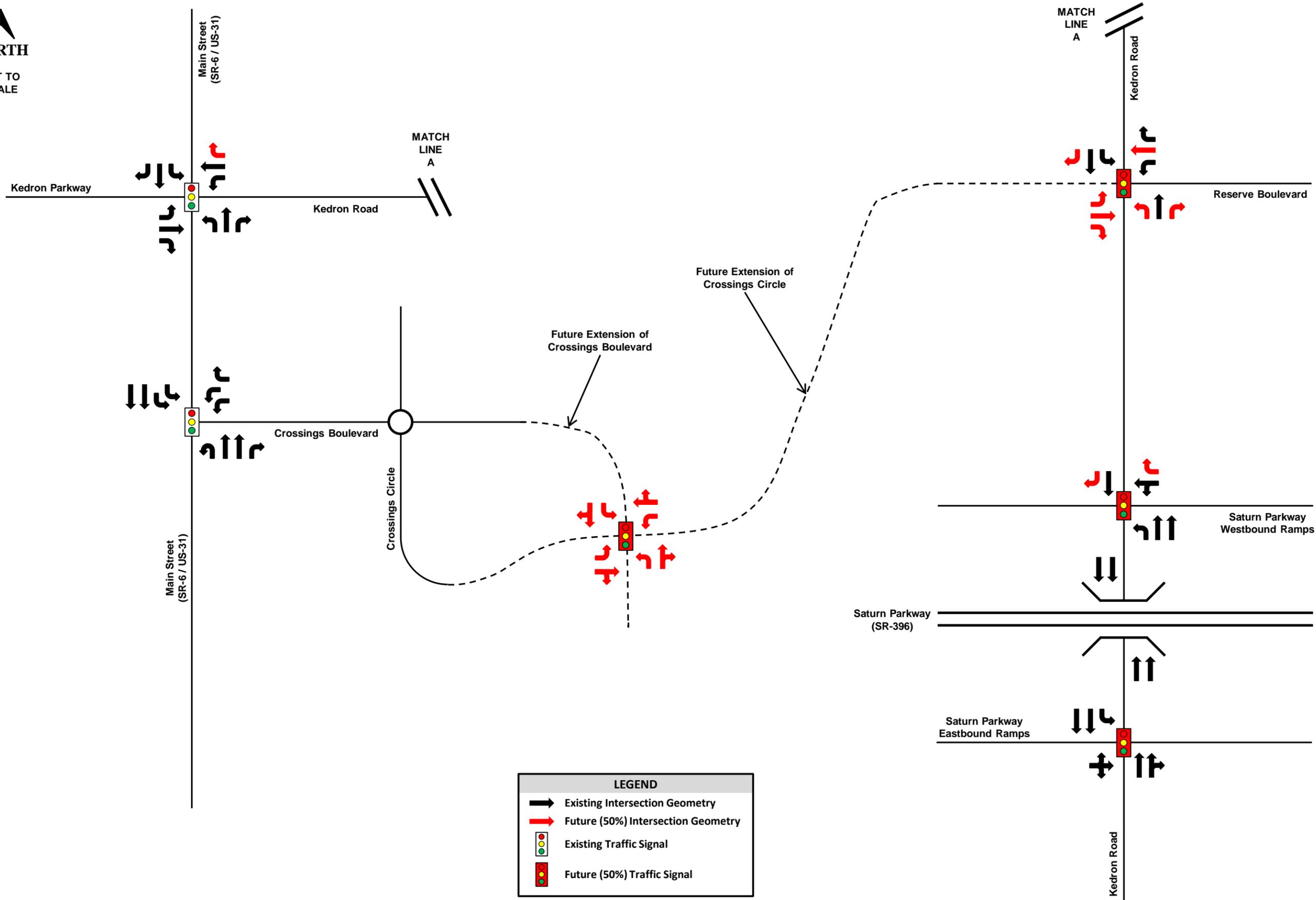
Crossings Circle Transportation Study

Future 2034 (100% Build-Out) Intersection Geometry

Figure 12



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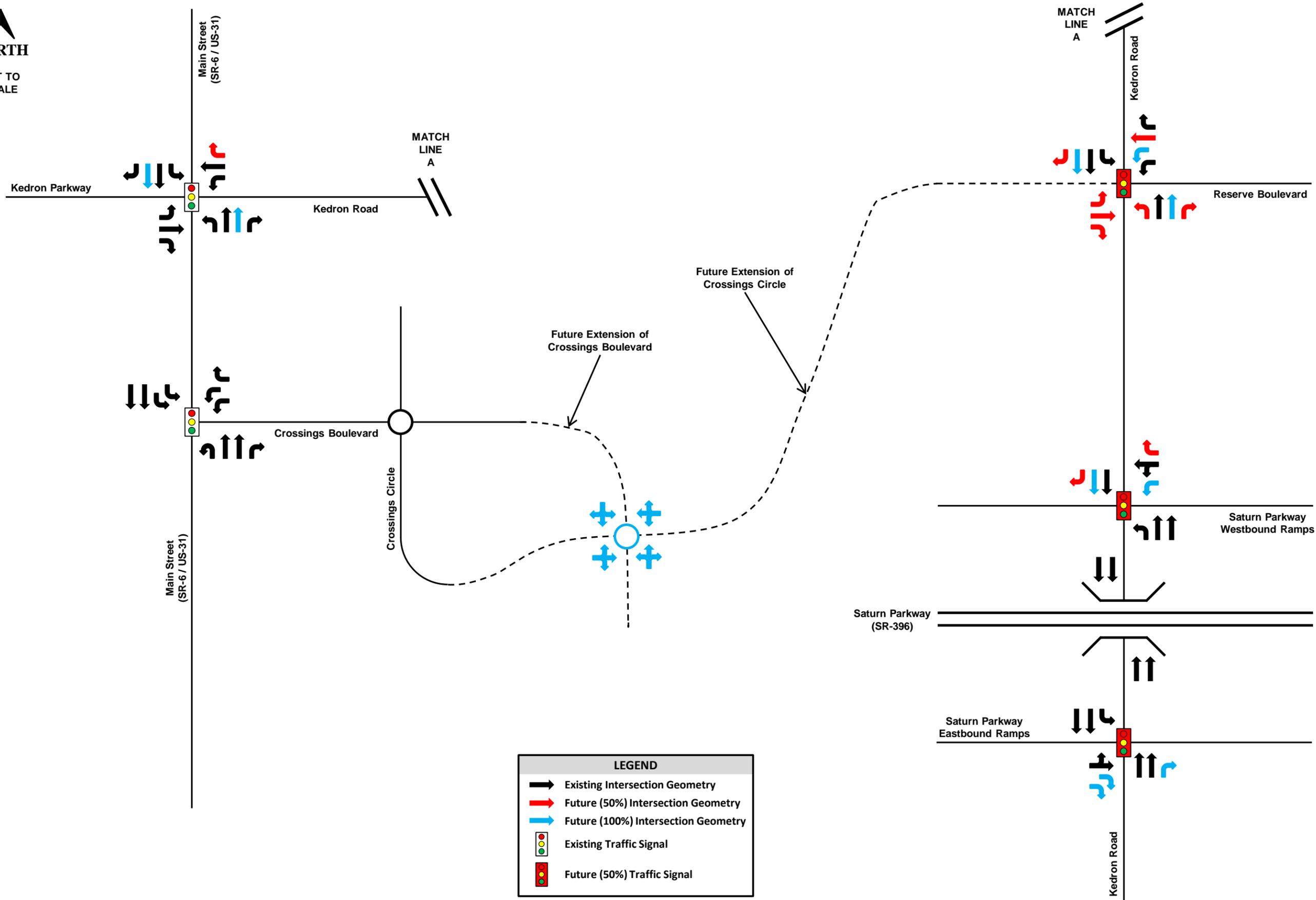


LEGEND

- Existing Intersection Geometry
- Future (50%) Intersection Geometry
- Existing Traffic Signal
- Future (50%) Traffic Signal



NOT TO SCALE



LEGEND

- Existing Intersection Geometry
- Future (50%) Intersection Geometry
- Future (100%) Intersection Geometry
- Existing Traffic Signal
- Future (50%) Traffic Signal



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Crossings Circle Transportation Study

Future 2034 (100% Build-Out) Intersection Geometry

Figure 14

7.0 CONTEXT SENSITIVE SOLUTIONS

The Future Crossings Circle alignment should focus on ‘fitting the road’s setting’, and to the greatest extent possible while implementing a new roadway, preserve the historic resource while maintaining safety and mobility. Each of the three (3) alignments will have an impact on the Civil War Battlefield, on which the Battle of Spring Hill occurred on November 29, 1864. As defined by the Federal Highway Administration (FHWA):

“Context sensitive solutions (CSS) is a collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic and environmental resources, while maintaining safety and mobility. CSS is an approach that considers the total context within which a transportation improvement project will exist.”

Using a collaborative approach, feedback and input were obtained from several sources to identify context sensitive solutions that would be appropriate considering the close proximity to the Spring Hill Battlefield. Phil Thomason (Thomason & Associates Preservation Planners), representatives from the Civil War Trust, and Eric Jacobson (Historic Preservationist, Spring Hill Citizen) were among the sources of input for measures that could be applied to the roadway to ‘fit the road’s setting’.

These context sensitive solutions included:

- Preserve the tree line buffer.
- Use natural colors for the roadway, bicycle lanes, and sidewalks.
- Use a stake-and-rider fence, since this particular type of fence was previously on property where the Battle of Spring Hill occurred.
- Use benches that incorporate natural elements.
- Use decorative features that communicate the historical events that occurred, and can provide educational opportunities for the community.
- Use street lighting with a lower height to reduce light pollution from the perspective of the Battlefield.

The preliminary Kit of Parts as well as a graphical rendering of the Future Crossings Circle are illustrated in the following **Exhibits**.



KIT OF PARTS

CROSSINGS CIRCLE - SPRING HILL, TENNESSEE



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SIDEWALKS



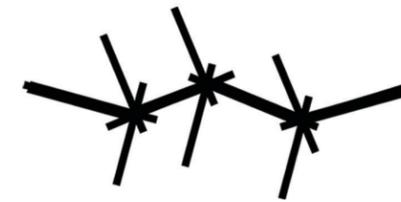
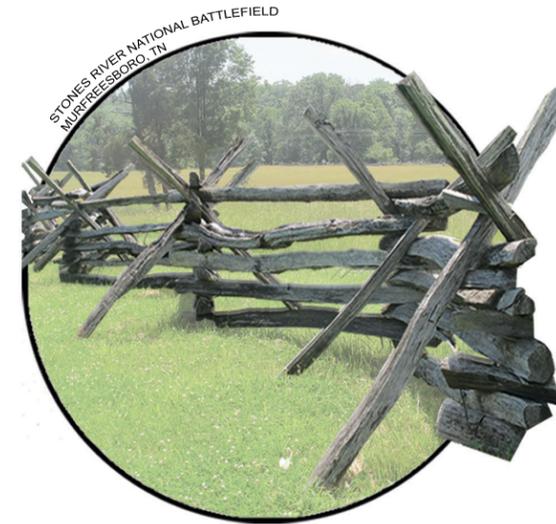
LIGHTING



BENCHES



FENCES



CANNONS





8.0 STAKEHOLDER INVOLVEMENT

Several meetings occurred that facilitated stakeholder involvement throughout the development of the Crossings Circle Transportation Study. These meetings are summarized in **Table 14**.

Table 14 – Summary of Meetings		
Meeting Purpose	Date	Location
Kick Off Meeting	November 4, 2014	Jerry Erwin Park & Spring Hill Battlefield
City of Spring Hill Transportation Advisory Committee	November 17, 2014	Spring Hill City Hall
Civil War Trust	December 11, 2014	Online Meeting / Conference Call
City of Spring Hill Transportation Advisory Committee	December 15, 2014	Spring Hill City Hall
City of Spring Hill Transportation Advisory Committee	January 20, 2015	Spring Hill City Hall
Public Meeting	January 22, 2015	Spring Hill Library
Civil War Trust	January 30, 2015	Online Meeting / Conference Call
City of Spring Hill Historic Commission	February 3, 2015	Spring Hill City Hall
City of Spring Hill Transportation Advisory Committee	February 23, 2015	Spring Hill City Hall
Board of Mayor and Alderman Work Session	April 6, 2015	Spring Hill City Hall

The Civil War Trust prepared a letter on March 25, 2015, that provided documentation of comments on behalf of the Civil War Trust organization.

The Meeting Minutes and Civil War Trust letter are provided in **Appendix F**.



9.0 OPINION OF PROBABLE COST

Four (4) scenarios were considered to develop an opinion of probable cost:

- Alternative B (East Leg as 2 Lane)
- Alternative B (East Leg as 4 Lane)
- Alternative C (East Leg as 2 Lane)
- Alternative C (East Leg as 4 Lane)

For Alternative B and Alternative C, the costs were generated for the east leg of Future Crossings Circle (between Future Crossings Boulevard and Kedron Road) as either a 2-lane or 4-lane roadway. This methodology was used because a 4-lane roadway is not anticipated to be needed immediately, but may be needed in the future if potential development generates the forecasted traffic volumes.

These opinions of probable cost are summarized in **Table 15**.

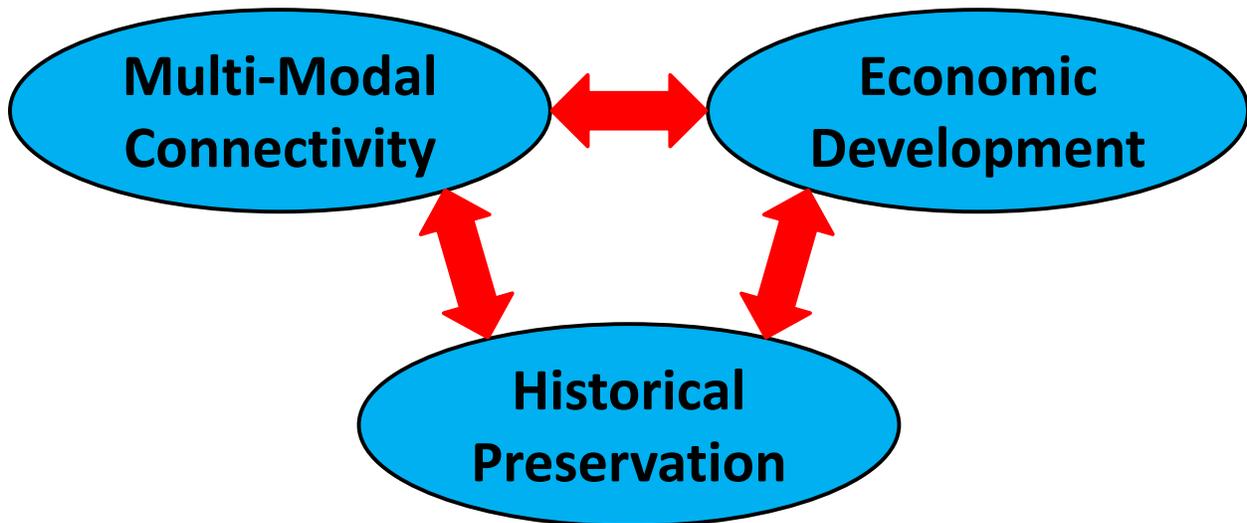
Table 15 – Opinion of Probable Cost				
Project Phase	Alternative B		Alternative C	
	East Leg as 2 Lane	East Leg as 4 Lane	East Leg as 2 Lane	East Leg as 4 Lane
Design and CEI	\$1,540,000	\$1,690,000	\$1,750,000	\$1,940,000
Right-Of-Way	\$1,650,000 – \$4,950,000	\$1,650,000 – \$4,950,000	\$1,850,000 – \$5,550,000	\$1,850,000 – \$5,550,000
Area for 150' Buffer	\$1,150,000 – \$3,450,000	\$1,150,000 – \$3,450,000	\$1,150,000 – \$3,450,000	\$1,150,000 – \$3,450,000
Roadway Construction	\$5,500,000	\$6,200,000	\$6,300,000	\$7,200,000
Context Sensitive Construction	\$2,200,000	\$2,250,000	\$2,450,000	\$2,500,000
TOTAL Construction	\$7,700,000	\$8,450,000	\$8,750,000	\$9,700,000
TOTAL	\$12,040,000 – \$17,640,000	\$12,940,000 – \$18,540,000	\$13,500,000 – \$19,500,000	\$14,640,000 – \$20,640,000

The detailed calculations for developing the opinion of probable cost for these four (4) scenarios are provided in **Appendix G**.



10.0 CONCLUSION

The Crossings Circle Transportation Study focused on three (3) areas of emphasis, in no particular order: Multi-Modal Connectivity, Economic Development, and Historical Preservation.



The following conclusions have been developed as part of the Crossings Circle Transportation Study:

- The City of Spring Hill Board of Mayor and Alderman should select a preferred option among the three (3) alignment alternatives.
- A multi-use path should be considered that connects the sidewalk network along the future roadway, the natural path that is currently located on the Civil War Trust property, and the multi-use path that is currently located on Jerry Erwin Park.
- Context Sensitive Solutions should be incorporated into the future roadway to promote the Battle of Spring Hill and the historical significance of the Civil War.

