

Final Traffic Engineering Report

Sunset Road Silverbell Road to I-10 (Segment I)

Prepared for:



Submitted to:



Submitted by:



1840 East River Road
Suite 123
Tucson, Arizona 85718

PCDOT Project No. 4RTSUN
SGI Project No. 20013-026
AECOM Project No. 60311412



August 2014

Expires 9/30/2015

TABLE OF CONTENTS

1.0	EXECUTIVE SUMMARY	1
1.1	Existing Conditions	1
1.2	Future Conditions.....	1
1.3	Recommendations	2
2.0	INTRODUCTION.....	3
2.1	Traffic Report Overview	6
3.0	EXISTING CONDITIONS	7
3.1	Land Use	7
3.2	Physical Conditions.....	7
3.2.1	Roadway.....	7
3.2.2	Speed Limits.....	7
3.2.3	Intersections and Driveways	9
3.3	Traffic Volumes and Factors	10
3.4	Crash Analysis.....	10
3.4.1	Intersection Crash Rate	12
3.4.2	Segment Crash Rate	13
3.5	Alternative Transportation Modes	14
4.0	FUTURE CONDITIONS	16
4.1	Planned Developments.....	16
4.2	Planned Transportation Improvements	16
4.3	Traffic Volume Projections	17
4.3.1	Future Volumes on Sunset Road and El Camino del Cerro.....	18
4.3.2	Future Daily and Hourly Traffic Volume Projections	19
4.4	Capacity and Level of Service Analysis.....	21
4.4.1	Intersection of Silverbell Road and Existing Sunset Road.....	22
4.4.2	Intersection of Sunset Road and Silverbell Road	23
4.4.3	Intersection of I-10 Frontage Roads and Sunset Road.....	24
4.5	Signalization Analysis	28
4.6	Turn Lane Warrant Analysis.....	31
5.0	PROPOSED IMPROVEMENTS	32
5.1	Design Parameters.....	32

5.2	Roadway Segments	32
5.3	Intersections.....	33
5.3.1	Intersection of Existing Sunset Road and Silverbell Road.....	33
5.3.2	Intersection of Sunset Road and Silverbell Road	33
5.3.3	Intersection of Sunset Road and I-10 Eastbound Frontage Road	33
5.3.4	Intersection of Sunset Road and I-10 Westbound Frontage Road	34
5.4	Turn Bay Storage	34
5.5	Access.....	34
5.6	Alternative Transportation Modes	34
5.7	Lighting and Intelligent Transportation Systems.....	36
6.0	CONCLUSIONS AND RECOMMENDATIONS	37
7.0	REFERENCES	41

APPENDICES

- Appendix A – Existing Traffic Volumes
- Appendix B – Crash Data
- Appendix C – Existing Sunset Road/Silverbell Road Future LOS
- Appendix D – Sunset Road/Silverbell Road Future LOS
- Appendix E – I-10/Sunset Road Traffic Interchange Future LOS
- Appendix F – 2025 Traffic Simulation Results
- Appendix G – Signal Warrant Analysis
- Appendix H – Turn Lane Warrant Analysis

LIST OF FIGURES

Figure 1 – Project Location Map	4
Figure 2 – Project Vicinity Map.....	5
Figure 3 – Zoning Map	8
Figure 4 – Existing Lane Configuration and Traffic Control	9
Figure 5 – Existing Traffic Volumes and Crashes.....	14
Figure 6 – Pima County “The Loop” Map	15
Figure 7 – 2018 Traffic Volume Projections	20
Figure 8 – 2025 Traffic Volume Projections	21
Figure 9 – Silverbell Road/Sunset Road Signal Warrant No. 2	29
Figure 10 – Frontage Road/Sunset Road Signal Warrant No. 2	30

Figure 11 – Sunset Road Typical Section 33
Figure 12 – Two Stage Crossing Concept..... 35
Figure 13 – Proposed Lane Configuration at Sunset Road/Silverbell Road Intersection 39
Figure 14 – Proposed Lane Configuration at I-10/Sunset Road TI 40

LIST OF TABLES

Table 1 – Silverbell Road Traffic Factors 10
Table 2 – Frontage Roads Traffic Factors..... 10
Table 3 – Intersection Crashes by Injury Severity 11
Table 4 – Intersection Crashes by Type..... 11
Table 5 – Segment Crashes by Injury Severity..... 12
Table 6 – Segment Crashes by Type 12
Table 7 – Traffic Volume Projections 18
Table 8 – 2018 Roadway Characteristics..... 19
Table 9 – Intersection Delay and Corresponding LOS..... 22
Table 10 – 2018 and 2025 Silverbell Road/Sunset Road TWSC LOS 22
Table 11 – 2018 and 2025 Silverbell Road/Sunset Road TWSC Queue Lengths..... 23
Table 12 – 2018 and 2025 Sunset Road/Silverbell Road TWSC LOS 23
Table 13 – 2018 and 2025 Sunset Road/Silverbell Road Signalized LOS..... 24
Table 14 – 2018 and 2025 Sunset Road/Silverbell Road Signalized Queue Lengths 24
Table 15 – 2018 Sunset Road/I-10 Frontage Roads Traffic Control Alternatives..... 25
Table 16 – 2025 Sunset Road/I-10 Frontage Roads Traffic Control Alternatives..... 26
Table 17 – 2025 Simulation Results for Stop Control on the Frontage Roads 27
Table 18 – 2025 I-10/Sunset Road TI Queue Lengths..... 28
Table 19 – Silverbell Road/Sunset Road Signal Warrant No. 1 29
Table 20 – Frontage Road/Sunset Road Signal Warrant No. 1 30
Table 21 – Recommended Storage Lengths 34

1.0 EXECUTIVE SUMMARY

The Pima County Department of Transportation (PCDOT) and the Regional Transportation Authority (RTA) are investigating alternatives to extend Sunset Road from Silverbell Road to River Road. PCDOT and RTA plan to develop this project in two phases. The first phase, referred to as Segment I, will extend Sunset Road from Silverbell Road to Interstate 10 (I-10) Eastbound Frontage Road (EBFR) at existing grade (interim improvements). The second phase of the project, referred to as Segment II, will extend Sunset Road from I-10 to River Road.

The anticipated opening year for Segment I is 2018 and consists of the interim design of the new intersection of Sunset Road and Silverbell Road, and interim improvements to the existing I-10/Sunset Road traffic interchange (TI) to provide access to Silverbell Road. Based on the Design Concept Reports prepared for the segments of Silverbell Road and I-10 adjacent to Sunset Road, it is assumed that the design year for the interim improvements is 2025. The roadway segment of Sunset Road between Silverbell Road and the I-10/Sunset Road TI will be designed for the ultimate configuration. The design year for the ultimate configuration is 2040.

This traffic engineering report evaluates exclusively the 2012 existing and 2018/2025 future conditions of Segment I of the Sunset Road improvements. For 2040 future conditions, please refer to the Traffic Engineering Report of Sunset Road, Silverbell Road to River Road.

1.1 Existing Conditions

Sunset Road once extended from Silverbell Road to the I-10 EBFR, but the Sunset Road Bridge over the Santa Cruz River collapsed during the flood of 1983 and the connection between Silverbell Road and I-10 was lost. Currently, Sunset Road only extends to the west of Silverbell Road as a two-lane roadway that is classified as an urban collector road with a posted speed limit of 35 miles per hour (mph). The traffic volume on the existing segment of Sunset Road, west of Silverbell Road, is approximately 1,400 vehicles per day (vpd). A review of the crash data from October 2008 through September 2013 revealed that both the segment and intersection crash rates of the existing Sunset Road are below Pima County averages.

Since the extension of Sunset Road would impact Silverbell Road and the I-10 frontage roads, traffic characteristics and crash data were also documented on these roadways. Like the existing segment of Sunset Road, Silverbell Road and the frontage roads have comparable traffic and safety characteristics.

1.2 Future Conditions

Due to the expected population growth in the northwest Tucson region, the connection of Silverbell Road to I-10 and ultimately to River Road was included in the RTA plan to increase mobility and improve operations and traffic safety in the area. The Pima Association of Governments (PAG) regional travel demand model predicts a traffic demand of 8,750 vpd on Sunset Road in the opening year (2018) and 10,750 vpd in the design year (2025). To accommodate the projected traffic demand, a three-lane facility is required for the new roadway.

Traffic signal warrant studies were conducted for future years 2018 and 2025 at the proposed Sunset Road/Silverbell Road intersection, and the I-10/Sunset Road TI. The proposed Sunset Road/Silverbell Road intersection is expected to meet the Manual on Uniform Traffic Control Devices (MUTCD) traffic signal warrants in 2018. On the contrary, the I-10/Sunset Road TI is not anticipated to meet traffic signal warrants by 2025.

Capacity analysis results indicate that the standard intersection configurations that include a traffic signal at the Sunset Road/Silverbell Road intersection and stop control on the frontage roads at the I-10/Sunset Road TI would provide adequate capacity to serve the projected 2025 traffic demand at acceptable level of service (LOS).

As part of the Sunset Road improvements, the only reconstruction required within the Arizona Department of Transportation (ADOT) right-of-way is at the northwest and southwest curb returns in order to match Sunset Road's proposed alignment. No other reconstruction would be required on the frontage roads since the intersections would operate at an acceptable LOS in 2025 without turn lane improvements.

1.3 Recommendations

Based on the traffic evaluation, the following recommendations should be considered:

- Construct Sunset Road from Silverbell Road to I-10 as a new three-lane roadway with 11-foot wide travel lanes, a 12-foot wide two-way left-turn lane and six-foot wide paved shoulders. The new roadway would include a new bridge over the Santa Cruz River.
- Construct five-foot (north side) and eight-foot (south side) wide asphaltic concrete paths along Sunset Road to connect multi-modal users to "The Loop".
- Provide Americans with Disabilities Act (ADA) accessibility to the asphaltic concrete paths tying into "The Loop".
- Provide a westbound left-turn lane, southbound left-turn lane, and northbound right-turn lane with the recommended storage lengths indicated in Section 5.4 of this report at the proposed Sunset Road/Silverbell Road intersection.
- Install a traffic signal and intersection street lighting at the proposed Sunset Road/Silverbell Road intersection.
- Install the conduit and pullboxes for future Intelligent Transportation System (ITS) on the south side of the Sunset Road alignment that would be designed for the ultimate configuration. This segment starts at the Santa Cruz Bridge and ends approximately 1,200 feet west of the EBFR.
- Provide a design speed of 40 mph and a posted speed limit of 35 mph on Sunset Road.
- Maintain a design speed of 50 mph and a posted speed limit of 45 mph on Silverbell Road.
- Modify the traffic control at the I-10/Sunset Road TI to have stop control on the eastbound and westbound frontage roads.
- Monitor the traffic volumes and operations at the intersections of Sunset Road with the I-10 frontage roads to install an All-Way Stop Control or a traffic signal if traffic warrants are met in the future.
- Restripe Sunset Road underneath I-10 to accommodate a westbound left-turn bay for vehicles accessing the EBFR.
- Update pavement markings and signing for the EBFR approach to Sunset Road to accommodate a shared through/right-turn lane.
- Provide a two stage crossing on Sunset Road for "The Loop" west of the Sunset Road/EBFR intersection. The crossing would include a two-way left-turn lane refuge area consisting of flexible delineators mounted to a curbing system. Also, the asphaltic concrete path along the north side of Sunset Road between the frontage road and this proposed two stage crossing would be eight feet wide.
- Additional intersection lighting at the Sunset Road/EBFR intersection should be considered as traffic volumes and operations are monitored for future traffic signals.

2.0 INTRODUCTION

In May 2006, the Regional Transportation Authority (RTA) plan and sales tax were approved by the voters of Pima County. One of the 35 roadway projects included in the RTA plan is Sunset Road from Silverbell Road to River Road. See Project Location Map in Figure 1 and Project Vicinity Map in Figure 2 for project site information. Sunset Road once extended from Silverbell Road to Interstate 10 (I-10), but the Sunset Road Bridge over the Santa Cruz River collapsed during the flood of 1983 and the connection between Silverbell Road and I-10 was lost. Due to the expected population growth in the northwest Tucson region, the connection of Silverbell Road to Interstate 10 and ultimately to River Road was included in the RTA plan to increase mobility and improve operations and traffic safety in the area.

The RTA plan identifies Sunset Road as a three-lane roadway (one lane in each direction of travel with a two-way left-turn lane) with appropriate auxiliary lanes at the intersections with Silverbell Road, the I-10 eastbound and westbound frontage roads and River Road. The ultimate configuration of Sunset Road would pass over the Santa Cruz River and the I-10 mainline that is planned to be lowered (reconstructed) in the future by the Arizona Department of Transportation (ADOT). East of I-10, Sunset Road would continue east and drop down to meet River Road at its current alignment north of the Rillito River. The proposed Sunset Road alignment will include bridges over the Santa Cruz River, the I-10 mainline, the Union Pacific Railroad (UPRR), and the Rillito River. The traffic interchange bridge structure over I-10 is included in the I-10 Mainline, Ina Road to Ruthrauff Road Design Concept Report (DCR) prepared by ADOT in 2012.

The Pima County Department of Transportation (PCDOT) plans to construct Sunset Road in two phases. The first phase, referred to as Segment I, would construct Sunset Road from Silverbell Road to the I-10 Eastbound Frontage Road (EBFR). This segment includes the ultimate bridge across the Santa Cruz River and interim at-grade intersections with Silverbell Road and the existing I-10 EBFR. The second phase of the project, referred to as Segment II, would begin along the Sunset Road alignment, west of I-10 (approximately 1,200 feet west of the EBFR) at the “touch down point” where the road would begin to rise to meet the future I-10/Sunset Road TI, travel over the UPRR and the then connect at River Road as an at-grade “T” intersection. Segment II includes bridge structures over UPRR and the Rillito River. The proposed improvements that fall within ADOT’s right-of-way would be ADOT’s responsibility; however, the improvements are not funded.

The anticipated opening year for Segment I is 2018 and consists of the interim design of the new intersection of Sunset Road and Silverbell Road, and interim improvements to the existing I-10/Sunset Road traffic interchange (TI) to provide access to Silverbell Road. Based on the Design Concept Reports prepared for the segments of Silverbell Road between Ina Road and Grant Road and for I-10 between Ina Road and Ruthrauff Road, it is assumed that the design year for the interim improvements is 2025. The roadway segment of Sunset Road between Silverbell Road and the I-10/Sunset Road TI will be designed for the ultimate configuration. The design year for the ultimate configuration is 2040.

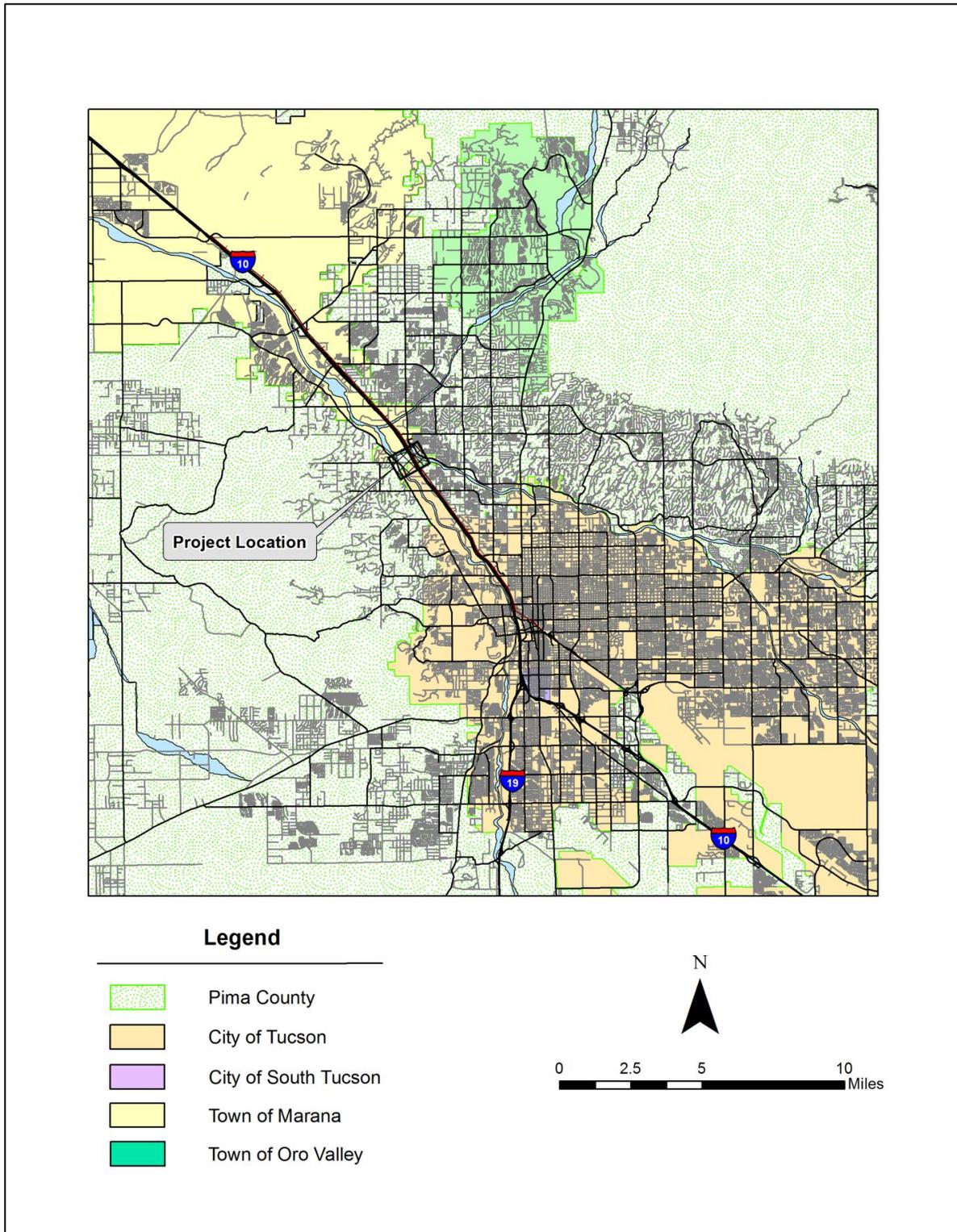


Figure 1 – Project Location Map

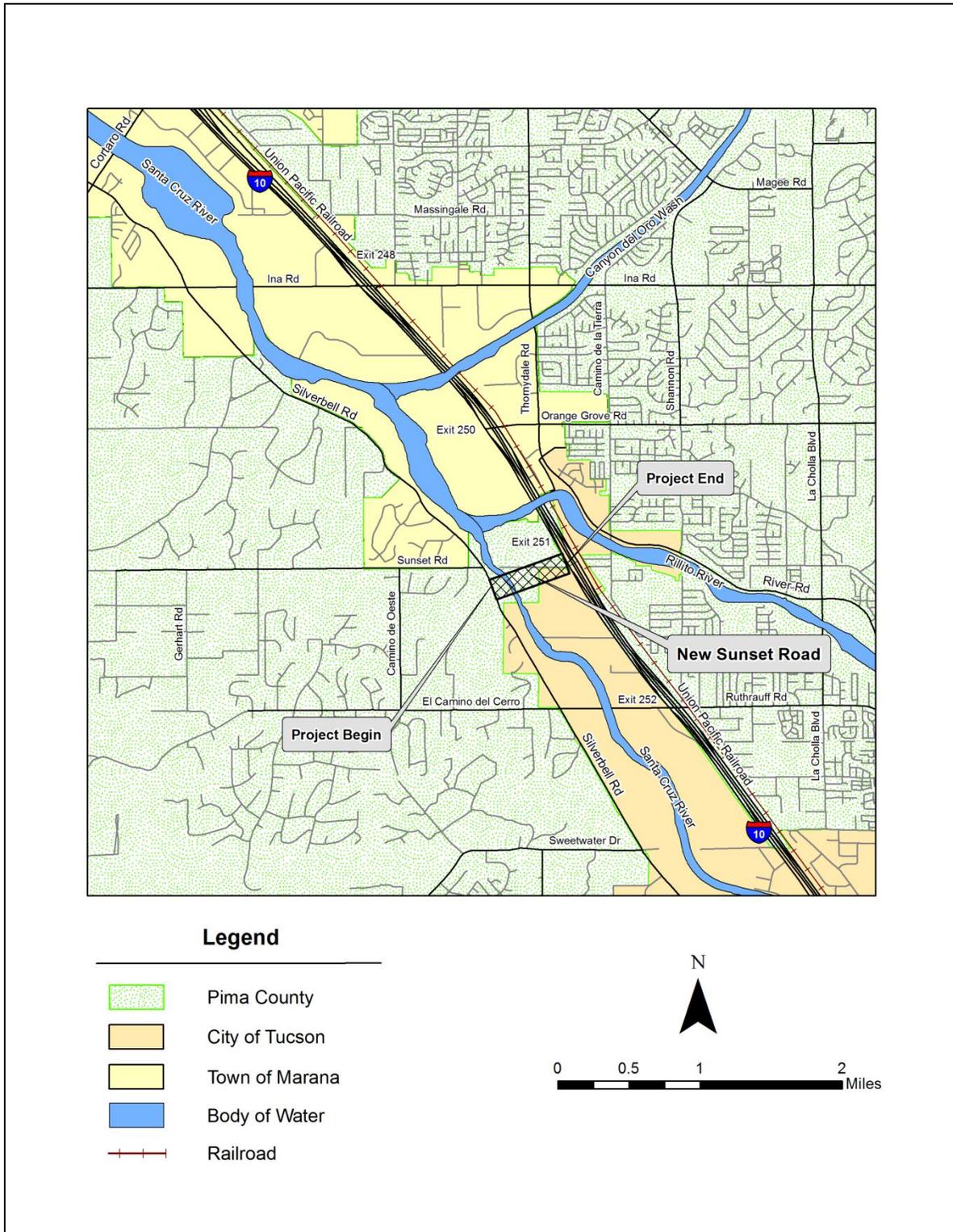


Figure 2 – Project Vicinity Map

2.1 Traffic Report Overview

This Traffic Engineering Report has been prepared exclusively for Segment I of the Sunset Road, Silverbell Road to River Road DCR. The study limits are on Sunset Road from Silverbell Road to the I-10 EBFR. Since Sunset Road within the study limits will be a new roadway, the purpose of this report is to document existing characteristics of the roadways that will be impacted by Sunset Road. Moreover, this report documents the evaluation of future traffic conditions for Segment I and provides traffic design recommendations for the study segment and intersections. As part of this report, the following major tasks were undertaken:

- Evaluation of existing conditions on adjacent roadways:
 - Inventory roadway characteristics.
 - Gather traffic volumes on Silverbell Road, Sunset Road west of Silverbell Road, and the I-10 frontage roads.
 - Collect and analyze crash data for aforementioned roadways.
- Evaluation of Future Conditions:
 - Forecast 2018 and 2025 traffic volume projections.
 - Compute 2018 and 2025 Level of Service (LOS).
 - Assess traffic control for the Sunset Road/Silverbell Road intersection and the I-10/Sunset Road TI.
- Provide recommendations for future improvements
 - Posted speed limits.
 - Traffic control at intersections.
 - Auxiliary lanes.
 - Turn lane storage.
 - Multi-modal design features.
 - Intelligent transportation systems.

The Sunset Road Traffic Engineering Report for Segment I was prepared in accordance with the guidelines set forth in Chapter 3 of the Pima County Roadway Design Manual.

3.0 EXISTING CONDITIONS

Sunset Road in the project area only extends to the west of Silverbell Road and consists of a two-lane roadway that is classified as an urban collector road. The following sections describe the existing conditions of the area and roadways adjacent to Sunset Road.

3.1 Land Use

The property along the west end of Segment I is undeveloped with little space for new development, as the roadway will be elevated to traverse over the Santa Cruz River. East of the Santa Cruz River, there is a portion of usable land between the Santa Cruz River and I-10 where there is space for potential future development.

Zoning of the property adjacent to the corridor includes residential and business/commercial land uses. Zoning along Sunset Road from Silverbell Road to I-10 includes SR, CB-1, SH, GR-1, and CB-2 under Pima County zoning ordinances, as well as I-1 and C-2 under City of Tucson zoning ordinances. The descriptions of the Pima County zoning ordinances are as follows:

- SR is the suburban ranch zone and allows for single-family residences.
- CB-1 is zoned for local business.
- SH is the suburban homestead zone.
- GR-1 is the rural residential zone, which is intended to discourage commercial development and serve the needs of the rural area.
- CB-2 is a general business zone excluding dwelling units.

In regards to City of Tucson zoning ordinances, I-1 is a light industrial zone and C-2 is a commercial zone. The zoning within the vicinity of the project can be seen in Figure 3.

3.2 Physical Conditions

3.2.1 Roadway

West of Silverbell Road, Sunset Road currently has one travel lane in each direction, coming to a "T" intersection at Silverbell Road. East of the Santa Cruz River, there is a section of dirt road providing access to a large gravel mining pit. At the I-10/Sunset Road TI, the road traverses underneath I-10 with a single lane per direction allowing access onto the eastbound and westbound frontage roads; which provides access to the ramps that connect to the I-10 mainline. Sunset Road is uncurbed at this location, but there is a hatched out (with striping) paved shoulder on both sides of the road. There are curb and gutter and sidewalk ramps at the intersections. The I-10 Bridge is at a height of 14 feet, 1 inch, allowing adequate clearance for most heavy vehicles. Sunset Road lies primarily within Pima County right-of-way, with the exception of the roadway segment near the I-10/Sunset Road TI; which is located within ADOT right-of-way.

3.2.2 Speed Limits

The existing posted speed limit on Sunset Road west of Silverbell Road is 35 mph. The posted speed on Silverbell Road and the frontage roads is 45 mph.

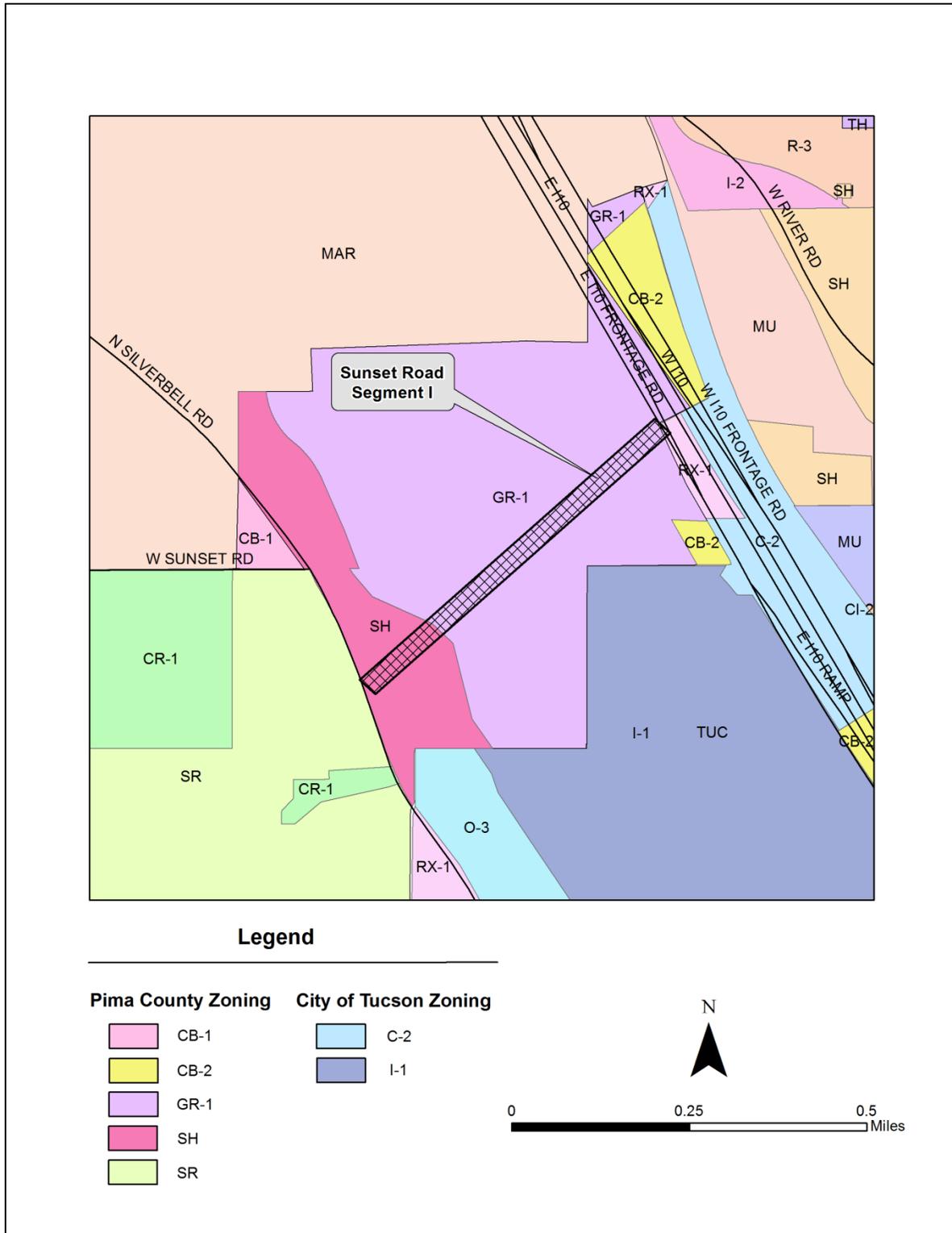


Figure 3 – Zoning Map

3.2.3 Intersections and Driveways

On the west end, the existing Sunset Road intersects Silverbell Road at a “T” intersection where Sunset Road traffic has stop control while Silverbell Road traffic is free-flow. On the east end, the I-10/Sunset Road TI has two intersections at the I-10 eastbound and westbound frontage roads. The intersections are under stop control, with traffic on Sunset Road having to stop while traffic on the frontage roads is free-flow.

Additionally, where the pavement ends on Sunset Road, west of the EBFR intersection, there is a crossing of “The Loop” multi-use path that runs parallel to the frontage road in this area. This crossing is currently uncontrolled, with no signage requiring motorists from the dirt road or bicyclists/pedestrians from the multi-use path to yield to the other movement.

Residential driveways are located on Silverbell Road south of the existing Sunset Road/Silverbell Road intersection. The driveways are located approximately 700 feet apart.

Figure 4 shows the existing lane configurations and traffic control devices for the intersections along Sunset Road.

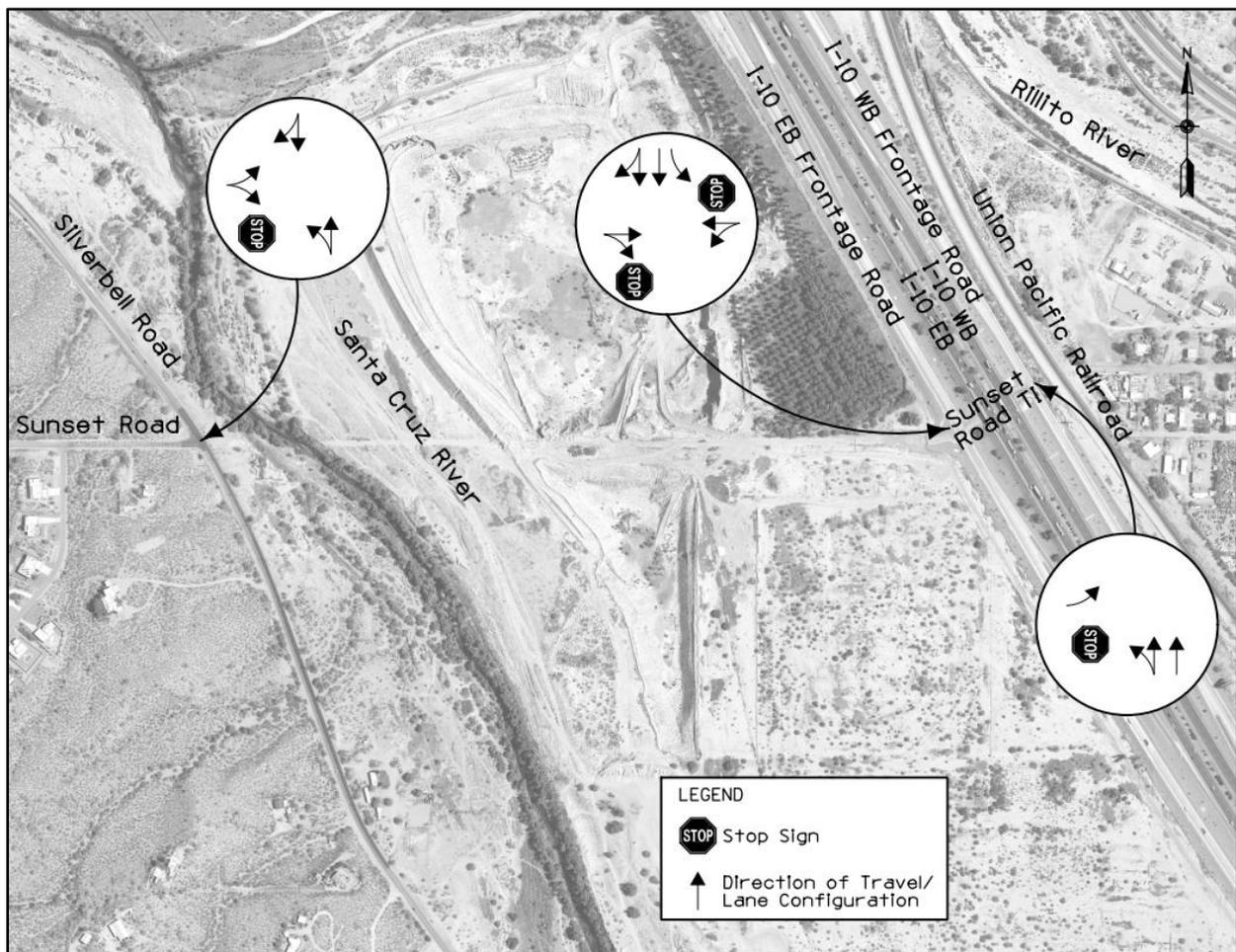


Figure 4 – Existing Lane Configuration and Traffic Control

3.3 Traffic Volumes and Factors

Pima Association of Governments (PAG) performed traffic counts on Silverbell Road in 2010. The PAG count within the study limits was taken on the segment of Silverbell Road between Ina Road and El Camino del Cerro. Based on the average of the two-day count, the 2010 average daily traffic (ADT) on Silverbell Road was 5,249 vehicles per day (vpd). From the volume data gathered from the PAG Database (1), traffic factors including K (the proportion of the daily traffic occurring in the peak hours), and D (directional split) were calculated. Table 1 illustrates the traffic volumes and factors on Silverbell Road.

Table 1 – Silverbell Road Traffic Factors

Street-Segment	ADT	K _{AM}	K _{PM}	D _{AM}	D _{PM}
Silverbell Road - Ina Road to El Camino del Cerro	5,249	0.11	0.11	0.76	0.73

Per the PAG traffic counts, the traffic volume on the existing segment of Sunset Road, west of Silverbell Road, is approximately 1,400 vpd.

Sunset Road intersects the existing I-10 frontage roads. Traffic volumes for the frontage roads were gathered from the Traffic Engineering Study prepared for the I-10, Ina Road TI to Ruthrauff Road TI DCR (2). The following table shows the traffic volumes and factors on the frontage roads.

Table 2 – Frontage Roads Traffic Factors

Street-Segment	ADT	K _{AM}	K _{PM}	D _{AM}	D _{PM}
EBFR - North of Sunset Road	2,356	0.09	0.08	1.00	1.00
EBFR - South of Sunset Road	2,600	0.08	0.08	1.00	1.00
WBFR - North of Sunset Road	2,719	0.07	0.09	1.00	1.00
WBFR - South of Sunset Road	2,342	0.07	0.09	1.00	1.00

WBFR - westbound frontage road

For additional information regarding traffic volumes, refer to Appendix A.

3.4 Crash Analysis

Crash data for the five-year period of October 1, 2008 to September 30, 2013 were obtained from PCDOT and ADOT. The crash data are included in Appendix B. The intersection crash data were analyzed and the results are summarized in Table 3 and Table 4. Table 3 classifies the recorded crashes by injury severity according to the following classification: fatal, class 4 injury, bodily injury, and property damage only (PDO) crashes. To analyze segment crashes, average daily traffic (ADT) was collected and is included in Table 4.

Table 3 – Intersection Crashes by Injury Severity

Injury Severity	Sunset Road at Silverbell Road		Sunset Road at EBFR		Sunset Road at WBFR	
	Number	% of Total	Number	% of Total	Number	% of Total
Fatal	0	0%	0	0%	0	0%
Class 4 Injury	0	0%	0	0%	0	0%
Bodily Injury	0	0%	1	100%	0	0%
PDO	2	100%	0	0%	0	0%
Total Crashes	2	100%	1	100%	0	0%
Severity Index*	1.00	N/A	2.00	N/A	N/A	N/A

*Severity index was calculated based on crash severity parameters developed by the National Safety Council. The Severity Index was calculated using the formula provided by Pima County.
Index = [5.8(Fatality & Class 4 Injury) + 2(Class 2 & 3 Bodily Injury) + Property Damage]/(Total No. of Crashes)

Table 4 – Intersection Crashes by Type

Crash Type	Sunset Road at Silverbell Road		Sunset Road at EBFR		Sunset Road at WBFR	
	Number	% of Total	Number	% of Total	Number	% of Total
Single Vehicle	0	0%	0	0%	0	0%
Rear End	2	100%	0	0%	0	0%
Turning	0	0%	0	0%	0	0%
Angle	0	0%	0	0%	0	0%
Sideswipe	0	0%	1	100%	0	0%
Misc.	0	0%	0	0%	0	0%
Fixed Object	0	0%	0	0%	0	0%
Backing	0	0%	0	0%	0	0%
Head On	0	0%	0	0%	0	0%
Animal	0	0%	0	0%	0	0%
Total Crashes	2	100%	1	100%	0	0%
ADT	6,700	N/A	4,950	N/A	5,050	N/A
Crash Rate*	0.16	N/A	0.11	N/A	N/A	N/A

*Intersection crash rates refer to the number of crashes per million vehicles entering the intersection.
Rate = (number of 5-year crashes x 10⁶)/(5 years x weekday entering volume x 365 days).

The segment crash data for the roadways adjacent to Sunset Road were analyzed and the results are summarized in Table 5 and Table 6. The crash data evaluated for Silverbell Road correspond to the segment of Silverbell Road from approximately 900 feet north of the existing Sunset Road/Silverbell Road intersection to approximately 2,000 feet south of the same intersection. Note that the proposed extension of Sunset Road will be located approximately 1,200 feet south of the existing Sunset Road/Silverbell Road intersection.

Table 5 – Segment Crashes by Injury Severity

Injury Severity	Silverbell Road		EBFR near Sunset Road TI		WBFR near Sunset Road TI	
	Number	% of Total	Number	% of Total	Number	% of Total
Fatal	0	0%	0	0%	0	0%
Class 4 Injury	0	0%	0	0%	0	0%
Bodily Injury	2	50%	0	0%	0	0%
PDO	2	50%	0	0%	0	0%
Total Crashes	4	100%	0	0%	0	0%
Severity Index*	1.50	N/A	N/A	N/A	N/A	N/A

*Severity index was calculated based on crash severity parameters developed by the National Safety Council.

The Severity Index was calculated using the formula provided by Pima County.

Index = [5.8(Fatality & Class 4 Injury) + 2(Class 2 & 3 Bodily Injury) + Property Damage]/(Total No. of Crashes)

Table 6 – Segment Crashes by Type

Crash Type	Silverbell Road		EBFR near Sunset Road TI		WBFR near Sunset Road TI	
	Number	% of Total	Number	% of Total	Number	% of Total
Single Vehicle	1	25%	0	0%	0	0%
Rear End	1	25%	0	0%	0	0%
Turning	0	0%	0	0%	0	0%
Angle	0	0%	0	0%	0	0%
Sideswipe	0	0%	0	0%	0	0%
Misc.	1	25%	0	0%	0	0%
Fixed Object	0	0%	0	0%	0	0%
Backing	0	0%	0	0%	0	0%
Head On	0	0%	0	0%	0	0%
Animal	1	25%	0	0%	0	0%
Total Crashes	4	100%	0	0%	0	0%
ADT	5,250	N/A	2,400	N/A	2,500	N/A
Crash Rate*	0.76	N/A	0.00	N/A	0.00	N/A

*Segment crash rates refer to the number of crashes per million vehicle-miles of travel.

Rate = (number of 5-year crashes x 10⁶)/(5 years x weekday volume x segment length x 365 days).

In addition to the crash data summarized in Table 5 and Table 6, crash data were gathered for the existing segment of Sunset Road west of Silverbell Road. No crashes were reported on the existing segment of Sunset Road for the five-year period evaluated.

3.4.1 Intersection Crash Rate

For the period of January 2009 through December 2011, the three-year average crash rate for unsignalized intersections within Pima County was 0.38 crashes per million entering vehicles. This average crash rate is representative of every unsignalized intersection within County limits that had four or more crashes in the study period. For the same three-year study period, the average severity index for unsignalized Pima County intersections was 1.50 (3).

Sunset Road at Silverbell Road

In the five-year period studied, the Sunset Road/Silverbell Road intersection only had two total crashes that occurred on Silverbell Road between October 2008 and September 2013. Both crashes were rear-end collisions where a northbound left turning vehicle was struck by a vehicle traveling in the same direction. Both crashes resulted in property damage only (PDO). The crash rate at this intersection is 0.16 crashes per million entering vehicles. The severity index is 1.00; which results in a lower severity index than the Pima County average. Rear-end crashes might be mitigated by adding auxiliary lanes at the intersection.

Sunset Road at I-10 EBFR

This unsignalized intersection had only one crash in the five-year period studied.

Sunset Road at I-10 WBFR

This unsignalized intersection had zero crashes in the five-year period studied.

3.4.2 Segment Crash Rate

For the period of January 2009 through December 2011, the three-year average crash rate for low volume roadway segments (roads with less than 10,000 vpd) within Pima County was 1.42 crashes per million vehicle-miles traveled. For the same three-year study period, the average severity index for low volume Pima County roadway segments was 1.55 (4).

Silverbell Road from 900 feet north of Sunset Road to 2,000 feet south of Sunset Road

In the five-year period studied, this segment of Silverbell Road had a crash rate of 0.76 crashes per million vehicle-miles traveled. The severity index on Silverbell Road from 2009 to 2013 was slightly lower than the Pima County average, with a severity index of 1.50.

One of the four crashes recorded on Silverbell Road was a rear-end collision, one involved a single vehicle leaving its travel lane, one involved a motorist striking a deer, and one involved a bicyclist colliding with another bicyclist. Two of the crashes involved PDO and two had non-serious injuries.

Sunset Road from Camino de Oeste to Silverbell Road

There were zero crashes recorded on the existing Sunset Road between Camino de Oeste and Silverbell Road during the five-year period from October 2008 through September 2013. There was one crash on Sunset Road west of Camino de Oeste during that time.

Sunset Road between I-10 EBFR and I-10 WBFR

This roadway segment had zero crashes in the five-year period studied.

I-10 EBFR near Sunset Road

This roadway segment had zero crashes in the five-year period studied.

I-10 WBFR near Sunset Road

This roadway segment had zero crashes in the five-year period studied.

Since there was such a low frequency of crashes on Sunset Road, Silverbell Road, and the frontage roads, no pattern with respect to the type of crash or other factors was evident. Refer to Figure 5 to see all crashes and existing traffic information.

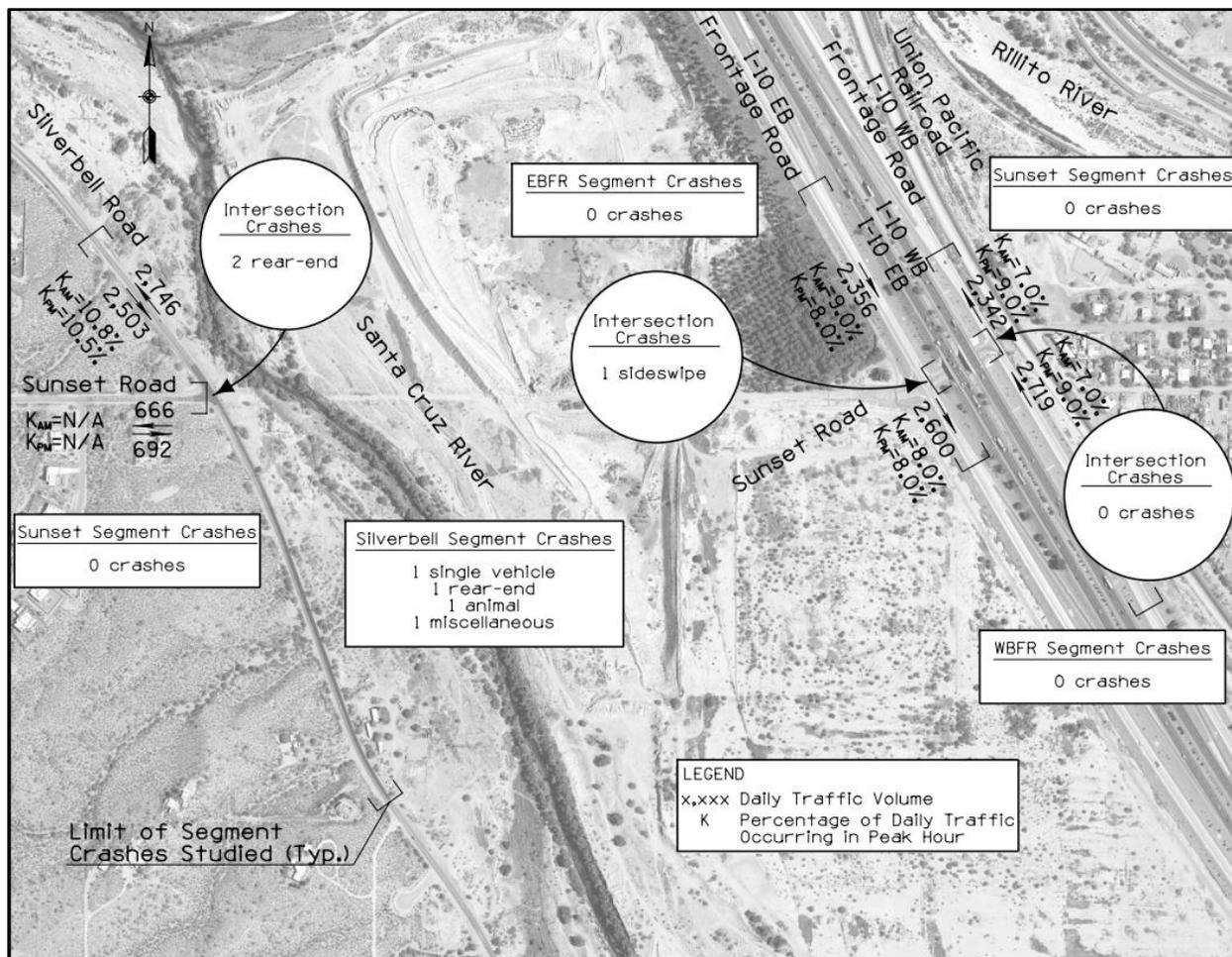


Figure 5 – Existing Traffic Volumes and Crashes

3.5 Alternative Transportation Modes

This section describes existing public transportation (Sun Tran) services as well as the pedestrian, bicycle, and equestrian amenities within the project area.

There are no regular or express Sun Tran routes along the existing Sunset Road, Silverbell Road or frontage roads. Route 104X (Marana-Downtown Express) travels eastbound along I-10 towards the downtown area in the morning and westbound to Cortaro Road in the evening, passing the I-10/Sunset Road TI, but does not make any stops near Sunset Road during its travels.

Sunset Road, west of Silverbell Road, is a two-lane roadway with unpaved shoulders. Silverbell Road north and south of Sunset Road serves as a bike route with four-foot striped, paved shoulders on each side of this two-lane roadway. Both frontage roads have paved shoulders, as does Sunset Road underneath I-10.

“The Loop”, a Pima County paved non-motorized multi-use path (5) that generally runs alongside the length of the Santa Cruz River, passes by Sunset Road in the area adjacent to the I-10/Sunset Road TI. In this area, “The Loop” runs along the west side of the EBFR and

crosses Sunset Road where the existing pavement ends, approximately 120 feet west of the EBFR. See Figure 6 for “The Loop” map - a facility that is used by pedestrians, bicyclists and horseback riders.

Other non-motorized multi-modal facilities near the project include the Santa Cruz River multi-use path. There are no sidewalks adjacent to the existing Sunset Road or Silverbell Road alignments and no sidewalk improvements are planned in the area.

There are no trails in the area specifically designated for equestrian usage.



Figure 6 – Pima County “The Loop” Map

4.0 FUTURE CONDITIONS

This section of the report documents the process followed to project future traffic volumes and the traffic analysis conducted to recommend traffic improvements.

4.1 Planned Developments

As of December 2013, there is a plan for residential development along Sunset Road west of Silverbell Road called Desert Senna Estates. The plan calls for a 46-lot subdivision on 71.5 acres of land. Per a PCDOT traffic memorandum from 12/6/13, this development would increase the daily traffic on Sunset Road by about 438 trips per day.

4.2 Planned Transportation Improvements

There exist a number of recently constructed and planned transportation improvements in the project vicinity. The transportation improvements funded by public agencies are summarized as follows:

- I-10, Ruthrauff Road to Prince Road – This ADOT project has being completed and includes the widening of the I-10 mainline from three travel lanes per direction to four travel lanes per direction, as well as a new grade-separated traffic interchange at Prince Road. The improvements were available to motorists in spring 2014.
- I-10, Ina Road to Ruthrauff Road – A couple of projects within this segment of I-10 are currently in the design process. The freeway and traffic interchange proposed improvements are summarized as follows:
 - Ruthrauff Road TI – Ruthrauff Road is currently under design to reconstruct Ruthrauff Road to pass over I-10 and the UPRR. The I-10 mainline would be reconstructed to accommodate a future ten-lane freeway section (five travel lanes in each direction) plus auxiliary lanes. The Ruthrauff Road TI would maintain the full diamond interchange configuration at its current location and include parallel entrance and exit ramps. Under the interim condition, the I-10 mainline would be paved and striped to accommodate four travel lanes in each direction. The construction phase for this project is anticipated to begin in Fiscal Year 2018.
 - Ina Road TI – Ina Road is currently under design to reconstruct Ina Road to pass over I-10 and the UPRR. The I-10 mainline would be reconstructed to accommodate a future ten-lane freeway section (five travel lanes in each direction) plus auxiliary lanes. The Ina Road TI would maintain the full diamond interchange configuration at its current location and include parallel entrance and exit ramps. Under the interim condition, the I-10 mainline would be paved and striped to accommodate four travel lanes in each direction. The construction phase for this project is anticipated to begin in Fiscal Year 2016.
- Ina Road, Silverbell Road to I-10 – The Town of Marana plans to widen Ina Road from a two-lane facility to a four-lane facility. The widening will include the construction of two new bridges over the Santa Cruz River and will tie into the ADOT I-10/Ina Road TI improvements.
- Silverbell Road, Grant Road to Ina Road – This RTA project will widen the existing two-lane roadway to a divided four-lane roadway with pedestrian facilities, bike lanes, drainage improvements, landscaping, and enhanced wildlife crossings. The project would be constructed in multiple phases. The first phase is currently under design and

involves the widening of Silverbell Road from Grant Road to Goret Road. Construction for this phase should be completed in 2017. The other phases of the project are scheduled to begin design in 2014, with construction of the entire corridor anticipated to be completed by 2026.

4.3 Traffic Volume Projections

Traffic volume projections for the years 2018 and 2025 were developed utilizing PAG's travel demand model. The year 2018 is anticipated to be the opening for Segment I and the year 2025 the design year. Since Sunset Road (Segment I) is a new roadway and direct calibration could not be made to the future traffic volume projections, it was important to fine-tune the PAG travel demand model to obtain accurate results. Based on the initial run of the PAG model, the following noteworthy observations occurred:

- The PAG model overestimated the volumes on the existing segment of Sunset Road. Recent counts were compared with traffic projections for the year 2018 for roadways in the surrounding area and it was found that the projections for Sunset Road were considerably higher by a range of 175% to 300%.
- The PAG model overestimated the volume on Camino de la Tierra north of River Road. Projections for the year 2018 were higher by approximately 200% for this segment of Camino de la Tierra. The model showed Camino de la Tierra intersecting at River Road, instead of modeling the road as one continuous link since Camino de la Tierra goes underneath River Road.
- The PAG model assumes four lanes on Silverbell Road. The model roadway network for the year 2018 includes a four-lane roadway on Silverbell Road north and south of Sunset Road.
- The PAG model assumes a 35 mph speed on Ina Road. A posted speed of 35 mph is utilized by the PAG model on Ina Road west of Silverbell Road where the current posted speed is 45 mph.
- The PAG socio-economic data seem to be consistent with the area adjacent to the study corridor.

Based on these observations, the following minor adjustments were made to the PAG model structure:

- Provide additional links from the Traffic Analysis Zones (TAZs) adjacent to Silverbell Road and Sunset Road to lower the traffic volume projection on Sunset Road. The PAG model only had two connectors from the TAZ centroids to the roadway network and as a result, the traffic generated by the residential development in the area was split 50% onto Sunset Road and 50% onto Silverbell Road. Based on the existing access points on Sunset Road, Silverbell Road and El Camino del Cerro, the majority of the residents have direct access off of Silverbell Road and El Camino del Cerro.
- Provide a continuous link on Camino de la Tierra to eliminate the intersection that the model previously had at River Road. By eliminating the intersection, the traffic projection on Camino de la Tierra did not increase north of River Road.
- Provide two lanes on Silverbell Road on the PAG model that will be utilized to estimate projections for the year 2018.
- Provide a 45 mph model speed on Ina Road.

Once the 2018 and 2025 daily traffic projections were acceptable, PAG performed an additional model run to provide peak hour turning volumes for the major study intersections. Future K and D factors were calculated based on the PAG volumes to ensure projected traffic volumes accurately reflected the anticipated travel patterns in the project area.

4.3.1 Future Volumes on Sunset Road and El Camino del Cerro

Between the years 2018 and 2025, the PAG travel demand model anticipates an average annual growth rate (AAGR) of 3.00% on the new segment of Sunset Road between the I-10 EBFR and Silverbell Road, while it only estimates an AAGR of 1.71% on El Camino del Cerro between the EBFR and Silverbell Road. The roadway network and PAG travel demand model characteristics that led to expect traffic volumes on Sunset Road to grow faster than traffic volumes on El Camino del Cerro are documented in this subsection. The PAG travel demand daily traffic volumes are presented in Table 7.

Table 7 – Traffic Volume Projections

Street - Segment	2018 Traffic Projections (vpd)	2025 Traffic Projections (vpd)
Sunset Road – EBFR to Silverbell Road	8,738	10,745
El Camino del Cerro – EBFR to Silverbell Road	12,492	14,065

Both roads will be two-lane roadways in 2018 and the PAG travel demand model assumes that the roads will remain that way through 2025. Furthermore, the PAG travel demand model accounts for the proposed improvements to the I-10/Ruthrauff Road TI by having four lanes on El Camino del Cerro within the traffic interchange limits.

The reasons Sunset Road is expected to grow at a faster rate are summarized as follows:

- West side trip attractors located on Silverbell Road.
- Shorter travel distance on Sunset Road between I-10 and Silverbell Road.
- Higher volume to capacity ratio on I-10 south of Sunset Road.

Located off of Silverbell Road are two of Tucson’s large trip attractors, Pima Community College West Campus and St. Mary’s hospital. Silverbell Road will be improved to a divided four-lane roadway from Ina Road to Grant Road, creating a four-lane roadway towards where the trip attractors are located. The more convenient roads to access the trip attractors on Silverbell Road coming from the northwest side of I-10 will be Sunset Road and El Camino del Cerro. The travel distance from the I-10/Sunset Road TI to the intersection of El Camino del Cerro and Silverbell Road will be approximately 2.07 miles taking the Sunset Road exit to Silverbell Road, and approximately 2.44 miles taking El Camino del Cerro to Silverbell Road. Under ideal travel (speed) conditions, the Sunset Road route would take approximately 2.97 minutes and the El Camino del Cerro route would take 2.75 minutes; which is a 12-second difference – see Table 8 for detailed information. However, due to the expected traffic growth on I-10, ideal travel conditions are unlikely to occur during peak hour periods.

Table 8 – 2018 Roadway Characteristics

Sunset Road - Silverbell Road					El Camino del Cerro - Silverbell Road				
Roadway	Lanes	Distance	Speed	Travel Time (min)	Roadway	Lanes	Distance	Speed	Travel Time (min)
I-10 EB Off-Ramp at Sunset Road	1	0.35	45	0.47	I-10 EB Mainline	3	1.22	65	1.13
I-10 EBFR	2	0.1	45	0.13	I-10 EB Off-Ramp at El Camino del Cerro	1	0.36	45	0.48
Sunset Road	1	0.56	35	0.96	I-10 EBFR	2	0.09	45	0.12
Silverbell Road	2	1.06	45	1.41	El Camino del Cerro	1	0.77	45	1.03
Total		2.07		2.97	Total		2.44		2.75

The estimated AAGR on the I-10 mainline in the eastbound direction, south of Sunset Road, between 2008 and 2018 is 1.92%. Assuming a six-lane facility on I-10 in 2018, the volume to capacity (V/C) ratio on the eastbound I-10 mainline is calculated to be about 0.84; which represents heavy congestion. Meanwhile, V/C on Sunset Road is estimated at 0.37, representing low congestion. In 2025, these V/C ratios are projected to be around 0.83 and 0.61, respectively. These factors suggest that some of the eastbound I-10 mainline motorists looking to utilize Silverbell Road will exit the freeway at Sunset Road rather than El Camino del Cerro to reach Silverbell Road as early as possible. Based on the V/C ratios anticipated, the travel time advantage of El Camino del Cerro versus Sunset Road is diminished.

In general, the PAG travel demand patterns are reasonable for Sunset Road based on the roadway characteristics and expected traffic operations of the roadways that provide access to the trip attractors on Silverbell Road.

4.3.2 Future Daily and Hourly Traffic Volume Projections

Once the 2018 and 2025 ADT and peak hour volumes were finalized and approved by Pima County Traffic Engineering Division, the capacity and LOS analyses were conducted for future conditions. Figure 7 and Figure 8 present the daily and hourly volumes projected for the years 2018 and 2025, respectively.

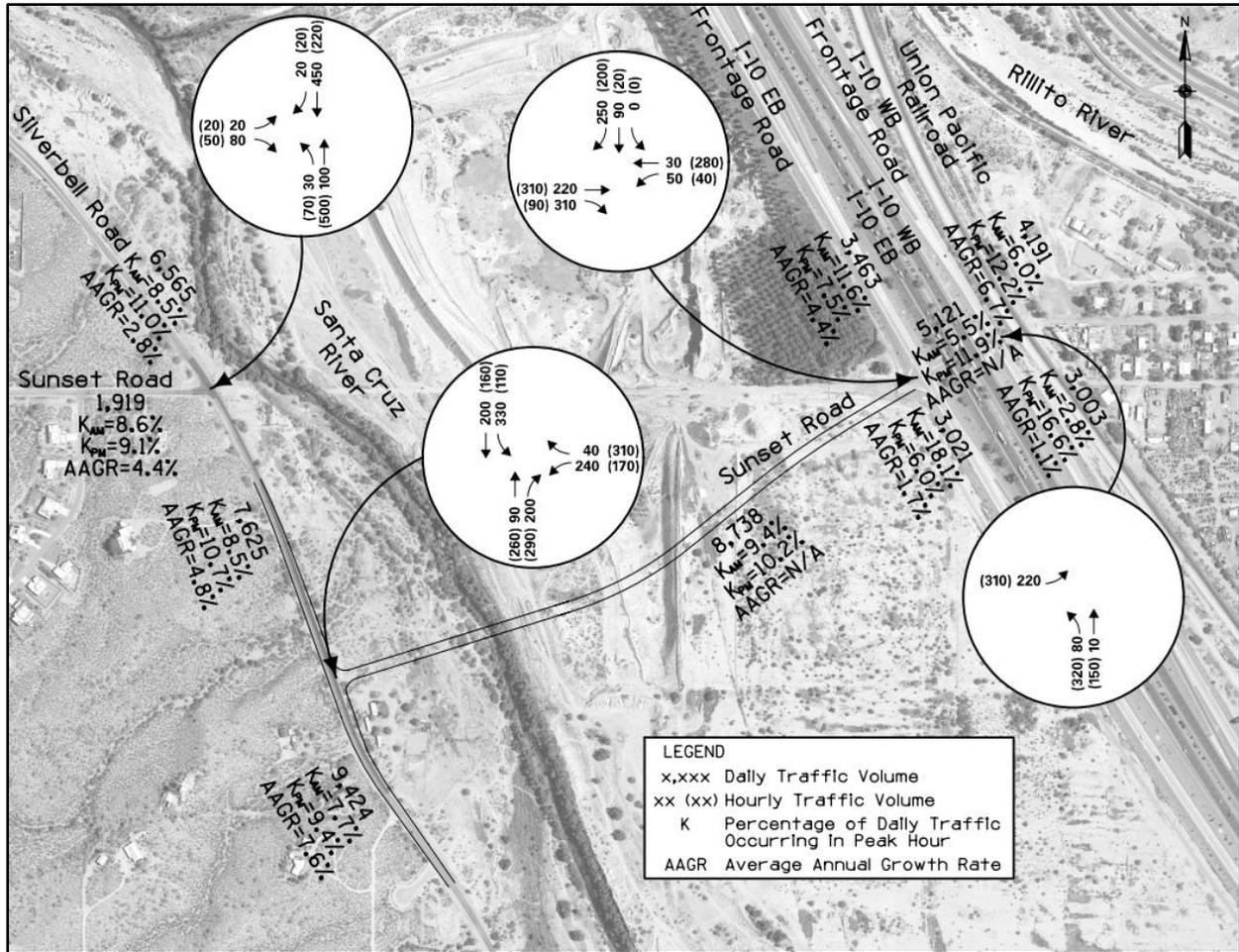


Figure 7 – 2018 Traffic Volume Projections

Based on the traffic volume projections shown in Figures 7 and 8, traffic volume projections are not expected to increase for all traffic movements between 2018 and 2025 since planned improvements on nearby roadways (as discussed in Section 4.2 of this document) are anticipated to accommodate portions of the future traffic demand.

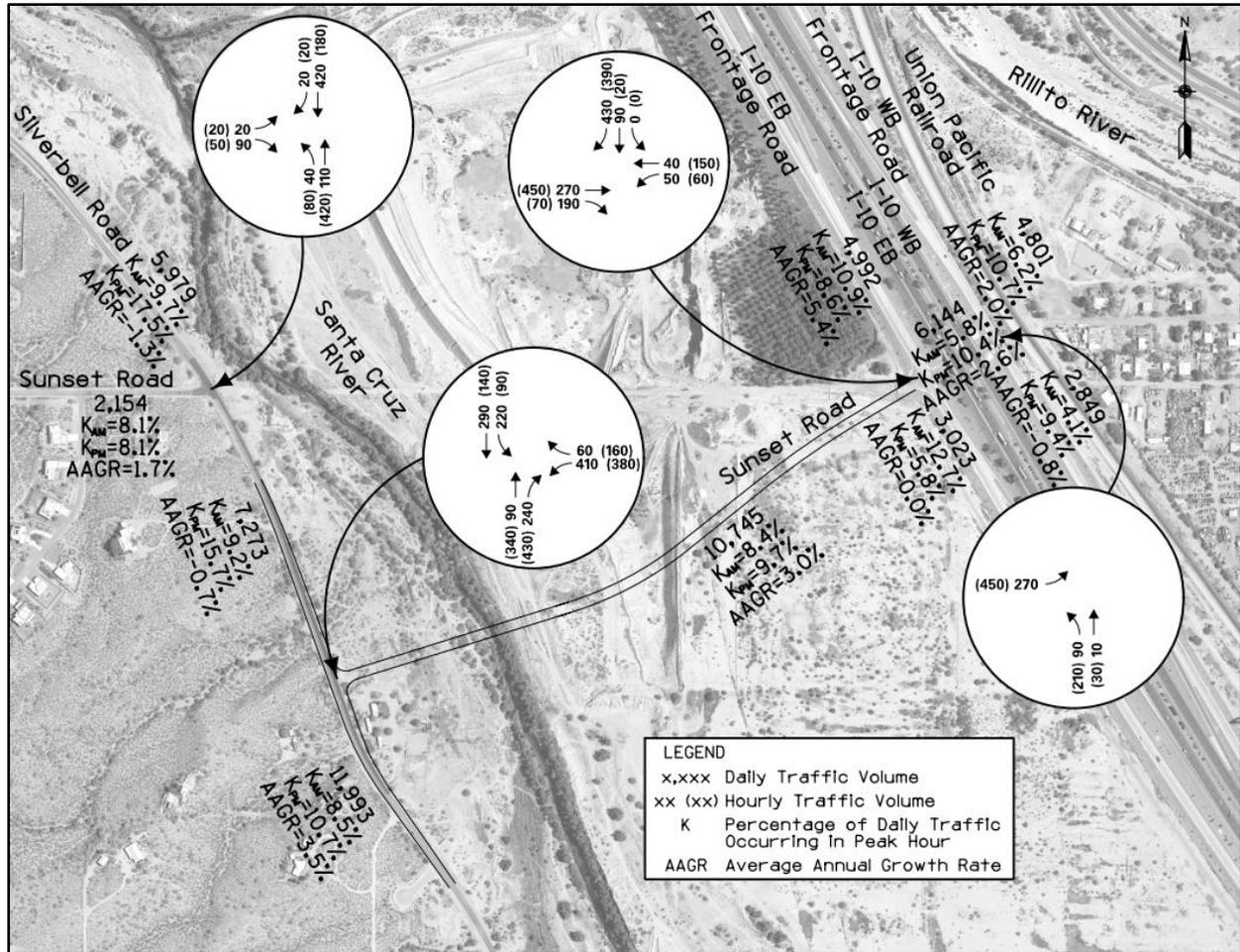


Figure 8 – 2025 Traffic Volume Projections

4.4 Capacity and Level of Service Analysis

This section of the report presents the capacity analysis results of Sunset Road (Segment I) and the LOS results for the intersections of Sunset Road/Silverbell Road and the I-10/Sunset Road TI.

The capacity of a roadway segment depends on intersection traffic control types along the segment, as well as street environment factors including driveway density, speed limit, median types, intersection density, etc. The Florida Department of Transportation (FDOT) has established capacity tables at the planning level and determined that a two-lane arterial roadway can generally accommodate 15,600 vpd at LOS E. The 2018 traffic volume projection on Sunset Road is approximately 8,750 vpd, and the 2025 is 10,750 vpd. Considering FDOT's LOS criteria, a two-lane cross section on the new Sunset Road will accommodate the future traffic demand at an acceptable LOS.

For the study intersections, the methodologies set forth in the 2010 Highway Capacity Manual (HCM) (6) were utilized through Synchro (version 8) to assess future traffic operations. The peak hour traffic volumes for the analysis were based on the 2018 and 2025 PAG volume projections described in the previous section. Table 9 shows the control delays in

seconds/vehicle (sec/veh) and corresponding LOS established in the HCM for signalized and unsignalized intersections.

Table 9 – Intersection Delay and Corresponding LOS

Level of Service	Signalized Intersection Control Delay (sec/veh)	Stop Controlled Intersection Control Delay (sec/veh)	All-Way Stop Controlled Intersection Control Delay (sec/veh)
A	0-10.0	0-10.0	0-10.0
B	>10.0-20.0	>10.0-15.0	>10.0-15.0
C	>20.0-35.0	>15.0-25.0	>15.0-25.0
D	>35.0-55.0	>25.0-35.0	>25.0-35.0
E	>55.0-80.0	>35.0-50.0	>35.0-50.0
F	>80.0	>50.0	>50.0

Source: 2010 HCM, pgs. 18-2, 19-2 and 20-3

Detailed analyses of the intersections, including type of traffic control, are discussed below. Signal warrants and turn lane warrants are discussed separately in Sections 4.5 and 4.6 of this document, respectively.

4.4.1 Intersection of Silverbell Road and Existing Sunset Road

This intersection currently operates with a stop control on the minor-street approach (Sunset Road traffic stops for traffic on Silverbell Road). According to the HCM, a three-leg intersection with stop control on the minor-street approach is classified as a two-way stop controlled (TWSC) intersection. With the existing lane configuration and traffic control, the intersection of Silverbell Road and existing Sunset Road is expected to operate at LOS B in 2018 during the AM and PM peak hours. This intersection would continue to operate at an acceptable LOS with the existing lane configuration through the year 2025. See Table 10 for summary of approach LOS and Appendix C for complete 2010 HCM Reports.

Table 10 – 2018 and 2025 Silverbell Road/Sunset Road TWSC LOS

2018 Opening Year									
Time Period	EB Approach		WB Approach		NB Approach		SB Approach		Intersection Delay (sec/veh)
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	
AM	B	14.0	N/A	N/A	A	2.0	A	0.0	2.4
PM	B	14.4	N/A	N/A	A	1.0	A	0.0	1.8
2025 Design Year									
Time Period	EB Approach		WB Approach		NB Approach		SB Approach		Intersection Delay (sec/veh)
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	
AM	B	13.7	N/A	N/A	A	2.3	A	0.0	2.7
PM	B	13.1	N/A	N/A	A	1.3	A	0.0	2.1

The 95th percentile HCM queue lengths estimated for the opening year and design year are shown in Table 11.

Table 11 – 2018 and 2025 Silverbell Road/Sunset Road TWSC Queue Lengths

2018 Opening Year Queue Lengths (feet)				
Time Period	EB Approach	WB Approach	NB Approach	SB Approach
AM	20	N/A	2.5	0.0
PM	15	N/A	5.0	0.0
2025 Design Year Queue Lengths (feet)				
Time Period	EB Approach	WB Approach	NB Approach	SB Approach
AM	22.5	N/A	2.5	0.0
PM	12.5	N/A	2.5	0.0

4.4.2 Intersection of Sunset Road and Silverbell Road

The proposed intersection was modeled with a southbound left-turn lane, northbound right-turn lane, and westbound left-turn lane for the opening year (2018). Since Silverbell Road is classified as an urban arterial, the analysis was conducted assuming a TWSC on Sunset Road. In 2018, the westbound approach is anticipated to operate at an unacceptable LOS F, with an average delay of 195.4 seconds per vehicle. Likewise, in the design year (2025) the westbound approach would operate at unacceptable LOS in both the AM and PM peak hours. See Table 12 for 2010 HCM approach delay results for the opening and design years.

Table 12 – 2018 and 2025 Sunset Road/Silverbell Road TWSC LOS

2018 Opening Year									
Time Period	EB Approach		WB Approach		NB Approach		SB Approach		Intersection Delay (sec/veh)
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	
AM	N/A	N/A	F	195.4	A	0.0	A	5.1	52.2
PM	N/A	N/A	C	17.3	A	0.0	A	3.3	7.1
2025 Design Year									
Time Period	EB Approach		WB Approach		NB Approach		SB Approach		Intersection Delay (sec/veh)
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	
AM	N/A	N/A	F	316.6	A	0.0	A	3.4	114.9
PM	N/A	N/A	F	90.7	A	0.0	A	3.2	32.3

Based on the anticipated operations under a TWSC intersection, a signalized intersection analysis was performed. The analysis assumed a 60-second actuated cycle length with the same lane configuration utilized for the TWSC analysis. The signalized intersection is expected to operate at LOS B in both the AM and PM peak hours in 2018. The intersection is anticipated to continue to operate at an acceptable LOS through 2025 (LOS B in the AM and LOS C in the PM peak hours). Approach and intersection delays and corresponding LOS are illustrated in Table 13. 2010 HCM Reports for the AM and PM peak hours are included in Appendix D.

Table 13 – 2018 and 2025 Sunset Road/Silverbell Road Signalized LOS

2018 Opening Year									
Time Period	EB Approach		WB Approach		NB Approach		SB Approach		Intersection Delay (sec/veh)
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	
AM	N/A	N/A	C	22.1	C	21.2	B	18.4	20.1
PM	N/A	N/A	C	28.1	B	19.9	B	13.8	21.7
2025 Design Year									
Time Period	EB Approach		WB Approach		NB Approach		SB Approach		Intersection Delay (sec/veh)
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	
AM	N/A	N/A	C	21.6	C	23.8	B	19.7	21.4
PM	N/A	N/A	C	22.9	D	43.3	B	17.3	32.2

Estimated queue lengths based on the signalized intersection analysis for the opening and design years are shown in Table 14.

Table 14 – 2018 and 2025 Sunset Road/Silverbell Road Signalized Queue Lengths

2018 Opening Year Queue Lengths (feet)				
Time Period	EB Approach	WB Approach	NB Approach	SB Approach
AM	N/A	144	60	118
PM	N/A	103	139	59
2025 Design Year Queue Lengths (feet)				
Time Period	EB Approach	WB Approach	NB Approach	SB Approach
AM	N/A	235	60	128
PM	N/A	247	197	59

4.4.3 Intersection of I-10 Frontage Roads and Sunset Road

Three traffic control alternatives were evaluated for the intersections of the I-10/Sunset Road TI. Currently, the traffic interchange operates with a free-flow movement for vehicles on the frontage roads. The extension of Sunset Road from Silverbell Road to I-10 will create a “T” intersection at the frontage roads of the I-10/Sunset Road TI. This configuration is similar to the configuration of the I-10/Avra Valley Road TI where vehicles traveling on the frontage roads stop for vehicles on the cross-street (Avra Valley Road). Based on these scenarios, the traffic control alternatives include:

- Stop control on Sunset Road
- Stop control on the frontage roads
- All-Way Stop Control (AWSC)

The LOS analysis was performed assuming the existing lane configuration on the frontage roads and shared through/right-turn lane on Sunset Road as shown in Figure 4. Table 15 and Table 16 illustrate the results of the LOS analysis for the years 2018 and 2025, respectively. For additional information regarding the LOS analysis, refer to Appendix E.

Table 15 – 2018 Sunset Road/I-10 Frontage Roads Traffic Control Alternatives

Traffic Control Alternative	Approach	Period	2010 HCM Approach Delay (sec/veh)	2010 HCM LOS	Traffic Interchange Delay* (sec/veh)
Stop Control on Sunset Road	Sunset Road at EBFR	AM	23.7	C	12.5
	EBFR (free-flow)		N/A	N/A	
	Sunset Road at WBFR		11.9	B	
	WBFR (free-flow)		N/A	N/A	
	Sunset Road at EBFR	PM	15.0	C	44.1
	EBFR (free-flow)		N/A	N/A	
	Sunset Road at WBFR		182.9	F	
	WBFR (free-flow)		N/A	N/A	
Stop Control on Frontage Roads	Sunset Road at EBFR	AM	N/A	N/A	5.3
	EBFR (stop)		13.3	B	
	Sunset Road at WBFR		N/A	N/A	
	WBFR (stop)		9.8	A	
	Sunset Road at EBFR	PM	N/A	N/A	3.3
	EBFR (stop)		13.0	B	
	Sunset Road at WBFR		N/A	N/A	
	WBFR (stop)		22.0	C	
All-Way Stop Control	Sunset Road at EBFR (stop)	AM	31.6	D	16.3
	EBFR (stop)		13.2	B	
	Sunset Road at WBFR (stop)		9.2	A	
	WBFR (stop)		9.1	A	
	Sunset Road at EBFR (stop)	PM	19.1	C	16.2
	EBFR (stop)		12.1	B	
	Sunset Road at WBFR (stop)		14.1	B	
	WBFR (stop)		17.3	C	

*Average delay for the two unsignalized intersections.

Table 16 – 2025 Sunset Road/I-10 Frontage Roads Traffic Control Alternatives

Traffic Control Alternative	Approach	Period	2010 HCM Approach Delay (sec/veh)	2010 HCM LOS	Traffic Interchange Delay* (sec/veh)
Stop Control on Sunset Road	Sunset Road at EBFR	AM	28.7	D	12.7
	EBFR (free-flow)		N/A	N/A	
	Sunset Road at WBFR		13.2	B	
	WBFR (free-flow)		N/A	N/A	
	Sunset Road at EBFR	PM	31.0	D	40.5
	EBFR (free-flow)		N/A	N/A	
	Sunset Road at WBFR		91.5	F	
	WBFR (free-flow)		N/A	N/A	
Stop Control on Frontage Roads	Sunset Road at EBFR	AM	N/A	N/A	6.7
	EBFR (stop)		14.9	B	
	Sunset Road at WBFR		N/A	N/A	
	WBFR (stop)		10.1	B	
	Sunset Road at EBFR	PM	N/A	N/A	5.4
	EBFR (stop)		14.0	B	
	Sunset Road at WBFR		N/A	N/A	
	WBFR (stop)		14.2	B	
All-Way Stop Control	Sunset Road at EBFR (stop)	AM	33.4	D	18.8
	EBFR (stop)		25.4	D	
	Sunset Road at WBFR (stop)		10.0	A	
	WBFR (stop)		9.4	A	
	Sunset Road at EBFR (stop)	PM	61.9	F	28.3
	EBFR (stop)		26.1	D	
	Sunset Road at WBFR (stop)		17.5	C	
	WBFR (stop)		13.1	B	

*Average delay for the two unsignalized intersections.

In 2018, under the stop control on Sunset Road alternative, a significant delay is anticipated at the intersection for the eastbound movement on Sunset Road approaching the WBFR. This movement would operate at an unacceptable LOS F with an average delay of 182.9 seconds per vehicle in the afternoon peak hour. The other two traffic control alternatives are anticipated to operate at acceptable LOS where the stop control on the frontage roads outperformed the AWSC. The 2025 results are similar to results obtained for the opening year (2018) where unacceptable LOS is anticipated for the eastbound movement on Sunset Road approaching the WBFR. Additionally in the year 2025, the eastbound approach on Sunset Road under the AWSC is expected to operate at an unacceptable LOS. Overall, the stop control on the frontage roads would provide better traffic operations.

It is important to note that the capacity analysis was performed using procedures of the 2010 HCM for unsignalized intersections and that the intersections at the I-10/Sunset Road TI have characteristics that might be beyond the scope of the 2010 HCM (one-way street on two approaches and the major street terminates at the minor street). Consequently, a microsimulation model was utilized to confirm the results. Due to the nature of macroscopic models (HCM) and microscopic models (simulation), delay obtained by the two methods should not be compared directly. The results of the simulation can be used to verify that stop control on the frontage roads is the traffic control alternative expected to outperform the other two traffic control alternatives evaluated. Table 17 illustrates the simulations delay estimated at the movement level for the I-10/Sunset Road TI.

Table 17 – 2025 Simulation Results for Stop Control on the Frontage Roads

Intersection	Time Period	Movement	Simulation Delay/Vehicle (sec)	Simulation Intersection Delay (sec)
EBFR/Sunset Road	AM	Sunset Road NB Thru	2.9	5.0
		Sunset Road NB Right	1.8	
		Sunset Road SB Left	4.2	
		Sunset Road SB Thru	1.6	
		EBFR Thru	8.8	
		EBFR Right	7.4	
	PM	Sunset Road NB Thru	2.0	3.9
		Sunset Road NB Right	1.4	
		Sunset Road SB Left	4.7	
		Sunset Road SB Thru	1.9	
		EBFR Thru	9.0	
		EBFR Right	6.9	
WBFR/Sunset Road	AM	Sunset Road NB Left	1.1	2.5
		WBFR Left	6.3	
		WBFR Thru	7.4	
	PM	Sunset Road NB Left	1.3	4.4
		WBFR Left	10.4	
		WBFR Thru	9.9	

For additional information regarding the 2025 traffic simulation results, refer to Appendix F.

The simulation results are the average of 30 runs performed for each of the peak hours and the magnitude of the average delay is similar to the average delay estimated using the 2010 HCM equations.

Estimated queue lengths for the stop control on the frontage roads alternative were estimated based on the 2010 HCM and the results of the simulation. The 95th percentile queue lengths for both methodologies are shown in Table 18.

Table 18 – 2025 I-10/Sunset Road TI Queue Lengths

Intersection	Time Period	Movement	HCM 95 th Percentile Queue Lengths (feet)	Simulation 95 th Percentile Queue Lengths (feet)
EBFR/Sunset Road	AM	Sunset Road SB Left	5	40
		EBFR Thru	13	57
		EBFR Right	98	149
	PM	Sunset Road SB Left	5	54
		EBFR Thru	3	43
		EBFR Right	78	114
WBFR/Sunset Road	AM	WBFR Left	10	59
		WBFR Thru	N/A	14
	PM	WBFR Left	45	106
		WBFR Thru	N/A	37

Even though the delay estimated using the simulation was lower than the delay estimated using the 2010 HCM, the 95th percentile queue lengths estimated using the simulation were greater than the queue lengths estimated using the 2010 HCM. The simulation queue lengths seem to be more appropriate for the expected traffic volumes. The simulation queue lengths were used as the basis for storage length recommendations discussed in Section 5.4.

In addition to using the simulation queues for storage length purposes, the simulation queues were utilized to evaluate the available distance for vehicles exiting I-10 and turning onto Sunset Road. The ramp/frontage road junctions are located approximately 700 feet (EBFR) and 1,100 feet (WBFR) away from the intersections. Based on the measured distance and estimated queue lengths, the available weaving distance is approximately 500 feet, which is consistent with weaving distances provided at other traffic interchanges.

4.5 Signalization Analysis

A preliminary signal warrant analysis was conducted for future conditions to determine if new signals might be needed at the Sunset Road/Silverbell Road intersection and the I-10/Sunset Road TI. The preliminary signal warrant analysis was based on the eight-hour (Warrant No. 1) and four-hour (Warrant No. 2) analyses contained in the 2009 Manual on Uniform Traffic Control Devices (MUTCD) (6).

In order to obtain eight-hour and four-hour volumes, ADOT Policies, Guidelines and Procedures (PGP) 611 (9) was utilized to obtain the hourly adjustment factors. The posted speed limit on Silverbell Road is 45 mph and consequently, Condition B was utilized to evaluate the Sunset Road/Silverbell Road intersection. The I-10/Sunset Road TI was analyzed under Condition A.

The intersection of Silverbell Road/Sunset Road is expected to meet Warrant No. 1 in 2018 and 2025 as shown in Table 19.

Table 19 – Silverbell Road/Sunset Road Signal Warrant No. 1

2018 Opening Year							
Sunset Road Number of Lanes	Silverbell Road Number of Lanes	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Cond A 100%	Cond A 70%	Cond B 100%	Cond B 70%
2 or more	2 or more	490	250	No	Yes	No	No
2025 Design Year							
Sunset Road Number of Lanes	Silverbell Road Number of Lanes	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Cond A 100%	Cond A 70%	Cond B 100%	Cond B 70%
2 or more	2 or more	550	310	No	Yes	No	No

vph: vehicles per hour

Likewise, the intersection is anticipated to meet Warrant No. 2 in the opening year and the design year. See Figure 9 for Warrant No. 2 results.

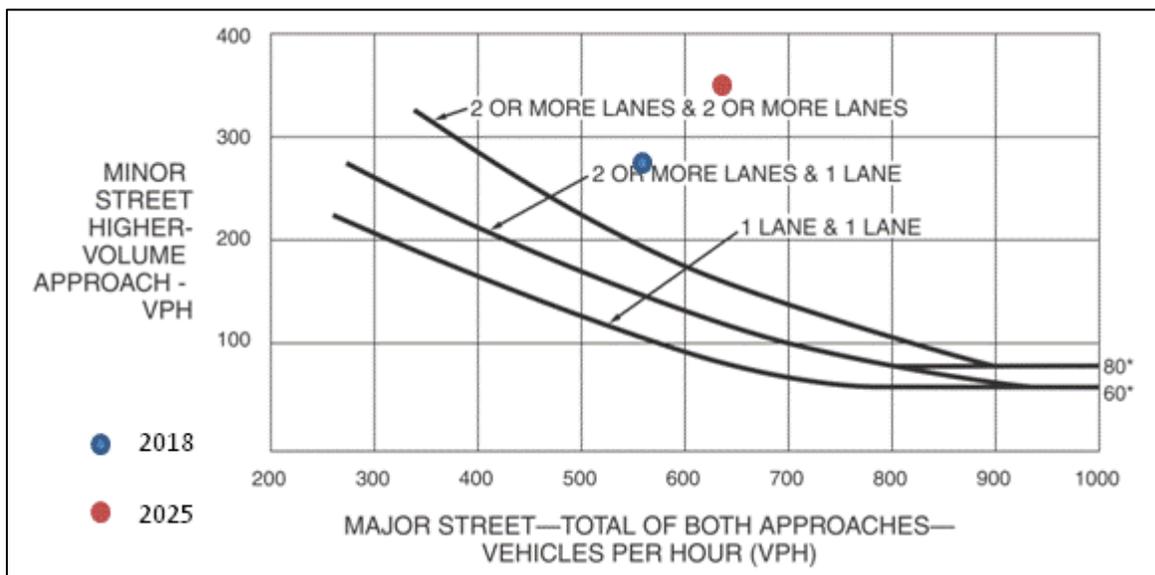


Figure 9 – Silverbell Road/Sunset Road Signal Warrant No. 2

Based on the eight-hour (Warrant No. 1) and four-hour (Warrant No. 2) analyses, the Silverbell Road/Sunset Road intersection meets the traffic signal warrants for the opening year. Therefore, it is recommended that a signal be installed at this new intersection as part of the Segment I improvements.

The intersections at the I-10/Sunset Road TI are not expected to meet Warrant No. 1 based on the PAG turning movement projections for 2018 and 2025 as illustrated in Table 20.

Table 20 – Frontage Road/Sunset Road Signal Warrant No. 1

2018 Opening Year							
Sunset Road Number of Lanes	Silverbell Road Number of Lanes	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Cond A 100%	Cond A 70%	Cond B 100%	Cond B 70%
1	1	400	100	No	N/A	No	N/A
2025 Design Year							
Sunset Road Number of Lanes	Silverbell Road Number of Lanes	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Cond A 100%	Cond A 70%	Cond B 100%	Cond B 70%
1	1	480	140	No	N/A	No	N/A

vph: vehicles per hour

Similarly, the intersections are not anticipated to meet Warrant No. 2 in the opening year and the design year. See Figure 10 for Warrant No. 2 results.

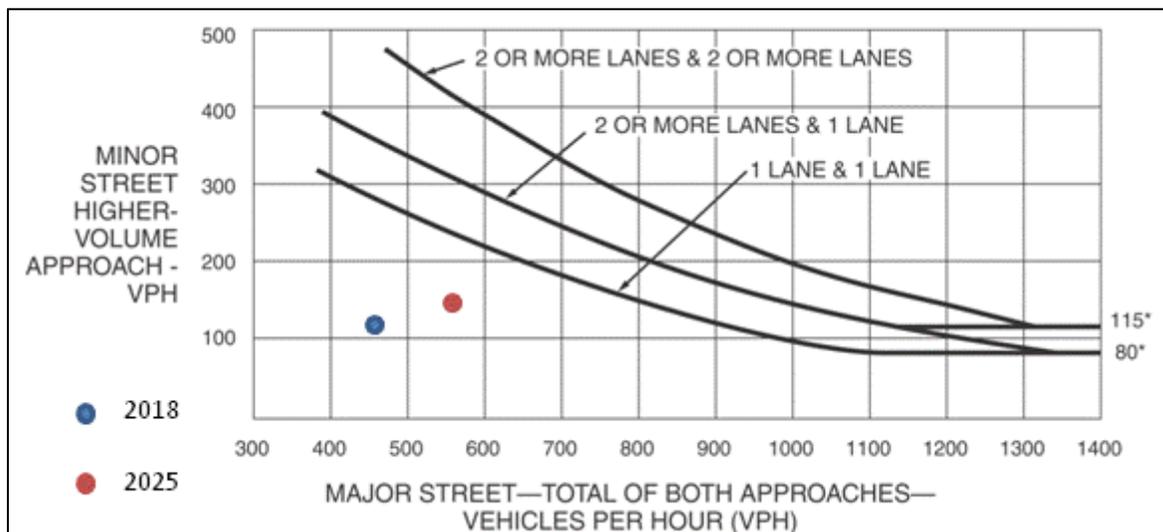


Figure 10 – Frontage Road/Sunset Road Signal Warrant No. 2

Based on the eight-hour (Warrant No. 1) and four-hour (Warrant No. 2) analyses, the intersections at the I-10/Sunset Road TI do not meet the traffic signal warrants for the opening year or the design year. Therefore, it is recommended that traffic volumes are monitored and signal warrant analyses conducted in the future after Sunset Road is in place to evaluate the need for a traffic signal with count data. For additional information regarding the traffic signal warrant studies, refer to Appendix G.

4.6 Turn Lane Warrant Analysis

Turn lane warrant studies for future conditions were conducted for the intersections of Sunset Road on Silverbell Road and at the I-10/Sunset Road TI. Pima County Subdivisions and Development Street Standards (10) criteria for turn lane warrants were utilized for the intersections within Pima County right-of-way. ADOT PGP 245 was utilized to evaluate the turn lane requirements at the I-10/Sunset Road TI. The results of the turn lane warrant analysis are summarized as follows:

- Intersection of Sunset Road and Silverbell Road - Turn lane warrants are met for the southbound left-turn, northbound right-turn, and westbound left-turn movements in 2018.
- Intersection of Sunset Road and I-10 EBFR - Turn lane warrants are met for the eastbound right-turn movement using both Pima County and ADOT criteria.
- Intersection of Sunset Road and I-10 WBFR - No turn lane warrants are met.

It is worth noting that the turn lane warrant analysis for the I-10/Sunset Road TI was performed assuming that stop control on the frontage roads would be implemented as part of the Segment I improvements. For additional information regarding the turn lane warrant studies, refer to Appendix H.

5.0 PROPOSED IMPROVEMENTS

Based on the results of the capacity, signalization and turn lane analyses, a set of improvements for Sunset Road was developed and recommended. The recommendations include the appropriate design parameters, number of through lanes on Sunset Road, lane configuration and traffic control at the corridor intersections including turn bay storage lengths, and other miscellaneous requirements. The following sections describe the proposed improvements in further detail.

5.1 Design Parameters

Sunset Road will be designed according to the requirements and standards identified in the Pima County Roadway Design Manual (7) and AASHTO's A Policy on Geometric Design of Highways and Streets ("The Green Book"), 2011 edition (8).

The following design criteria are recommended for this project.

- **Design Speed:** The design speed of the new Sunset Road should be consistent with the length of Segment I (distance between the intersection of Sunset Road/Silverbell Road and the I-10/Sunset Road TI) and the potential land use in the area. Considering that Sunset Road will also serve as a connection to two arterial roads, a 40 mph design speed is recommended. A posted speed limit of 35 mph should be in place.
- **Stopping Sight Distance:** The stopping sight distance should be a minimum of 305 feet for a design speed of 40 mph, according to the criteria established in Table 7-1 of the AASHTO Green Book, 2011.
- **Clear Zone:** According to the AASHTO Roadside Design Guide (11), the clear zone for a 40 mph design speed with an ADT over 6,000 vpd should range between 14 – 16 feet for the foreslope condition and between 16 - 18 feet for the backslope condition. This criterion should be followed for Sunset Road. For the short segment of Silverbell Road to be improved as part of the project, the clear zone for a 45 – 50 mph design speed with an ADT over 6,000 vpd ranges between 22 – 24 feet.
- **Design Vehicle:** Sunset Road should be designed to accommodate a WB-62 semi-trailer.

5.2 Roadway Segments

A rural three-lane roadway is proposed for Sunset Road from Silverbell Road to I-10 that consists of 11-foot wide travel lanes and a 12-foot wide two-way left-turn lane. Ten-foot shoulders should be provided along Sunset Road of which six feet would be paved. Figure 11 illustrates the proposed roadway section.

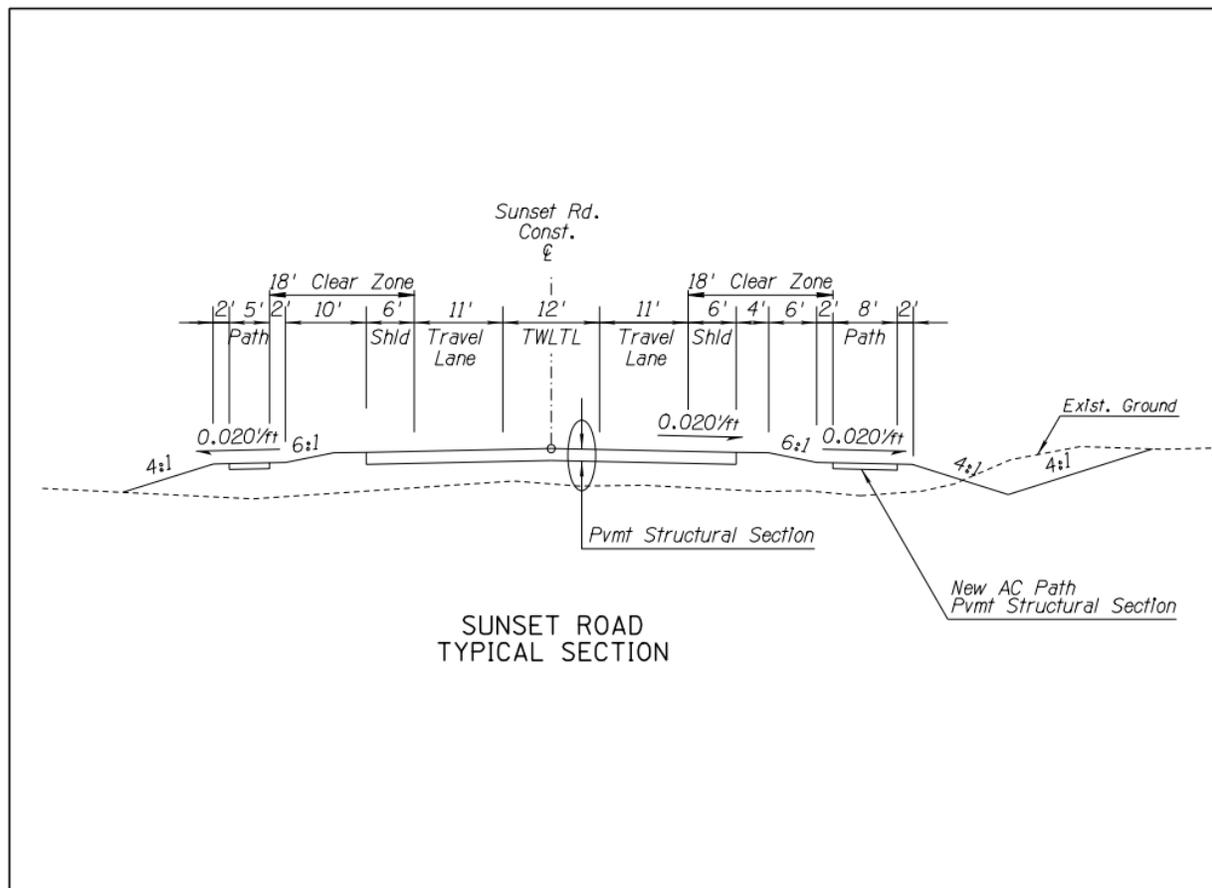


Figure 11 – Sunset Road Typical Section

5.3 Intersections

5.3.1 Intersection of Existing Sunset Road and Silverbell Road

Segment I improvements do not include modifications to this intersection. This intersection can remain under existing conditions until the Silverbell Road corridor is improved as part of a separate project discussed in Section 4.2 of this document. The Silverbell Road corridor improvements should include auxiliary lanes at the intersection (northbound left-turn lane, eastbound left- and right-turn lanes and southbound right-turn lane).

5.3.2 Intersection of Sunset Road and Silverbell Road

To provide efficient operations at this intersection in its opening year, a traffic signal is recommended as part of the proposed improvements. In addition, the southbound and westbound approaches should have a left-turn bay and the northbound approach should have a right-turn bay. Turn bay storage lengths should be provided in accordance with the recommendations in Section 5.4 of this traffic engineering report.

5.3.3 Intersection of Sunset Road and I-10 Eastbound Frontage Road

Based on the results of the LOS analyses under the different traffic control scenarios tested, it is recommended that the intersection changes from stop control on Sunset Road to stop control on the EBFR with Sunset Road operating as free-flow. This would result in the best operation of

the intersection without installing a traffic signal. No turn lanes will be added at this intersection, as it is within ADOT right-of-way.

5.3.4 Intersection of Sunset Road and I-10 Westbound Frontage Road

In concurrence with the EBFR analysis, it is recommended that the intersection changes from stop control on Sunset Road and free-flow on the WBFR to stop control on the WBFR with Sunset Road operating as free-flow. No turn lanes will be added at this intersection for these interim improvements since it is within ADOT right-of-way.

5.4 Turn Bay Storage

Storage lengths were based on the 95th percentile queue lengths calculated in the Synchro analysis, as well as guidance on minimum lengths provided in the PCDOT/TDOT Pavement Marking Design Manual (12). Recommended storage lengths are provided in Table 21.

Table 21 – Recommended Storage Lengths

Intersection	Turn Bay	Recommended Storage Length (feet)	Comment
Sunset Road/ Silverbell Road	WB LT	250	Based on the estimated queue length
	SB LT	150	Minimum turn bay length = 150'
	NB RT	150	Minimum turn bay length = 150'
Sunset Road/EBFR	WB LT	110	Based on estimated queue length and physical constraints

No improvements are planned as part of this project within ADOT right-of-way at this time.

5.5 Access

The new Sunset Road is being designed to accommodate a three-lane cross section, including a two-way left-turn lane. The two-way left-turn lane would serve to allow access into potential future developments east of the Santa Cruz River Bridge and west of I-10. No side-streets or driveways are anticipated to be constructed as part of this project's roadway improvements.

5.6 Alternative Transportation Modes

As discussed in Section 3.5 of this document, there are no regular or express bus routes along the existing Sunset Road or adjacent roadways. As Sunset Road is located in an area of low density housing and little retail development, Sun Tran does not have plans for transit expansion within the vicinity of the project.

Silverbell Road, north and south of the existing Sunset Road, currently serves as a bike route with four-foot striped, paved shoulders on each side of this two-lane roadway. Implementation of

five- and eight-foot wide asphaltic concrete paths along Sunset Road would provide access to “The Loop” paved multi-use path; which generally runs alongside the Santa Cruz River and the EBFR. The paths along Sunset Road would continue to the Sunset Road/Silverbell Road intersection to tie into concrete curb access ramps. The Sunset Road cross section also includes six-foot wide paved shoulders that could be used by bicyclists.

To provide a safe crossing for “The Loop” at Sunset Road, it is proposed to install a two stage crossing to the west of the Sunset Road/EBFR intersection. An eight-foot asphaltic concrete path between the frontage road and the proposed crossing and parallel to Sunset Road would direct bicyclist and pedestrians to the crossing location, From this point on the north side of Sunset Road, “The Loop” users would cross the westbound travel lane when a gap in vehicular traffic flow is available and obtain refuge inside the two-way left-turn lane, which would be surrounded by flexible delineators mounted to a curbing system for approximately 100 feet in length. From there, the bicyclist or pedestrian would complete the second stage of the crossing movement, crossing the eastbound travel lane during a gap in vehicular traffic. They would then access the asphaltic concrete path located on the south side of Sunset Road. The opposite crossing sequence would be used for users crossing from the south to the north. A conceptual layout of the two stage crossing can be seen in Figure 12.

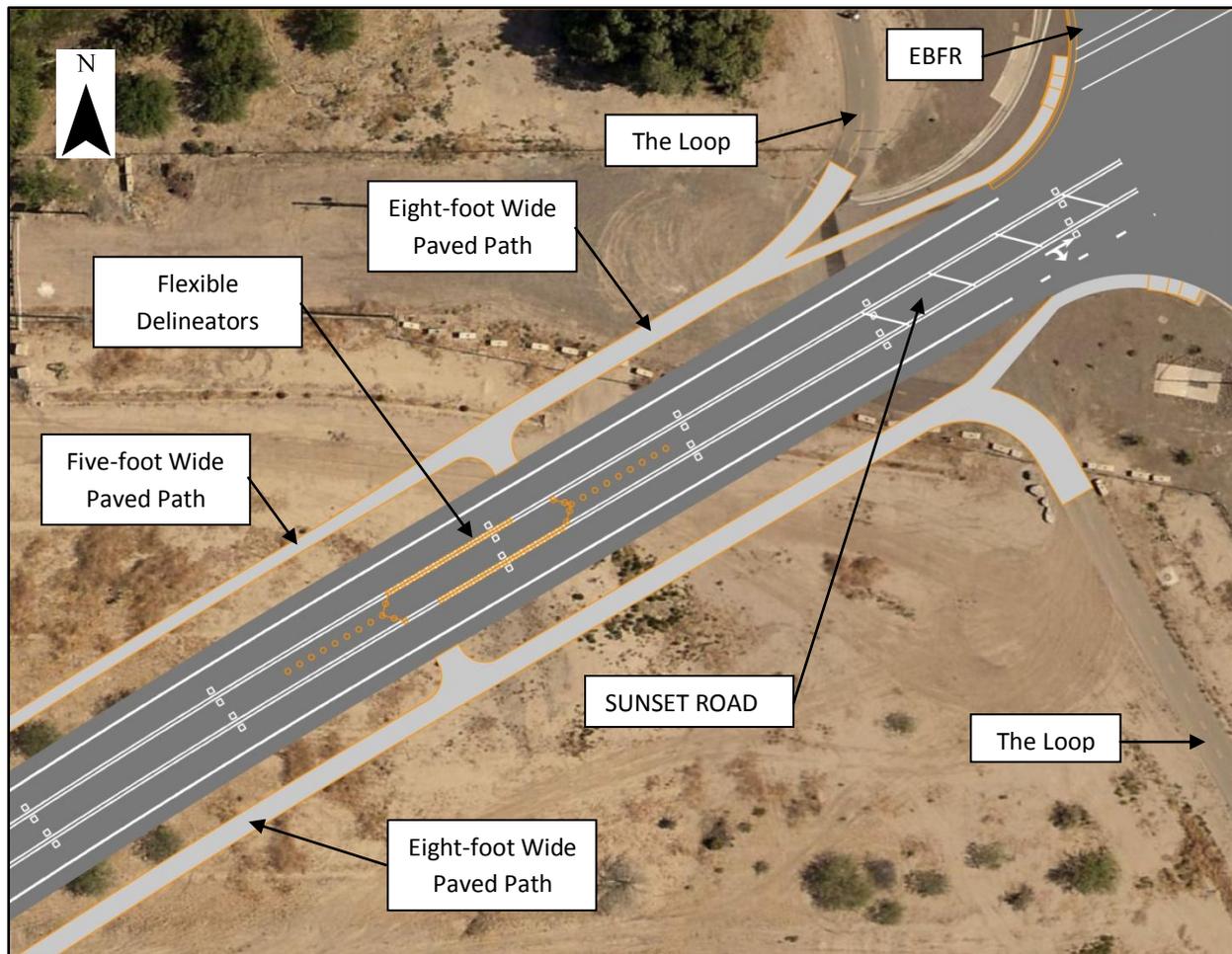


Figure 12 – Two Stage Crossing Concept

The crossing configuration would be modeled after the existing two stage crossing located on El Camino del Cerro west of the EBFR.

5.7 Lighting and Intelligent Transportation Systems

Intersection lighting would be installed at the new Sunset Road/Silverbell Road intersection. No lighting improvements will be installed at the frontage road intersections as part of this project as no improvements will be implemented within ADOT right-of-way.

Additional intersection lighting at the frontage road intersections should be considered as traffic volumes and operations are monitored for future traffic signals.

Conduits and pullboxes would be installed for future Intelligent Transportation Systems (ITS) on the south side of the Sunset Road alignment that would be designed for the ultimate configuration. This segment starts east of Silverbell Road (at the Santa Cruz Bridge) and ends west of I-10 (approximately 1,200 feet west of the EBFR) at the "touch down point" where the road would begin to rise to meet the future elevated I-10/Sunset Road TI.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Existing traffic volumes and crash data were gathered to determine the traffic characteristics of the roadways adjacent to Sunset Road (Segment I). Moreover, PAG's travel demand model was utilized to attain traffic volume projections to evaluate future traffic operations. The following conclusions were reached from the existing and future traffic operational analyses conducted:

- Existing traffic volumes and factors for the roadways adjacent to Sunset Road (Segment I) are consistent with traffic characteristics observed in Pima County.
- Segment and intersection crash rates for the adjacent roadways are below Pima County averages. There is not currently a safety problem on the project roadways.
- The PAG regional travel demand model predicts a traffic demand on Sunset Road of 8,750 vpd in the opening year (2018) and 10,750 vpd in the design year (2025). To accommodate the projected traffic demands, a three-lane facility is recommended for the new roadway.
- Traffic signal warrant studies were conducted for future years 2018 and 2025 at the proposed Sunset Road/Silverbell Road intersection and the I-10/Sunset Road TI. The proposed Sunset Road/Silverbell Road intersection is expected to meet the MUTCD's traffic signal warrants in 2018. On the contrary, the I-10/Sunset Road TI is not anticipated to meet traffic signal warrants by 2025.
- Capacity analysis results indicate that the proposed improvements as shown on Figures 11 and 12 that include a traffic signal at the Sunset Road/Silverbell Road intersection and stop control on the frontage roads at the I-10/Sunset Road TI would provide sufficient capacity to serve the projected 2025 traffic demand at acceptable LOS.
- Based on 2025 traffic volumes, the recommended storage lengths for turn bays at the proposed Sunset Road/Silverbell Road intersection are provided in Section 5.4.
- As part of the Segment I improvements, no roadway reconstruction within ADOT right-of-way is anticipated since the frontage roads should operate at an acceptable LOS in 2025 without turn lane improvements.

The following improvements are proposed for Sunset Road (Segment I):

- Construct a new three-lane facility from Silverbell Road to I-10 that consists of 11-foot wide travel lanes, a 12-foot wide two-way left-turn lane and six-foot wide paved shoulders. The roadway will include a new bridge over the Santa Cruz River.
- Construct five-foot (north side) and eight-foot (south side) wide asphaltic concrete paths along Sunset Road to connect multi-modal users to "The Loop".
- Provide Americans with Disabilities Act (ADA) accessibility to the asphaltic concrete paths tying into "The Loop".
- Provide a westbound left-turn lane, southbound left-turn lane, and northbound right-turn lane with the recommended storage lengths indicated in Section 5.4 at the proposed Sunset Road/Silverbell Road intersection.
- Install a traffic signal and intersection street lighting at the proposed Sunset Road/Silverbell Road intersection.
- Install conduit and pullboxes for future ITS on the south side of the Sunset Road alignment that would be designed for the ultimate configuration. This segment starts at the Santa Cruz Bridge and ends approximately 1,200 feet west of the EBFR.
- Provide a design speed of 40 mph and a posted speed limit of 35 mph on Sunset Road.

- Maintain a design speed of 50 mph and a posted speed limit of 45 mph on Silverbell Road.
- Modify the traffic control at the I-10/Sunset Road TI to have stop control on the eastbound and westbound frontage roads.
- Monitor the traffic volumes and operations at the intersection of Sunset Road with the I-10 frontage roads to install an All-Way Stop Control or a traffic signal if traffic warrants are met in the future.
- Restripe Sunset Road underneath I-10 to accommodate a westbound left-turn bay for vehicles accessing the EBFR.
- Update pavement markings and signing for the EBFR approach to Sunset Road to accommodate a shared through/right-turn lane.
- Provide a two stage crossing on Sunset Road for “The Loop” west of the Sunset Road/EBFR intersection. The crossing would include a two-way left-turn lane refuge area consisting of flexible delineators mounted to a curbing system. Also, the asphaltic concrete path along the north side of Sunset Road between the frontage road and this proposed two stage crossing would be eight feet wide.
- Additional intersection lighting at the Sunset Road/EBFR intersection should be considered as traffic volumes and operations are monitored for future traffic signals.

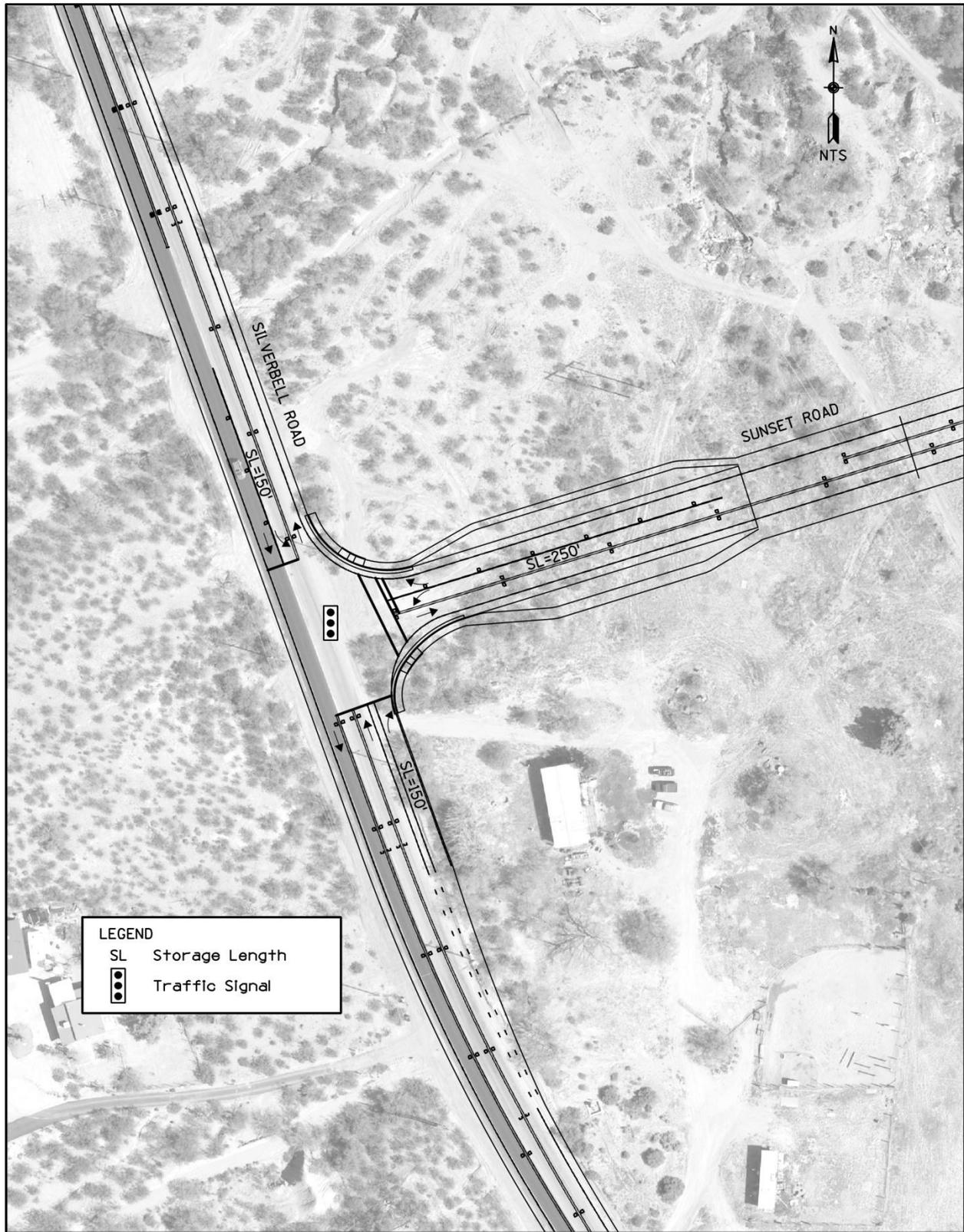


Figure 13 – Proposed Lane Configuration at Sunset Road/Silverbell Road Intersection

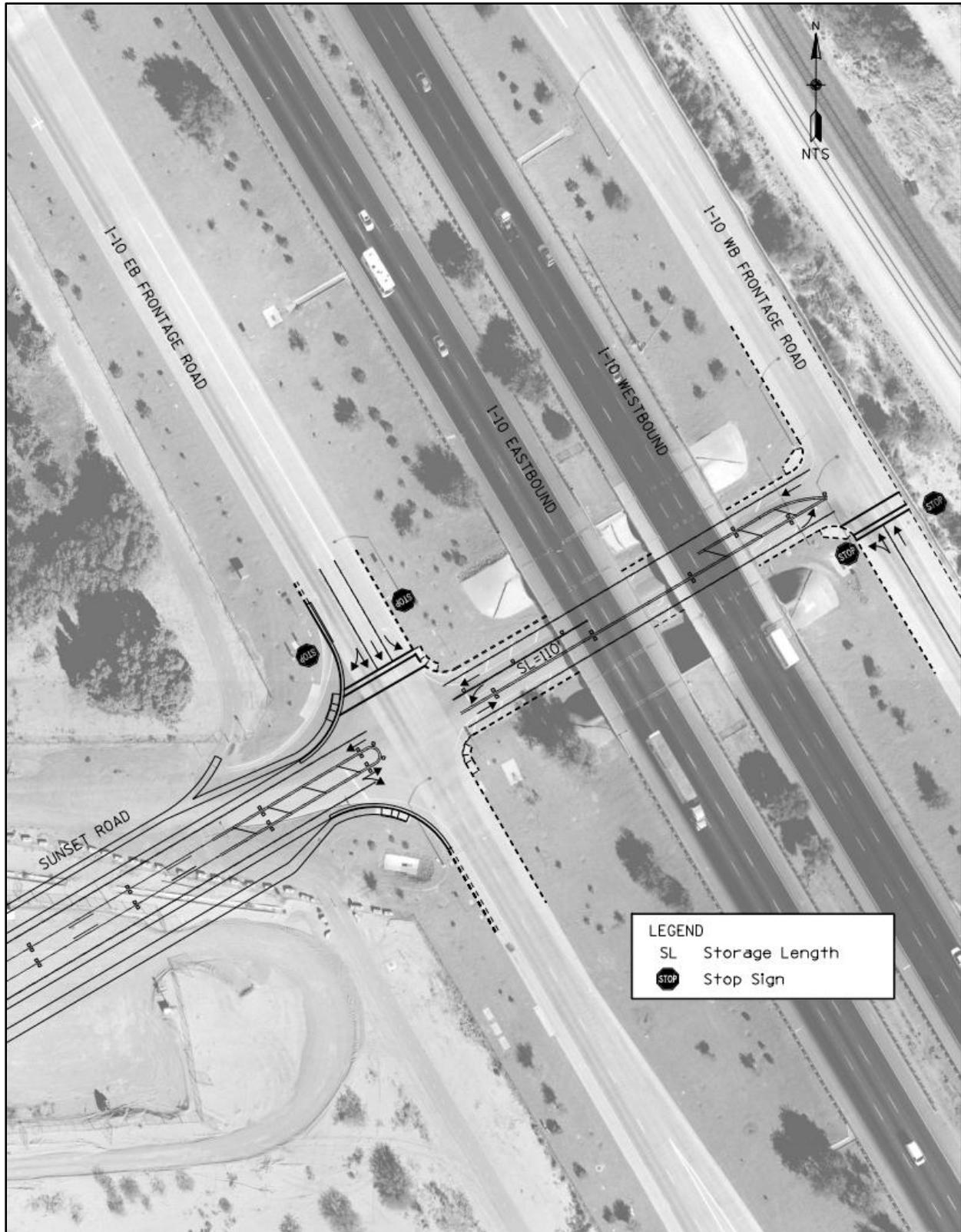


Figure 14 – Proposed Lane Configuration at I-10/Sunset Road TI

7.0 REFERENCES

1. PAG Traffic Count Database. <http://www.pagnet.org/RegionalData/TravelDataandForecasting/AnnualTrafficCountProgram/TrafficVolumeDatabase/tabid/909/Default.aspx>
2. Kittelson and Associates, Inc. Final Traffic Engineering Study, I-10, Ina Rd TI to Ruthrauff Rd TI. 2010.
3. PCDOT Unsignalized Intersections Crash Data. <http://dot.pima.gov/trafeng/accstat/WEB.unsignalized.pdf>
4. PCDOT Roadway Segment Crash Data. <http://dot.pima.gov/trafeng/accstat/WEB.LowVolSegments.pdf>
5. Pima County's "The Loop" Website. http://webcms.pima.gov/government/the_loop/
6. Transportation Research Board. Highway Capacity Manual. 2010.
7. Pima County. Roadway Design Manual, Second Edition. 2003.
8. AASHTO. A Policy on Geometric Design of Highways and Streets (The Green Book). 2011.
9. ADOT Policies, Guidelines and Procedures. 2011
[http://www.azdot.gov/business/engineering-and-construction/traffic/policies-guidelines-and-procedures-\(pgp\)](http://www.azdot.gov/business/engineering-and-construction/traffic/policies-guidelines-and-procedures-(pgp))
10. Pima County. Subdivision and Development Street Standards. 2005.
11. AASHTO. Roadside Design Guide. 2011.
12. PCDOT/Tucson Department of Transportation. Pavement Marking Design Manual. 2008.

APPENDIX A

Existing Traffic Volumes



PAG TRAFFIC COUNTS

Home | Map

WELCOME TO PAG TRAFFIC COUNT RECORDS

Street: SUNSET RD
 Location: CAMINO DE OESTE to SILVERBELL RD
 Year: 2010

Day 1 | Day 2 | 2 Day Average | Totals | Graph | Trend

This count was taken on: 10/20/2010 12:00:00 AM

Time	East	West	Time	East	West									
00:00	0	1	05:00	4	0	10:00	9	9	15:00	7	13	20:00	2	12
00:15	0	2	05:15	2	0	10:15	8	4	15:15	13	14	20:15	4	5
00:30	2	0	05:30	4	0	10:30	10	6	15:30	12	26	20:30	2	10
00:45	0	0	05:45	6	1	10:45	13	6	15:45	20	18	20:45	1	6
01:00	0	0	06:00	12	0	11:00	9	6	16:00	18	18	21:00	2	7
01:15	0	0	06:15	8	2	11:15	10	6	16:15	22	16	21:15	4	8
01:30	0	0	06:30	13	4	11:30	10	8	16:30	16	10	21:30	4	6
01:45	0	0	06:45	10	2	11:45	8	6	16:45	10	14	21:45	3	3
02:00	0	0	07:00	18	4	12:00	6	10	17:00	5	15	22:00	0	4
02:15	0	0	07:15	21	8	12:15	10	8	17:15	12	14	22:15	1	6
02:30	2	0	07:30	20	8	12:30	9	12	17:30	12	11	22:30	2	2
02:45	0	0	07:45	22	11	12:45	10	10	17:45	14	20	22:45	1	2
03:00	0	0	08:00	17	23	13:00	8	8	18:00	10	16	23:00	2	3
03:15	1	0	08:15	22	22	13:15	11	8	18:15	6	13	23:15	1	1
03:30	0	0	08:30	25	9	13:30	10	14	18:30	6	13	23:30	0	1
03:45	1	0	08:45	16	6	13:45	9	11	18:45	10	14	23:45	1	2
04:00	0	1	09:00	12	8	14:00	8	10	19:00	5	12	Directional	692	666
04:15	0	1	09:15	8	9	14:15	11	12	19:15	2	9	Totals		
04:30	2	0	09:30	8	10	14:30	11	12	19:30	3	6	Total	1358	
04:45	0	0	09:45	10	6	14:45	11	8	19:45	2	4	AM Peak	151	
												PM Peak	150	

[Segment Counts](#) | [Turn Counts](#) | [Map](#)

[Contact Us](#)

COPYRIGHT © 2012 PIMA ASSOCIATION OF GOVERNMENTS

Appendix A

EBFR north of Sunset Rd 2009 Traffic Volumes

Frontage Road Volume										Ramp Volume										Combined Volume		
Monday	Tuesday	Wed	TH	Friday	Weekday	Sat	Sunday	Weekend		Monday	Tuesday	Wed	TH	Friday	Weekday	Sat	Sunday	Weekend		Weekday		
6	3	4	5	6	4	9	14	6	12:00 AM	4	2	0	4	0	2	5	3	2	12:00 AM	6	12:00 AM	
3	3	2	5	5	3	7	8	4	1:00 AM	1	0	0	1	1	0	0	1	0	1:00 AM	3	1:00 AM	
6	3	4	3	5	4	1	3	3	2:00 AM	0	0	2	1	1	0	1	0	0	2:00 AM	4	2:00 AM	
1	3	5	6	3	3	6	3	3	3:00 AM	1	0	2	2	2	1	0	0	1	3:00 AM	4	3:00 AM	
5	9	18	14	8	10	8	6	9	4:00 AM	2	3	2	4	2	2	2	1	2	4:00 AM	12	4:00 AM	
14	52	50	39	56	42	13	7	33	5:00 AM	2	18	6	10	14	10	1	1	7	5:00 AM	52	5:00 AM	
21	160	116	108	112	103	31	10	79	6:00 AM	6	30	29	28	23	23	5	1	17	6:00 AM	126	6:00 AM	
28	236	189	188	182	164	58	20	128	7:00 AM	6	70	64	58	53	50	10	4	37	7:00 AM	214	7:00 AM	
49	211	146	133	118	131	62	29	106	8:00 AM	5	44	24	31	34	27	14	5	22	8:00 AM	158	8:00 AM	
46	175	134	122	126	120	96	44	106	9:00 AM	9	24	24	24	21	20	12	8	17	9:00 AM	140	9:00 AM	
66	188	101	140	122	123	124	74	116	10:00 AM	14	20	26	27	22	21	28	15	21	10:00 AM	144	10:00 AM	
68	224	107	132	119	130	98	70	116	11:00 AM	13	18	35	18	22	21	12	19	19	11:00 AM	151	11:00 AM	
80	210	130	138	140	139	102	92	127	12:00 PM	17	24	31	31	18	24	20	18	22	12:00 PM	163	12:00 PM	
74	206	114	128	132	130	96	71	117	1:00 PM	16	32	30	24	36	27	22	25	26	1:00 PM	157	1:00 PM	
83	234	155	156	176	160	100	72	139	2:00 PM	17	37	24	26	30	26	18	19	24	2:00 PM	186	2:00 PM	
76	238	164	148	138	152	107	88	137	3:00 PM	16	45	34	29	23	29	18	10	25	3:00 PM	181	3:00 PM	
86	238	133	132	164	150	84	82	131	4:00 PM	17	29	24	17	18	21	15	15	19	4:00 PM	171	4:00 PM	
60	233	139	139	115	137	82	56	117	5:00 PM	18	22	12	19	20	18	20	10	17	5:00 PM	155	5:00 PM	
45	145	92	126	92	100	88	53	91	6:00 PM	18	11	24	14	20	17	21	19	18	6:00 PM	117	6:00 PM	
63	106	63	60	56	69	38	35	60	7:00 PM	8	8	12	10	7	9	9	5	8	7:00 PM	78	7:00 PM	
28	66	42	47	47	46	29	29	41	8:00 PM	7	9	11	9	5	8	6	12	8	8:00 PM	54	8:00 PM	
20	47	23	24	37	30	28	28	29	9:00 PM	7	10	8	9	12	9	4	2	7	9:00 PM	39	9:00 PM	
11	24	14	19	32	20	23	21	20	10:00 PM	8	8	1	3	7	5	4	8	5	10:00 PM	25	10:00 PM	
12	13	8	8	22	12	8	12	11	11:00 PM	2	9	4	1	4	4	4	1	3	11:00 PM	16	11:00 PM	
951	3027	1953	2020	2013	1982	1298	927	1729	Day Total	214	473	429	400	395	374	251	202	327	Day Total	2,356		
				AM PK HR	164	7:00 AM								AM PK HR	50	7:00 AM				AM PK HR	214	7:00 AM
				PM PK HR	160	2:00 PM								PM PK HR	29	3:00 PM				PM PK HR	186	2:00 PM
																				KAM	0.09	
																				KPM	0.08	

EBFR south of Sunset Rd 2009 Traffic Volumes

Frontage Road Volume										Ramp Volume										Combined Volume	
Monday	Tuesday	Wed	TH	Friday	Weekday	Sat	Sunday	Weekend	12:00 AM	Monday	Tuesday	Wed	TH	Friday	Weekday	Sat	Sunday	Weekend	12:00 AM	Weekday	12:00 AM
8	4	8	7	5	6	16	15	9	12:00 AM	2	1	0	2	2	1	0	2	1	12:00 AM	7	12:00 AM
3	3	3	8	8	5	10	9	6	1:00 AM	1	0	0	0	0	0	1	2	0	1:00 AM	5	1:00 AM
5	4	4	4	5	4	2	2	3	2:00 AM	2	0	1	0	1	0	1	0	0	2:00 AM	4	2:00 AM
2	5	10	9	5	6	6	7	6	3:00 AM	1	0	1	0	0	0	0	0	0	3:00 AM	6	3:00 AM
7	19	26	25	18	19	9	11	16	4:00 AM	0	1	2	1	0	0	3	0	1	4:00 AM	19	4:00 AM
16	73	78	78	75	64	8	8	48	5:00 AM	1	18	5	8	8	8	3	0	6	5:00 AM	72	5:00 AM
24	192	132	122	134	120	35	12	93	6:00 AM	2	44	14	20	15	19	2	0	13	6:00 AM	139	6:00 AM
29	264	208	210	209	184	62	24	143	7:00 AM	1	64	43	36	32	35	3	0	25	7:00 AM	219	7:00 AM
52	233	175	150	148	151	71	32	123	8:00 AM	1	43	27	22	20	22	2	1	16	8:00 AM	173	8:00 AM
53	195	168	142	148	141	103	50	122	9:00 AM	4	26	12	19	19	16	2	4	12	9:00 AM	157	9:00 AM
77	204	128	171	152	146	136	82	135	10:00 AM	2	40	16	12	20	18	9	6	15	10:00 AM	164	10:00 AM
76	252	157	158	148	158	104	80	139	11:00 AM	6	38	14	17	22	19	11	4	16	11:00 AM	177	11:00 AM
90	226	160	160	166	160	107	103	144	12:00 PM	9	24	21	28	16	19	9	10	16	12:00 PM	179	12:00 PM
88	234	162	171	170	165	109	90	146	1:00 PM	10	44	26	14	9	20	13	7	17	1:00 PM	185	1:00 PM
96	254	181	197	192	184	112	88	160	2:00 PM	6	39	26	22	30	24	8	3	19	2:00 PM	208	2:00 PM
86	275	187	181	164	178	113	98	157	3:00 PM	4	42	22	28	16	22	14	4	18	3:00 PM	200	3:00 PM
100	270	146	150	172	167	92	90	145	4:00 PM	7	48	34	28	15	26	13	2	21	4:00 PM	193	4:00 PM
76	244	145	152	125	148	86	61	127	5:00 PM	3	24	12	12	15	13	7	5	11	5:00 PM	161	5:00 PM
58	150	104	133	106	110	96	69	102	6:00 PM	3	8	10	5	10	7	8	1	6	6:00 PM	117	6:00 PM
66	112	68	56	62	72	40	36	62	7:00 PM	4	16	8	5	5	7	4	2	6	7:00 PM	79	7:00 PM
34	66	47	51	46	48	30	35	44	8:00 PM	2	11	5	6	6	6	3	4	5	8:00 PM	54	8:00 PM
21	52	30	33	46	36	30	25	33	9:00 PM	5	12	5	3	6	6	3	3	5	9:00 PM	42	9:00 PM
16	27	14	20	38	23	22	18	22	10:00 PM	0	3	1	3	2	1	1	2	1	10:00 PM	24	10:00 PM
12	14	8	12	25	14	8	11	12	11:00 PM	1	1	1	5	2	2	2	1	1	11:00 PM	16	11:00 PM
1095	3372	2349	2400	2367	2309	1407	1056	1997	Day Total	77	547	306	296	271	291	122	63	231	Day Total	2,600	
				AM PK HR	184	7:00 AM							AM PK HR	35	7:00 AM				AM PK HR	219	7:00 AM
				PM PK HR	184	7:00 PM							PM PK HR	26	4:00 PM				PM PK HR	208	2:00 PM
																			KAM	0.08	
																			KPM	0.08	

WBFR north of Sunset Rd 2009 Traffic Volumes

Frontage Road Volume										Ramp Volume										Combined Volume		
Monday	Tuesday	Wed	TH	Friday	Weekday	Sat	Sunday	Weekend		Monday	Tuesday	Wed	TH	Friday	Weekday	Sat	Sunday	Weekend		Weekday		
14	4	3	8	3	6	17	14	9	12:00 AM	2	5	3	7	3	4	6	15	6	12:00 AM	10	12:00 AM	
3	6	5	4	4	4	11	9	6	1:00 AM	3	1	10	1	0	3	8	4	3	1:00 AM	7	1:00 AM	
7	1	4	2	2	3	10	4	4	2:00 AM	6	1	3	4	1	3	4	1	2	2:00 AM	6	2:00 AM	
6	3	4	5	5	4	7	3	4	3:00 AM	9	4	3	1	9	5	2	5	4	3:00 AM	9	3:00 AM	
15	13	15	19	12	14	3	3	11	4:00 AM	11	11	8	19	10	11	4	2	9	4:00 AM	25	4:00 AM	
52	54	58	52	50	53	12	6	40	5:00 AM	47	48	55	59	44	50	4	2	37	5:00 AM	103	5:00 AM	
53	55	61	60	55	56	32	15	47	6:00 AM	69	48	49	42	36	48	15	4	37	6:00 AM	104	6:00 AM	
69	90	84	88	88	83	35	35	69	7:00 AM	67	73	59	56	71	65	12	5	49	7:00 AM	148	7:00 AM	
119	89	129	108	100	109	61	27	90	8:00 AM	49	33	51	63	67	52	16	14	41	8:00 AM	161	8:00 AM	
106	101	124	129	105	113	93	40	99	9:00 AM	54	39	37	40	37	41	26	7	34	9:00 AM	154	9:00 AM	
125	124	134	137	133	130	98	84	119	10:00 AM	44	47	38	52	46	45	26	23	39	10:00 AM	175	10:00 AM	
120	128	125	147	159	135	107	73	122	11:00 AM	61	52	47	46	54	52	36	21	45	11:00 AM	187	11:00 AM	
188	115	149	104	149	141	111	104	131	12:00 PM	51	49	36	54	38	45	37	20	40	12:00 PM	186	12:00 PM	
141	123	140	131	117	130	104	73	118	1:00 PM	68	62	50	60	61	60	29	37	52	1:00 PM	190	1:00 PM	
120	136	105	118	119	119	80	68	106	2:00 PM	72	96	86	70	76	80	28	26	64	2:00 PM	199	2:00 PM	
120	127	147	112	139	129	81	64	112	3:00 PM	81	80	93	91	89	86	20	24	68	3:00 PM	215	3:00 PM	
126	140	139	134	141	136	64	60	114	4:00 PM	121	91	111	86	94	100	25	23	78	4:00 PM	236	4:00 PM	
112	170	109	149	122	132	67	48	111	5:00 PM	93	80	108	100	76	91	16	12	69	5:00 PM	223	5:00 PM	
60	55	81	98	80	74	62	34	67	6:00 PM	43	60	61	61	43	53	18	20	43	6:00 PM	127	6:00 PM	
46	73	57	58	52	57	47	35	52	7:00 PM	27	31	40	29	24	30	21	22	27	7:00 PM	87	7:00 PM	
27	50	52	50	40	43	37	43	42	8:00 PM	17	27	26	31	33	26	16	11	23	8:00 PM	69	8:00 PM	
27	38	26	36	32	31	17	77	36	9:00 PM	14	22	23	21	14	18	15	4	16	9:00 PM	49	9:00 PM	
12	16	17	19	20	16	17	127	32	10:00 PM	12	11	10	17	13	12	15	5	11	10:00 PM	28	10:00 PM	
3	10	11	9	23	11	19	73	21	11:00 PM	12	10	11	7	11	10	6	3	8	11:00 PM	21	11:00 PM	
1671	1721	1779	1777	1750	1729	1192	1119	1562	Day Total	1033	981	1018	1017	950	990	408	310	805	Day Total	2,719		
				AM PK HR	135	11:00 AM							AM PK HR	65	7:00 AM					AM PK HR	187	11:00 AM
				PM PK HR	141	12:00 PM							PM PK HR	100	4:00 PM					PM PK HR	236	4:00 PM
																				KAM	0.07	
																				KPM	0.09	

WBFR south of Sunset Rd 2009 Traffic Volumes

Frontage Road Volume										Ramp Volume										Combined Volume		
Monday	Tuesday	Wed	TH	Friday	Weekday	Sat	Sunday	Weekend		Monday	Tuesday	Wed	TH	Friday	Weekday	Sat	Sunday	Weekend		Weekday		
13	9	6	13	5	9	20	22	12	12:00 AM	1	0	1	3	1	1	3	3	3	1	12:00 AM	10	12:00 AM
2	9	10	5	2	5	14	12	7	1:00 AM	1	3	1	2	2	1	1	0	1	1:00 AM	6	1:00 AM	
8	1	4	4	2	3	10	5	4	2:00 AM	0	1	2	1	2	1	1	0	1	2:00 AM	4	2:00 AM	
4	6	3	2	4	3	4	6	4	3:00 AM	1	0	0	1	1	0	4	1	1	3:00 AM	3	3:00 AM	
10	5	12	12	11	10	5	4	8	4:00 AM	3	1	2	0	0	1	0	0	0	4:00 AM	11	4:00 AM	
51	52	50	59	55	53	14	6	41	5:00 AM	4	4	6	6	2	4	2	1	3	5:00 AM	57	5:00 AM	
76	71	84	74	60	73	43	19	61	6:00 AM	4	8	6	3	2	4	3	1	3	6:00 AM	77	6:00 AM	
116	141	117	134	128	127	46	36	102	7:00 AM	20	16	16	8	8	13	2	3	10	7:00 AM	140	7:00 AM	
124	104	133	118	123	120	71	42	102	8:00 AM	27	11	16	6	8	13	6	1	10	8:00 AM	133	8:00 AM	
135	117	113	124	111	120	108	45	107	9:00 AM	20	14	14	5	9	12	8	4	10	9:00 AM	132	9:00 AM	
123	112	144	140	124	128	121	97	123	10:00 AM	22	31	10	12	15	18	12	6	15	10:00 AM	146	10:00 AM	
154	138	122	147	160	144	144	85	135	11:00 AM	16	20	14	10	12	14	10	7	12	11:00 AM	158	11:00 AM	
199	119	140	120	128	141	138	116	137	12:00 PM	15	26	18	8	10	15	11	6	13	12:00 PM	156	12:00 PM	
163	134	142	135	134	141	122	101	133	1:00 PM	22	29	13	18	20	20	8	11	17	1:00 PM	161	1:00 PM	
160	164	160	151	166	160	100	88	141	2:00 PM	18	29	7	8	13	15	5	4	12	2:00 PM	175	2:00 PM	
156	172	198	148	190	172	82	82	146	3:00 PM	9	14	12	18	12	13	9	4	11	3:00 PM	185	3:00 PM	
222	194	215	193	200	204	82	80	169	4:00 PM	16	12	13	12	15	13	8	6	11	4:00 PM	217	4:00 PM	
182	228	197	230	178	203	72	57	163	5:00 PM	10	12	4	15	9	10	7	2	8	5:00 PM	213	5:00 PM	
91	104	126	144	114	115	70	54	100	6:00 PM	8	7	10	2	9	7	5	3	6	6:00 PM	122	6:00 PM	
67	102	79	83	68	79	69	49	73	7:00 PM	2	3	4	5	4	3	1	2	3	7:00 PM	82	7:00 PM	
21	70	67	66	62	57	54	46	55	8:00 PM	2	3	0	4	2	2	0	5	2	8:00 PM	59	8:00 PM	
38	50	38	54	44	44	31	70	46	9:00 PM	2	7	4	0	1	2	2	13	4	9:00 PM	46	9:00 PM	
27	22	29	29	25	26	30	92	36	10:00 PM	2	3	0	2	8	3	2	40	8	10:00 PM	29	10:00 PM	
7	17	18	17	29	17	23	55	23	11:00 PM	0	3	6	2	4	3	1	20	5	11:00 PM	20	11:00 PM	
2149	2141	2207	2202	2123	2154	1473	1269	1928	Day Total	225	257	179	151	169	188	111	143	167	Day Total	2,342		
				AM PK HR	144	11:00 AM								AM PK HR	18	10:00 AM				AM PK HR	158	11:00 AM
				PM PK HR	204	4:00 PM								PM PK HR	20	1:00 PM				PM PK HR	217	4:00 PM
																				KAM	0.07	
																				KPM	0.09	

APPENDIX B

Crash Data



Pima County Department of Transportation

Traffic Engineering Division

-----Collision Diagram -----



SILVERBELL RD@SUNSET RD

10/1/2008 to 9/30/2013

LEGEND

- REAR END
- TURNING
- ANGLE
- OUT OF CONTROL
- MISC
- FIXED OBJ
- BACKING
- HEAD ON
- BODILY INJURY
- FATALITY

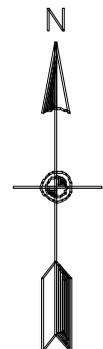
CRASH AND INJURY SEVERITY SUMMARY

PROPERTY	2
INJURY	0
FATALITY	0
TOTAL	2



SUNSET RD

SILVERBELL RD



Print Date: 11/26/2013



Pima County Department of Transportation Traffic Engineering Division

----- Crash Summary Sheet -----

SILVERBELL RD @ SUNSET RD

10/1/2008 to 9/30/2013



TYPE	DATE	TIME	DAY	LIGHT	CASE #	SEVERITY	VIOLATIONS CITED	NARRATIVE
7	03-02-13	12:28	SAT	DAY	130302140	PROPERTY	VEH 1: NONE VEH 2: FOLLOWED TOO CLOSELY	NB RE NB LT
	05-11-12	16:52	FRI	DAY	120511296	PROPERTY	VEH 1: NONE VEH 2: FOLLOWED TOO CLOSELY	NB REAR-ENDED A NB LT (HIT & RUN)



Pima County Department of Transportation

Traffic Engineering Division

-----Collision Diagram -----

SILVERBELL RD FROM 5324N TO 5699N

10/1/2008 THROUGH 9/30/2013

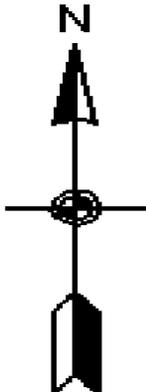


LEGEND

- REAR END
- TURNING
- ANGLE
- OUT OF CONTROL
- MISC.
- FIXED OBJ.
- BACKING
- HEAD ON
- SIDE SWIPE
- PEDESTRIAN OR ANIMAL
- BODILY INJURY
- FATALITY

CRASH AND INJURY SEVERITY SUMMARY

PROPERTY	2
INJURY	2
FATALITY	0
TOTAL	4



5
6
9
9
N

S
I
L
V
E
R
B
E
L
L
R
D

5
3
2
4
N

Sunset Road at 5599-5600

11
↓

9
↑

15
(*)

5

(*)



Pima County Department of Transportation Traffic Engineering Division

----- Crash Summary Sheet -----

SILVERBELL RD: 5324 - 5699 N

10/1/2008 to 9/30/2013



TYPE	DATE	TIME	DAY	LIGHT	CASE #	SEVERITY	VIOLATIONS CITED	BLOCK	NARRATIVE
15	02-19-12	21:44	SUN	DARK-- LIGHTED	120219277	INJURY - 2	** VEH 1: FAILED TO KEEP IN PROPER LANE	5390 N	NB LEFT RDWY OVERCORRECTED HIT TREE & ROLLED
5	11-19-11	14:10	SAT	DAY	111119162	INJURY - 2	** VEH 1: NONE VEH 2: UNKNOWN	5610 N	UNKNOWN DIRECTION TANDEM BICYCLE WAS HIT BY ANOTHER BICYCLE IN TOUR DE TUCSON BIKE RACE (HIT & RUN)
9	05-13-11	22:45	FRI	DARK	110513333	PROPERTY	VEH 1: NONE	5570 N	NB HIT AN ANIMAL IN THE RDWY (DEER)
11	04-02-09	17:37	THU	DAY	090402311	PROPERTY	VEH 1: SPEED TOO FAST FOR CONDITIONS FAILURE TO YIELD VEH 2: NONE	5570 N	SB REAR-END

Arizona Department of Transportation
Traffic Records Section
Standard Detailed Report

IncidentId	IncidentMicrofilm	IncidentDateTime	IncidentOnroad	IncidentCrossingFeature	IncidentOffset	IncidentInjurySeverityDesc	IncidentFirstHarmfulDesc	IncidentCollisionMannerDesc
2175801	18501247	11/17/2008 16:00	I 010 1	10 EL CAMINO DEL CERRO	-0.5	NON_INCAPACITATING_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_SAME_DIRECTION
2175801	18501247	11/17/2008 16:00	I 010 1	10 EL CAMINO DEL CERRO	-0.5	NON_INCAPACITATING_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_SAME_DIRECTION
2216758	18420297	10/13/2008 7:13	I 010 1	I 010250A	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2216758	18420297	10/13/2008 7:13	I 010 1	I 010250A	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2298276	18735731	4/19/2009 23:35	I 010 1	10 ORANGE GROVE RD	-0.0189	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_SAME_DIRECTION
2298276	18735731	4/19/2009 23:35	I 010 1	10 ORANGE GROVE RD	-0.0189	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_SAME_DIRECTION
2334665	19162311	8/11/2009 11:00	10 ORANGE GROVE RD	I 010 1	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_SAME_DIRECTION
2334665	19162311	8/11/2009 11:00	10 ORANGE GROVE RD	I 010 1	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_SAME_DIRECTION
2360418	19345056	11/17/2009 15:48	I 010 1	10 ORANGE GROVE RD	0.0095	POSSIBLE_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2360418	19345056	11/17/2009 15:48	I 010 1	10 ORANGE GROVE RD	0.0095	POSSIBLE_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2371552	19393672	12/30/2009 7:49	I 010 1	10 ORANGE GROVE RD	0.0729	POSSIBLE_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2371552	19393672	12/30/2009 7:49	I 010 1	10 ORANGE GROVE RD	0.0729	POSSIBLE_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2371562	19393683	12/30/2009 17:41	I 010 1	10 ORANGE GROVE RD	0.0095	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2371562	19393683	12/30/2009 17:41	I 010 1	10 ORANGE GROVE RD	0.0095	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2386759	19491145	2/9/2010 6:17	10 ORANGE GROVE RD	I 010 1	0	NO_INJURY	CURB	SINGLE_VEHICLE
2389651	19791009	10/17/2010 11:06	10 ORANGE GROVE RD	I 010 1	0	POSSIBLE_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_OPPOSITE_DIRECTION
2389651	19791009	10/17/2010 11:06	10 ORANGE GROVE RD	I 010 1	0	POSSIBLE_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_OPPOSITE_DIRECTION
2396038	19552498	3/24/2010 16:46	I 010 1	10 ORANGE GROVE RD	-0.1729	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_SAME_DIRECTION
2396038	19552498	3/24/2010 16:46	I 010 1	10 ORANGE GROVE RD	-0.1729	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_SAME_DIRECTION
2433532	19805315	7/7/2010 12:40	10 ORANGE GROVE RD	I 010 1	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_SAME_DIRECTION
2433532	19805315	7/7/2010 12:40	10 ORANGE GROVE RD	I 010 1	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_SAME_DIRECTION
2451233	19825433	8/24/2010 16:33	10 ORANGE GROVE RD	I 010 1	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	LEFT_TURN
2451233	19825433	8/24/2010 16:33	10 ORANGE GROVE RD	I 010 1	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	LEFT_TURN
2462654	19982745	10/11/2010 7:52	I 010 1	10 ORANGE GROVE RD	0.1136	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2462654	19982745	10/11/2010 7:52	I 010 1	10 ORANGE GROVE RD	0.1136	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2569613	20723447	12/1/2011 15:30	I 010 1	10 ORANGE GROVE RD	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2569613	20723447	12/1/2011 15:30	I 010 1	10 ORANGE GROVE RD	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2601804	20845185	3/4/2012 16:30	I 010 1	10 ORANGE GROVE RD	0	NO_INJURY	CONCRETE_TRAFFIC_BARRIER	SINGLE_VEHICLE
2616386		6/27/2012 18:35	I 010 1	I 010250A	0	NO_INJURY	OVERTURN_ROLLOVER	SINGLE_VEHICLE
2658009		10/15/2012 8:30	10 ORANGE GROVE RD	I 010 1	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_SAME_DIRECTION
2658009		10/15/2012 8:30	10 ORANGE GROVE RD	I 010 1	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_SAME_DIRECTION
2662091		10/6/2012 15:40	I 010 1	10 ORANGE GROVE RD	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	LEFT_TURN
2662091		10/6/2012 15:40	I 010 1	10 ORANGE GROVE RD	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	LEFT_TURN
2702404		2/11/2013 14:46	I 010 1	10 ORANGE GROVE RD	-0.0028	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	LEFT_TURN
2702404		2/11/2013 14:46	I 010 1	10 ORANGE GROVE RD	-0.0028	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	LEFT_TURN
2705212		1/31/2013 7:14	10 SUNSET RD	I 010 1	0	POSSIBLE_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_OPPOSITE_DIRECTION
2705212		1/31/2013 7:14	10 SUNSET RD	I 010 1	0	POSSIBLE_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	SIDESWIPE_OPPOSITE_DIRECTION
2749734		7/25/2013 8:15	I 010 1	10 ORANGE GROVE RD	0.0133	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2749734		7/25/2013 8:15	I 010 1	10 ORANGE GROVE RD	0.0133	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2770270		9/16/2013 8:25	I 010 1	10 ORANGE GROVE RD	0.1894	POSSIBLE_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2770270		9/16/2013 8:25	I 010 1	10 ORANGE GROVE RD	0.1894	POSSIBLE_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2770270		9/16/2013 8:25	I 010 1	10 ORANGE GROVE RD	0.1894	POSSIBLE_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	REAR_END
2770297		9/26/2013 7:11	10 ORANGE GROVE RD	I 010 1	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	ANGLE (front to side)(other than left turn)
2770297		9/26/2013 7:11	10 ORANGE GROVE RD	I 010 1	0	NO_INJURY	MOTOR_VEHICLE_IN_TRANSPORT	ANGLE (front to side)(other than left turn)

Report Parameters

Report Generated on: 1/16/2014 01:59:51
 Report ID: 170a1961-fb6a-4354-8c50-ecc246a87fa7
 Incident Date Between '10/1/2008' And '9/30/2013'
 Route : 'Interstate 10 Frontage (EB)'
 PersonTypeDesc : 'DRIVER', 'DRIVERLESS', 'PEDALCYCLIST', 'PEDESTRIAN'
 From Feature/Offset : Walker Rd
 To Feature/Offset : Diamond St

APPENDIX C

Existing Sunset Road/Silverbell Road Future LOS

Intersection

Int Delay, s/veh 2.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR
Vol, veh/h	20	0	80	0	1	0	30	100	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	22	0	87	0	1	0	33	109	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	674	674	500	717	685	109	511	0	0
Stage 1	500	500	-	174	174	-	-	-	-
Stage 2	174	174	-	543	511	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-
Pot Cap-1 Maneuver	368	376	571	345	371	945	1054	-	-
Stage 1	553	543	-	828	755	-	-	-	-
Stage 2	828	755	-	524	537	-	-	-	-
Platoon blocked, %									
Mov Cap-1 Maneuver	358	364	571	285	359	945	1054	-	-
Mov Cap-2 Maneuver	358	364	-	285	359	-	-	-	-
Stage 1	535	543	-	801	730	-	-	-	-
Stage 2	799	730	-	444	537	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	14	15.1	2
HCM LOS	B	C	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1054	-	-	510	359	1481	-	-
HCM Lane V/C Ratio	0.031	-	-	0.213	0.003	-	-	-
HCM Control Delay (s)	8.5	0	-	14	15.1	0	-	-
HCM Lane LOS	A	A	-	B	C	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.8	0	0	-	-

Intersection

Int Delay, s/veh

Movement	SBL	SBT	SBR
Vol, veh/h	0	450	20
Conflicting Peds, #/hr	0	0	0
Sign Control	Free	Free	Free
RT Channelized	-	-	None
Storage Length	-	-	-
Veh in Median Storage, #	-	0	-
Grade, %	-	0	-
Peak Hour Factor	92	92	92
Heavy Vehicles, %	2	2	2
Mvmt Flow	0	489	22

Major/Minor

Major2

Conflicting Flow All	109	0	0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	4.12	-	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	2.218	-	-
Pot Cap-1 Maneuver	1481	-	-
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	1481	-	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach

SB

HCM Control Delay, s	0
HCM LOS	

Minor Lane/Major Mvmt

HCM 2010 TWSC
 17: Silverbell Rd & Old Sunset Rd

2/18/2014

Intersection

Int Delay, s/veh 1.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	20	0	50	0	1	0	70	500	0	0	220	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	22	0	54	0	1	0	76	543	0	0	239	22

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	946	946	250	973	957	543	261	0	0	543	0	0
Stage 1	250	250	-	696	696	-	-	-	-	-	-	-
Stage 2	696	696	-	277	261	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	241	262	789	231	258	540	1303	-	-	1026	-	-
Stage 1	754	700	-	432	443	-	-	-	-	-	-	-
Stage 2	432	443	-	729	692	-	-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	225	240	789	201	236	540	1303	-	-	1026	-	-
Mov Cap-2 Maneuver	225	240	-	201	236	-	-	-	-	-	-	-
Stage 1	691	700	-	396	406	-	-	-	-	-	-	-
Stage 2	395	406	-	679	692	-	-	-	-	-	-	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	14.4			20.3			1			0		
HCM LOS	B			C								

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1303	-	-	460	236	1026	-	-
HCM Lane V/C Ratio	0.058	-	-	0.165	0.005	-	-	-
HCM Control Delay (s)	7.9	0	-	14.4	20.3	0	-	-
HCM Lane LOS	A	A	-	B	C	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	0.6	0	0	-	-

HCM 2010 TWSC
 17: Silverbell Rd & Old Sunset Rd

2/18/2014

Intersection

Int Delay, s/veh 2.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	20	0	90	0	1	0	40	110	0	0	420	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	22	0	98	0	1	0	43	120	0	0	457	22

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	674	674	467	723	685	120	478	0	0	120	0	0
Stage 1	467	467	-	207	207	-	-	-	-	-	-	-
Stage 2	207	207	-	516	478	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	368	376	596	342	371	931	1084	-	-	1468	-	-
Stage 1	576	562	-	795	731	-	-	-	-	-	-	-
Stage 2	795	731	-	542	556	-	-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	355	360	596	277	355	931	1084	-	-	1468	-	-
Mov Cap-2 Maneuver	355	360	-	277	355	-	-	-	-	-	-	-
Stage 1	552	562	-	762	700	-	-	-	-	-	-	-
Stage 2	760	700	-	453	556	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.7	15.2	2.3	0
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1084	-	-	531	355	1468	-	-
HCM Lane V/C Ratio	0.04	-	-	0.225	0.003	-	-	-
HCM Control Delay (s)	8.5	0	-	13.7	15.2	0	-	-
HCM Lane LOS	A	A	-	B	C	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.9	0	0	-	-

HCM 2010 TWSC
 17: Silverbell Rd & Old Sunset Rd

2/18/2014

Intersection

Int Delay, s/veh 2.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	20	0	50	0	1	0	80	420	0	0	180	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	22	0	54	0	1	0	87	457	0	0	196	22

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	838	837	207	864	847	457	217	0	0	457	0	0
Stage 1	207	207	-	630	630	-	-	-	-	-	-	-
Stage 2	631	630	-	234	217	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	286	303	833	274	299	604	1353	-	-	1104	-	-
Stage 1	795	731	-	470	475	-	-	-	-	-	-	-
Stage 2	469	475	-	769	723	-	-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	266	277	833	239	273	604	1353	-	-	1104	-	-
Mov Cap-2 Maneuver	266	277	-	239	273	-	-	-	-	-	-	-
Stage 1	727	731	-	430	434	-	-	-	-	-	-	-
Stage 2	428	434	-	719	723	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.1	18.2	1.3	0
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1353	-	-	518	273	1104	-	-
HCM Lane V/C Ratio	0.064	-	-	0.147	0.004	-	-	-
HCM Control Delay (s)	7.8	0	-	13.1	18.2	0	-	-
HCM Lane LOS	A	A	-	B	C	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	0.5	0	0	-	-

APPENDIX D

Sunset Road/Silverbell Road Future LOS

APPENDIX D-1

Sunset Road/Silverbell Road Future LOS

TWSC Analysis

Intersection

Int Delay, s/veh 52.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	240	40	90	200	330	200
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	150	0	-	150	150	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	261	43	98	217	359	217

Major/Minor	Minor1	Minor2	Major1	Major2	Major3	Major4
Conflicting Flow All	1033	98	0	0	98	0
Stage 1	98	-	-	-	-	-
Stage 2	935	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	~ 258	958	-	-	1495	-
Stage 1	926	-	-	-	-	-
Stage 2	382	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	~ 196	958	-	-	1495	-
Mov Cap-2 Maneuver	~ 196	-	-	-	-	-
Stage 1	926	-	-	-	-	-
Stage 2	290	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	195.4	0	5.1
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	196	958	1495	-
HCM Lane V/C Ratio	-	-	1.331	0.045	0.24	-
HCM Control Delay (s)	-	-	226.5	8.9	8.2	-
HCM Lane LOS	-	-	F	A	A	-
HCM 95th %tile Q(veh)	-	-	14.7	0.1	0.9	-

Notes

-: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection

Int Delay, s/veh 7.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	170	310	260	290	110	160
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	150	0	-	150	150	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	185	337	283	315	120	174

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	696	283	0
Stage 1	283	-	-
Stage 2	413	-	-
Critical Hdwy	6.42	6.22	4.12
Critical Hdwy Stg 1	5.42	-	-
Critical Hdwy Stg 2	5.42	-	-
Follow-up Hdwy	3.518	3.318	2.218
Pot Cap-1 Maneuver	408	756	1279
Stage 1	765	-	-
Stage 2	668	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	370	756	1279
Mov Cap-2 Maneuver	370	-	-
Stage 1	765	-	-
Stage 2	605	-	-

Approach	WB	NB	SB
HCM Control Delay, s	17.3	0	3.3
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	370	756	1279	-
HCM Lane V/C Ratio	-	-	0.499	0.446	0.093	-
HCM Control Delay (s)	-	-	24.1	13.5	8.1	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	2.7	2.3	0.3	-

Intersection

Int Delay, s/veh 114.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	410	60	90	240	220	290
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	150	0	-	150	150	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	446	65	98	261	239	315

Major/Minor	Minor1	Minor2	Major1	Major2	Major3	Major4
Conflicting Flow All	891	98	0	0	98	0
Stage 1	98	-	-	-	-	-
Stage 2	793	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	~ 313	958	-	-	1495	-
Stage 1	926	-	-	-	-	-
Stage 2	446	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	~ 263	958	-	-	1495	-
Mov Cap-2 Maneuver	~ 263	-	-	-	-	-
Stage 1	926	-	-	-	-	-
Stage 2	~ 375	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	\$ 316.6	0	3.4
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	263	958	1495	-
HCM Lane V/C Ratio	-	-	1.694	0.068	0.16	-
HCM Control Delay (s)	-	-	\$ 361.6	9	7.9	-
HCM Lane LOS	-	-	F	A	A	-
HCM 95th %tile Q(veh)	-	-	28.7	0.2	0.6	-

Notes

-: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection

Int Delay, s/veh 32.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	380	160	340	430	90	140
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	150	0	-	150	150	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	413	174	370	467	98	152

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	718	370	0
Stage 1	370	-	-
Stage 2	348	-	-
Critical Hdwy	6.42	6.22	-
Critical Hdwy Stg 1	5.42	-	-
Critical Hdwy Stg 2	5.42	-	-
Follow-up Hdwy	3.518	3.318	-
Pot Cap-1 Maneuver	~ 396	676	-
Stage 1	699	-	-
Stage 2	715	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	~ 363	676	-
Mov Cap-2 Maneuver	~ 363	-	-
Stage 1	699	-	-
Stage 2	656	-	-

Approach	WB	NB	SB
HCM Control Delay, s	90.7	0	3.2
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	363	676	1189	-
HCM Lane V/C Ratio	-	-	1.138	0.257	0.082	-
HCM Control Delay (s)	-	-	123.7	12.2	8.3	-
HCM Lane LOS	-	-	F	B	A	-
HCM 95th %tile Q(veh)	-	-	16	1	0.3	-

Notes

-: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

APPENDIX D-2

Sunset Road/Silverbell Road Future LOS

Signalized Analysis

HCM 2010 Signalized Intersection Summary

1: Silverbell Rd & New Sunset Rd

2/19/2014

								
Movement	WBL	WBR	NBT	NBR	SBL	SBT		
Lane Configurations								
Volume (veh/h)	240	40	90	200	330	200		
Number	3	18	2	12	1	6		
Initial Q (Qb), veh	0	0	0	0	0	0		
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00		
Adj Sat Flow, veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3		
Adj Flow Rate, veh/h	261	43	98	217	359	217		
Adj No. of Lanes	1	1	1	1	1	1		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92		
Percent Heavy Veh, %	2	2	2	2	2	2		
Cap, veh/h	482	430	503	428	564	969		
Arrive On Green	0.27	0.27	0.27	0.27	0.13	0.52		
Sat Flow, veh/h	1774	1583	1863	1583	1774	1863		
Grp Volume(v), veh/h	261	43	98	217	359	217		
Grp Sat Flow(s),veh/h/ln	1774	1583	1863	1583	1774	1863		
Q Serve(g_s), s	7.5	1.2	2.4	7.0	0.0	3.8		
Cycle Q Clear(g_c), s	7.5	1.2	2.4	7.0	0.0	3.8		
Prop In Lane	1.00	1.00		1.00	1.00			
Lane Grp Cap(c), veh/h	482	430	503	428	564	969		
V/C Ratio(X)	0.54	0.10	0.19	0.51	0.64	0.22		
Avail Cap(c_a), veh/h	482	430	503	428	564	969		
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00		
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00		
Uniform Delay (d), s/veh	18.7	16.4	16.9	18.5	19.1	7.8		
Incr Delay (d2), s/veh	4.3	0.5	0.9	4.3	5.4	0.5		
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0		
%ile BackOfQ(50%),veh/ln	4.3	0.6	1.4	3.5	6.0	2.1		
LnGrp Delay(d),s/veh	23.0	16.8	17.7	22.8	24.5	8.4		
LnGrp LOS	C	B	B	C	C	A		
Approach Vol, veh/h	304		315			576		
Approach Delay, s/veh	22.1		21.2			18.4		
Approach LOS	C		C			B		
Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	15.0	23.2				38.2		21.8
Change Period (Y+Rc), s	7.0	* 7				7.0		5.5
Max Green Setting (Gmax), s	8.06	20.0001				31.2		16.3
Max Q Clear Time (g_c+I1), s	2.0	9.0				5.8		9.5
Green Ext Time (p_c), s	1.3	0.7				2.4		0.5
Intersection Summary								
HCM 2010 Ctrl Delay			20.1					
HCM 2010 LOS			C					
Notes								
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.								

HCM 2010 Signalized Intersection Summary
 1: Silverbell Rd & New Sunset Rd

2/19/2014

Movement	WBL	WBR	NBT	NBR	SBL	SBT				
Lane Configurations										
Volume (veh/h)	170	310	260	290	110	160				
Number	3	18	2	12	1	6				
Initial Q (Qb), veh	0	0	0	0	0	0				
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00					
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00				
Adj Sat Flow, veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3				
Adj Flow Rate, veh/h	185	337	283	315	120	174				
Adj No. of Lanes	1	1	1	1	1	1				
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92				
Percent Heavy Veh, %	2	2	2	2	2	2				
Cap, veh/h	488	435	621	528	386	962				
Arrive On Green	0.28	0.28	0.33	0.33	0.07	0.52				
Sat Flow, veh/h	1774	1583	1863	1583	1774	1863				
Grp Volume(v), veh/h	185	337	283	315	120	174				
Grp Sat Flow(s),veh/h/ln	1774	1583	1863	1583	1774	1863				
Q Serve(g_s), s	5.1	11.8	7.2	9.9	0.0	3.0				
Cycle Q Clear(g_c), s	5.1	11.8	7.2	9.9	0.0	3.0				
Prop In Lane	1.00	1.00		1.00	1.00					
Lane Grp Cap(c), veh/h	488	435	621	528	386	962				
V/C Ratio(X)	0.38	0.77	0.46	0.60	0.31	0.18				
Avail Cap(c_a), veh/h	488	435	621	528	386	962				
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00				
Upstream Filter(l)	1.00	1.00	1.00	1.00	1.00	1.00				
Uniform Delay (d), s/veh	17.6	20.0	15.7	16.6	19.9	7.7				
Incr Delay (d2), s/veh	2.2	12.6	2.4	4.9	2.1	0.4				
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				
%ile BackOfQ(50%),veh/ln	2.8	6.6	4.0	5.0	2.0	1.6				
LnGrp Delay(d),s/veh	19.8	32.6	18.1	21.6	22.0	8.1				
LnGrp LOS	B	C	B	C	C	A				
Approach Vol, veh/h	522		598			294				
Approach Delay, s/veh	28.1		19.9			13.8				
Approach LOS	C		B			B				
Timer	1	2	3	4	5	6	7	8		
Assigned Phs	1	2				6		8		
Phs Duration (G+Y+Rc), s	11.0	27.0				38.0		22.0		
Change Period (Y+Rc), s	7.0	* 7				7.0		5.5		
Max Green Setting (Gmax), s	4.0	* 20				31.0		16.5		
Max Q Clear Time (g_c+l1), s	2.0	11.9				5.0		13.8		
Green Ext Time (p_c), s	0.3	1.8				1.3		0.6		
Intersection Summary										
HCM 2010 Ctrl Delay			21.7							
HCM 2010 LOS			C							
Notes										
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.										

HCM 2010 Signalized Intersection Summary

1: Silverbell Rd & New Sunset Rd

2/19/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT		
Lane Configurations								
Volume (veh/h)	410	60	90	240	220	290		
Number	3	18	2	12	1	6		
Initial Q (Qb), veh	0	0	0	0	0	0		
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00		
Adj Sat Flow, veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3		
Adj Flow Rate, veh/h	446	65	98	261	239	315		
Adj No. of Lanes	1	1	1	1	1	1		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92		
Percent Heavy Veh, %	2	2	2	2	2	2		
Cap, veh/h	636	567	497	422	405	807		
Arrive On Green	0.36	0.36	0.27	0.27	0.05	0.43		
Sat Flow, veh/h	1774	1583	1863	1583	1774	1863		
Grp Volume(v), veh/h	446	65	98	261	239	315		
Grp Sat Flow(s),veh/h/ln	1774	1583	1863	1583	1774	1863		
Q Serve(g_s), s	12.9	1.6	2.4	8.7	0.0	6.9		
Cycle Q Clear(g_c), s	12.9	1.6	2.4	8.7	0.0	6.9		
Prop In Lane	1.00	1.00		1.00	1.00			
Lane Grp Cap(c), veh/h	636	567	497	422	405	807		
V/C Ratio(X)	0.70	0.11	0.20	0.62	0.59	0.39		
Avail Cap(c_a), veh/h	636	567	497	422	405	807		
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00		
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00		
Uniform Delay (d), s/veh	16.5	12.9	17.0	19.3	22.3	11.6		
Incr Delay (d2), s/veh	6.4	0.4	0.9	6.6	6.2	1.4		
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0		
%ile BackOfQ(50%),veh/ln	7.4	0.8	1.4	4.5	4.5	3.8		
LnGrp Delay(d),s/veh	22.9	13.3	17.9	26.0	28.5	13.0		
LnGrp LOS	C	B	B	C	C	B		
Approach Vol, veh/h	511		359			554		
Approach Delay, s/veh	21.6		23.8			19.7		
Approach LOS	C		C			B		
Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	10.0	23.0				33.0		27.0
Change Period (Y+Rc), s	7.0	* 7				7.0		5.5
Max Green Setting (Gmax), s		* 16				26.0		21.5
Max Q Clear Time (g_c+I), s		10.7				8.9		14.9
Green Ext Time (p_c), s	0.3	0.7				2.4		1.0
Intersection Summary								
HCM 2010 Ctrl Delay			21.4					
HCM 2010 LOS			C					
Notes								
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.								

HCM 2010 Signalized Intersection Summary
 1: Silverbell Rd & New Sunset Rd

2/19/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	380	160	340	430	90	140
Number	3	18	2	12	1	6
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3
Adj Flow Rate, veh/h	413	174	370	467	98	152
Adj No. of Lanes	1	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	577	515	559	475	270	869
Arrive On Green	0.32	0.32	0.30	0.30	0.05	0.47
Sat Flow, veh/h	1774	1583	1863	1583	1774	1863
Grp Volume(v), veh/h	413	174	370	467	98	152
Grp Sat Flow(s),veh/h/ln	1774	1583	1863	1583	1774	1863
Q Serve(g_s), s	12.3	5.0	10.4	17.6	0.0	2.8
Cycle Q Clear(g_c), s	12.3	5.0	10.4	17.6	0.0	2.8
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	577	515	559	475	270	869
V/C Ratio(X)	0.72	0.34	0.66	0.98	0.36	0.17
Avail Cap(c_a), veh/h	577	515	559	475	270	869
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(l)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	17.8	15.4	18.3	20.8	25.3	9.3
Incr Delay (d2), s/veh	7.4	1.8	6.1	37.3	3.8	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.2	2.4	6.3	12.6	1.8	1.5
LnGrp Delay(d),s/veh	25.3	17.1	24.4	58.2	29.1	9.7
LnGrp LOS	C	B	C	E	C	A
Approach Vol, veh/h	587		837			250
Approach Delay, s/veh	22.9		43.3			17.3
Approach LOS	C		D			B

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	10.0	25.0				35.0		25.0
Change Period (Y+Rc), s	7.0	* 7				7.0		5.5
Max Green Setting (Gmax), s		* 18				28.0		19.5
Max Q Clear Time (g_c+I), s		19.6				4.8		14.3
Green Ext Time (p_c), s	0.1	0.0				1.1		1.0

Intersection Summary	
HCM 2010 Ctrl Delay	32.2
HCM 2010 LOS	C

Notes
 * HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.

APPENDIX E

I-10/Sunset Road Traffic Interchange Future LOS

APPENDIX E-1

I-10/Sunset Road Traffic Interchange Future LOS

TWSC Analysis – Stop Control on Sunset Road

HCM 2010 TWSC
8: EB Frontage Rd & Sunset Rd

2/13/2014

Intersection

Int Delay, s/veh 14.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	220	310	50	30	0	0	1	0	0	90	250
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	360	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	239	337	54	33	0	0	1	0	0	98	272

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	251	235	185	169	371	1	370	0	0	1	0	0
Stage 1	234	234	-	1	1	-	-	-	-	-	-	-
Stage 2	17	1	-	168	370	-	-	-	-	-	-	-
Critical Hdwy	7.33	6.53	6.93	7.33	6.53	6.23	4.14	-	-	4.12	-	-
Critical Hdwy Stg 1	6.53	5.53	-	6.13	5.53	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.13	5.53	-	6.53	5.53	-	-	-	-	-	-	-
Follow-up Hdwy	3.519	4.019	3.319	3.519	4.019	3.319	2.22	-	-	2.218	-	-
Pot Cap-1 Maneuver	692	665	826	787	558	1083	1185	-	-	1622	-	-
Stage 1	749	711	-	1022	895	-	-	-	-	-	-	-
Stage 2	1002	895	-	818	619	-	-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	661	665	826	336	558	1083	1185	-	-	1622	-	-
Mov Cap-2 Maneuver	661	665	-	336	558	-	-	-	-	-	-	-
Stage 1	749	711	-	1022	895	-	-	-	-	-	-	-
Stage 2	965	895	-	321	619	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	23.7	16.7	0	0
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1185	-	-	751	395	1622	-
HCM Lane V/C Ratio	-	-	-	0.767	0.22	-	-
HCM Control Delay (s)	0	-	-	23.7	16.7	0	-
HCM Lane LOS	A	-	-	C	C	A	-
HCM 95th %tile Q(veh)	0	-	-	7.4	0.8	0	-

Intersection

Int Delay, s/veh 10.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	220	0	80	10	1	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	239	0	87	11	1	0

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	180	1	0
Stage 1	1	-	-
Stage 2	179	-	-
Critical Hdwy	6.63	6.23	4.12
Critical Hdwy Stg 1	5.43	-	-
Critical Hdwy Stg 2	5.83	-	-
Follow-up Hdwy	3.519	3.319	2.218
Pot Cap-1 Maneuver	801	1083	1622
Stage 1	1022	-	-
Stage 2	835	-	-
Platoon blocked, %			
Mov Cap-1 Maneuver	758	1083	1622
Mov Cap-2 Maneuver	758	-	-
Stage 1	1022	-	-
Stage 2	790	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.9	6.5	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1622	-	758	-	-
HCM Lane V/C Ratio	0.054	-	0.315	-	-
HCM Control Delay (s)	7.3	0	11.9	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.2	-	1.4	-	-

HCM 2010 TWSC
 8: EB Frontage Rd & Sunset Rd

2/13/2014

Intersection

Int Delay, s/veh 12.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	310	90	40	280	0	0	1	0	0	20	200
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	360	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	337	98	43	304	0	0	1	0	0	22	217

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	283	131	120	180	240	1	239	0	0	1	0	0
Stage 1	130	130	-	1	1	-	-	-	-	-	-	-
Stage 2	153	1	-	179	239	-	-	-	-	-	-	-
Critical Hdwy	7.33	6.53	6.93	7.33	6.53	6.23	4.14	-	-	4.12	-	-
Critical Hdwy Stg 1	6.53	5.53	-	6.13	5.53	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.13	5.53	-	6.53	5.53	-	-	-	-	-	-	-
Follow-up Hdwy	3.519	4.019	3.319	3.519	4.019	3.319	2.22	-	-	2.218	-	-
Pot Cap-1 Maneuver	658	759	909	773	661	1083	1325	-	-	1622	-	-
Stage 1	861	788	-	1022	895	-	-	-	-	-	-	-
Stage 2	849	895	-	806	707	-	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	420	759	909	450	661	1083	1325	-	-	1622	-	-
Mov Cap-2 Maneuver	420	759	-	450	661	-	-	-	-	-	-	-
Stage 1	861	788	-	1022	895	-	-	-	-	-	-	-
Stage 2	560	895	-	412	707	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	15	17.8	0	0
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1325	-	-	788	624	1622	-	-
HCM Lane V/C Ratio	-	-	-	0.552	0.557	-	-	-
HCM Control Delay (s)	0	-	-	15	17.8	0	-	-
HCM Lane LOS	A	-	-	C	C	A	-	-
HCM 95th %tile Q(veh)	0	-	-	3.4	3.4	0	-	-

Intersection

Int Delay, s/veh 75.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	310	0	320	150	1	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	337	0	348	163	1	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	778	1	1	0	-	0
Stage 1	1	-	-	-	-	-
Stage 2	777	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.12	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.218	-	-	-
Pot Cap-1 Maneuver	349	1083	1622	-	-	-
Stage 1	1022	-	-	-	-	-
Stage 2	415	-	-	-	-	-
Platoon blocked, %						
Mov Cap-1 Maneuver	~ 267	1083	1622	-	-	-
Mov Cap-2 Maneuver	~ 267	-	-	-	-	-
Stage 1	1022	-	-	-	-	-
Stage 2	~ 317	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	182.9	5.4	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1622	-	267	-	-
HCM Lane V/C Ratio	0.214	-	1.262	-	-
HCM Control Delay (s)	7.8	0.2	182.9	-	-
HCM Lane LOS	A	A	F	-	-
HCM 95th %tile Q(veh)	0.8	-	16.4	-	-

Notes

-: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 2010 TWSC
8: EB Frontage Rd & Sunset Rd

2/13/2014

Intersection

Int Delay, s/veh 13.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	270	190	50	40	0	0	1	0	0	90	430
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	360	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	293	207	54	43	0	0	1	0	0	98	467

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	355	333	283	197	566	1	565	0	0	1	0	0
Stage 1	332	332	-	1	1	-	-	-	-	-	-	-
Stage 2	23	1	-	196	565	-	-	-	-	-	-	-
Critical Hdwy	7.33	6.53	6.93	7.33	6.53	6.23	4.14	-	-	4.12	-	-
Critical Hdwy Stg 1	6.53	5.53	-	6.13	5.53	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.13	5.53	-	6.53	5.53	-	-	-	-	-	-	-
Follow-up Hdwy	3.519	4.019	3.319	3.519	4.019	3.319	2.22	-	-	2.218	-	-
Pot Cap-1 Maneuver	588	586	715	753	433	1083	1003	-	-	1622	-	-
Stage 1	656	644	-	1022	895	-	-	-	-	-	-	-
Stage 2	995	895	-	788	507	-	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	543	586	715	324	433	1083	1003	-	-	1622	-	-
Mov Cap-2 Maneuver	543	586	-	324	433	-	-	-	-	-	-	-
Stage 1	656	644	-	1022	895	-	-	-	-	-	-	-
Stage 2	947	895	-	305	507	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	28.7	18.4	0	0
HCM LOS	D	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1003	-	-	633	365	1622	-	-
HCM Lane V/C Ratio	-	-	-	0.79	0.268	-	-	-
HCM Control Delay (s)	0	-	-	28.7	18.4	0	-	-
HCM Lane LOS	A	-	-	D	C	A	-	-
HCM 95th %tile Q(veh)	0	-	-	7.7	1.1	0	-	-

Intersection

Int Delay, s/veh 11.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	270	0	90	10	1	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	293	0	98	11	1	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	202	1	1	0	-	0
Stage 1	1	-	-	-	-	-
Stage 2	201	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.12	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.218	-	-	-
Pot Cap-1 Maneuver	777	1083	1622	-	-	-
Stage 1	1022	-	-	-	-	-
Stage 2	814	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	730	1083	1622	-	-	-
Mov Cap-2 Maneuver	730	-	-	-	-	-
Stage 1	1022	-	-	-	-	-
Stage 2	764	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.2	6.6	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1622	-	730	-	-
HCM Lane V/C Ratio	0.06	-	0.402	-	-
HCM Control Delay (s)	7.4	0	13.2	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.2	-	1.9	-	-

HCM 2010 TWSC
8: EB Frontage Rd & Sunset Rd

2/13/2014

Intersection

Int Delay, s/veh 19

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	450	70	60	150	0	0	1	0	0	20	390
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	360	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	489	76	65	163	0	0	1	0	0	22	424

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	317	235	223	256	447	1	446	0	0	1	0	0
Stage 1	234	234	-	1	1	-	-	-	-	-	-	-
Stage 2	83	1	-	255	446	-	-	-	-	-	-	-
Critical Hdwy	7.33	6.53	6.93	7.33	6.53	6.23	4.14	-	-	4.12	-	-
Critical Hdwy Stg 1	6.53	5.53	-	6.13	5.53	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.13	5.53	-	6.53	5.53	-	-	-	-	-	-	-
Follow-up Hdwy	3.519	4.019	3.319	3.519	4.019	3.319	2.22	-	-	2.218	-	-
Pot Cap-1 Maneuver	624	665	781	687	506	1083	1111	-	-	1622	-	-
Stage 1	749	711	-	1022	895	-	-	-	-	-	-	-
Stage 2	925	895	-	728	573	-	-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	468	665	781	248	506	1083	1111	-	-	1622	-	-
Mov Cap-2 Maneuver	468	665	-	248	506	-	-	-	-	-	-	-
Stage 1	749	711	-	1022	895	-	-	-	-	-	-	-
Stage 2	756	895	-	205	573	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	31	26.5	0	0
HCM LOS	D	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1111	-	-	679	390	1622	-	-
HCM Lane V/C Ratio	-	-	-	0.832	0.585	-	-	-
HCM Control Delay (s)	0	-	-	31	26.5	0	-	-
HCM Lane LOS	A	-	-	D	D	A	-	-
HCM 95th %tile Q(veh)	0	-	-	9.1	3.6	0	-	-

Intersection

Int Delay, s/veh 61.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	450	0	210	30	1	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	489	0	228	33	1	0

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	474	1	0
Stage 1	1	-	-
Stage 2	473	-	-
Critical Hdwy	6.63	6.23	4.12
Critical Hdwy Stg 1	5.43	-	-
Critical Hdwy Stg 2	5.83	-	-
Follow-up Hdwy	3.519	3.319	2.218
Pot Cap-1 Maneuver	534	1083	1622
Stage 1	1022	-	-
Stage 2	594	-	-
Platoon blocked, %			
Mov Cap-1 Maneuver	~ 458	1083	1622
Mov Cap-2 Maneuver	~ 458	-	-
Stage 1	1022	-	-
Stage 2	509	-	-

Approach	EB	NB	SB
HCM Control Delay, s	91.5	6.6	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1622	-	458	-	-
HCM Lane V/C Ratio	0.141	-	1.068	-	-
HCM Control Delay (s)	7.6	0	91.5	-	-
HCM Lane LOS	A	A	F	-	-
HCM 95th %tile Q(veh)	0.5	-	15.6	-	-

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

APPENDIX E-2

I-10/Sunset Road Traffic Interchange Future LOS

TWSC Analysis – Stop Control on I-10 Frontage Roads

HCM 2010 TWSC
8: EB Frontage Rd & Sunset Rd

2/13/2014

Intersection													
Int Delay, s/veh	5.2												

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	220	310	50	30	0	0	1	0	0	90	250
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	360	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	239	337	54	33	0	0	1	0	0	98	272

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	33	0	0	576	0	0	734	549	408	549	717	33
Stage 1	-	-	-	-	-	-	408	408	-	141	141	-
Stage 2	-	-	-	-	-	-	326	141	-	408	576	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1579	-	-	997	-	-	336	443	643	446	355	1041
Stage 1	-	-	-	-	-	-	620	597	-	862	780	-
Stage 2	-	-	-	-	-	-	687	780	-	620	502	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1579	-	-	997	-	-	185	419	643	426	335	1041
Mov Cap-2 Maneuver	-	-	-	-	-	-	185	419	-	426	335	-
Stage 1	-	-	-	-	-	-	620	597	-	862	737	-
Stage 2	-	-	-	-	-	-	416	737	-	619	502	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	5.5	13.6	13.3
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2	SBLn3
Capacity (veh/h)	419	1579	-	-	997	-	-	-	335	788
HCM Lane V/C Ratio	0.003	-	-	-	0.055	-	-	-	0.146	0.407
HCM Control Delay (s)	13.6	0	-	-	8.8	0	-	0	17.6	12.7
HCM Lane LOS	B	A	-	-	A	A	-	A	C	B
HCM 95th %tile Q(veh)	0	0	-	-	0.2	-	-	-	0.5	2

HCM 2010 TWSC
3: WB Frontage Rd & Sunset Rd

2/13/2014

Intersection

Int Delay, s/veh 5.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	220	0	0	0	1	0	80	10	0	0	1	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	239	0	0	0	1	0	87	11	0	0	1	0

Major/Minor

	Major1		Major2		Minor1		Minor2					
Conflicting Flow All	1	0	0	0	0	0	2	479	0	6	479	1
Stage 1	-	-	-	-	-	-	0	478	-	1	1	-
Stage 2	-	-	-	-	-	-	2	1	-	5	478	-
Critical Hdwy	4.12	-	-	-	-	-	7.12	6.52	-	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	-	-	-
Follow-up Hdwy	2.218	-	-	-	-	-	3.518	4.018	-	3.518	4.018	3.318
Pot Cap-1 Maneuver	1622	-	-	-	-	-	1020	486	-	1014	486	1084
Stage 1	-	-	-	-	-	-	-	-	-	1022	895	-
Stage 2	-	-	-	-	-	-	1021	895	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1622	-	-	-	-	-	903	414	-	-	414	1084
Mov Cap-2 Maneuver	-	-	-	-	-	-	903	414	-	-	414	-
Stage 1	-	-	-	-	-	-	-	-	-	871	895	-
Stage 2	-	-	-	-	-	-	1020	895	-	-	-	-

Approach

	EB	WB	NB	SB
HCM Control Delay, s	7.6	0		
HCM LOS			-	-

Minor Lane/Major Mvmt

	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	844	-	1622	-	-	-	-	-	-
HCM Lane V/C Ratio	0.109	-	0.147	-	-	-	-	-	-
HCM Control Delay (s)	9.8	-	7.6	-	-	0	-	-	-
HCM Lane LOS	A	-	A	-	-	A	-	-	-
HCM 95th %tile Q(veh)	0.4	-	0.5	-	-	-	-	-	-

HCM 2010 TWSC
8: EB Frontage Rd & Sunset Rd

2/13/2014

Intersection

Int Delay, s/veh 3.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	310	90	40	280	0	0	1	0	0	20	200
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	360	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	337	98	43	304	0	0	1	0	0	22	217

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	304	0	0	435	0	0	897	777	386	777	826	304
Stage 1	-	-	-	-	-	-	386	386	-	391	391	-
Stage 2	-	-	-	-	-	-	511	391	-	386	435	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1257	-	-	1125	-	-	261	328	662	314	307	736
Stage 1	-	-	-	-	-	-	637	610	-	633	607	-
Stage 2	-	-	-	-	-	-	545	607	-	637	580	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1257	-	-	1125	-	-	167	313	662	302	293	736
Mov Cap-2 Maneuver	-	-	-	-	-	-	167	313	-	302	293	-
Stage 1	-	-	-	-	-	-	637	610	-	633	579	-
Stage 2	-	-	-	-	-	-	353	579	-	636	580	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	1	16.5	13
HCM LOS			C	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2	SBLn3
Capacity (veh/h)	313	1257	-	-	1125	-	-	-	293	687
HCM Lane V/C Ratio	0.003	-	-	-	0.039	-	-	-	0.037	0.332
HCM Control Delay (s)	16.5	0	-	-	8.3	0	-	0	17.8	12.8
HCM Lane LOS	C	A	-	-	A	A	-	A	C	B
HCM 95th %tile Q(veh)	0	0	-	-	0.1	-	-	-	0.1	1.5

HCM 2010 TWSC
 3: WB Frontage Rd & Sunset Rd

2/13/2014

Intersection

Int Delay, s/veh 3.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	310	0	0	0	1	0	320	150	0	0	1	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	337	0	0	0	1	0	348	163	0	0	1	0

Major/Minor	Major1	Major2	Minor1	Minor2					
Conflicting Flow All	1	0	0	2	675	0	83	675	1
Stage 1	-	-	-	0	674	-	1	1	-
Stage 2	-	-	-	2	1	-	82	674	-
Critical Hdwy	4.12	-	-	7.12	6.52	-	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	6.12	5.52	-	-	-	-
Follow-up Hdwy	2.218	-	-	3.518	4.018	-	3.518	4.018	3.318
Pot Cap-1 Maneuver	1622	-	-	1020	376	-	904	376	1084
Stage 1	-	-	-	-	-	-	1022	895	-
Stage 2	-	-	-	1021	895	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1622	-	-	855	298	-	-	298	1084
Mov Cap-2 Maneuver	-	-	-	855	298	-	-	298	-
Stage 1	-	-	-	-	-	-	810	895	-
Stage 2	-	-	-	1020	895	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	7.8	0	-	-
HCM LOS	-	-	-	-

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	631	-	1622	-	-	-	-	-	-
HCM Lane V/C Ratio	0.68	-	0.208	-	-	-	-	-	-
HCM Control Delay (s)	22	-	7.8	-	-	0	-	-	-
HCM Lane LOS	C	-	A	-	-	A	-	-	-
HCM 95th %tile Q(veh)	5.3	-	0.8	-	-	-	-	-	-

HCM 2010 TWSC
8: EB Frontage Rd & Sunset Rd

2/13/2014

Intersection

Int Delay, s/veh 7.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	270	190	50	40	0	0	1	0	0	90	430
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	360	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	293	207	54	43	0	0	1	0	0	98	467

Major/Minor	Major1	Major2	Minor1	Minor2								
Conflicting Flow All	43	0	0	500	0	0	832	549	397	549	652	43
Stage 1	-	-	-	-	-	-	397	397	-	152	152	-
Stage 2	-	-	-	-	-	-	435	152	-	397	500	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1566	-	-	1064	-	-	288	443	652	446	387	1027
Stage 1	-	-	-	-	-	-	629	603	-	850	772	-
Stage 2	-	-	-	-	-	-	600	772	-	629	543	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1566	-	-	1064	-	-	120	420	652	427	367	1027
Mov Cap-2 Maneuver	-	-	-	-	-	-	120	420	-	427	367	-
Stage 1	-	-	-	-	-	-	629	603	-	850	732	-
Stage 2	-	-	-	-	-	-	269	732	-	628	543	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	4.8	13.6	14.9
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2	SBLn3
Capacity (veh/h)	420	1566	-	-	1064	-	-	-	367	877
HCM Lane V/C Ratio	0.003	-	-	-	0.051	-	-	-	0.133	0.589
HCM Control Delay (s)	13.6	0	-	-	8.6	0	-	0	16.3	14.8
HCM Lane LOS	B	A	-	-	A	A	-	A	C	B
HCM 95th %tile Q(veh)	0	0	-	-	0.2	-	-	-	0.5	3.9

HCM 2010 TWSC
 3: WB Frontage Rd & Sunset Rd

2/13/2014

Intersection

Int Delay, s/veh 5.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	270	0	0	0	1	0	90	10	0	0	1	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	293	0	0	0	1	0	98	11	0	0	1	0

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	1	0	0	2 588 0
Stage 1	-	-	-	0 587 -
Stage 2	-	-	-	2 1 -
Critical Hdwy	4.12	-	-	7.12 6.52 -
Critical Hdwy Stg 1	-	-	-	- - -
Critical Hdwy Stg 2	-	-	-	6.12 5.52 -
Follow-up Hdwy	2.218	-	-	3.518 4.018 -
Pot Cap-1 Maneuver	1622	-	-	1020 421 -
Stage 1	-	-	-	- - -
Stage 2	-	-	-	1021 895 -
Platoon blocked, %	-	-	-	- - -
Mov Cap-1 Maneuver	1622	-	-	876 345 -
Mov Cap-2 Maneuver	-	-	-	876 345 -
Stage 1	-	-	-	- - -
Stage 2	-	-	-	1020 895 -

Approach	EB	WB	NB	SB
HCM Control Delay, s	7.7	0	-	-
HCM LOS	-	-	-	-

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	810	-	1622	-	-	-	-	-	-
HCM Lane V/C Ratio	0.127	-	0.181	-	-	-	-	-	-
HCM Control Delay (s)	10.1	-	7.7	-	-	0	-	-	-
HCM Lane LOS	B	-	A	-	-	A	-	-	-
HCM 95th %tile Q(veh)	0.4	-	0.7	-	-	-	-	-	-

HCM 2010 TWSC
 8: EB Frontage Rd & Sunset Rd

2/13/2014

Intersection

Int Delay, s/veh 5.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	450	70	60	150	0	0	1	0	0	20	390
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	360	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	489	76	65	163	0	0	1	0	0	22	424

Major/Minor	Major1	Major2	Minor1	Minor2								
Conflicting Flow All	163	0	0	565	0	0	1043	820	527	821	858	163
Stage 1	-	-	-	-	-	-	527	527	-	293	293	-
Stage 2	-	-	-	-	-	-	516	293	-	528	565	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1416	-	-	1007	-	-	207	310	551	293	294	882
Stage 1	-	-	-	-	-	-	535	528	-	715	670	-
Stage 2	-	-	-	-	-	-	542	670	-	534	508	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1416	-	-	1007	-	-	96	288	551	276	273	882
Mov Cap-2 Maneuver	-	-	-	-	-	-	96	288	-	276	273	-
Stage 1	-	-	-	-	-	-	535	528	-	715	622	-
Stage 2	-	-	-	-	-	-	252	622	-	533	508	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	2.5	17.5	14
HCM LOS			C	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2	SBLn3
Capacity (veh/h)	288	1416	-	-	1007	-	-	-	273	835
HCM Lane V/C Ratio	0.004	-	-	-	0.065	-	-	-	0.04	0.521
HCM Control Delay (s)	17.5	0	-	-	8.8	0	-	0	18.7	13.9
HCM Lane LOS	C	A	-	-	A	A	-	A	C	B
HCM 95th %tile Q(veh)	0	0	-	-	0.2	-	-	-	0.1	3.1

HCM 2010 TWSC
3: WB Frontage Rd & Sunset Rd

2/13/2014

Intersection

Int Delay, s/veh 5.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	450	0	0	0	1	0	210	30	0	0	1	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	489	0	0	0	1	0	228	33	0	0	1	0

Major/Minor	Major1	Major2	Minor1	Minor2
-------------	--------	--------	--------	--------

Conflicting Flow All	1	0	0	0	0	0	2	979	0	17	979	1
Stage 1	-	-	-	-	-	-	0	978	-	1	1	-
Stage 2	-	-	-	-	-	-	2	1	-	16	978	-
Critical Hdwy	4.12	-	-	-	-	-	7.12	6.52	-	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	-	-	-
Follow-up Hdwy	2.218	-	-	-	-	-	3.518	4.018	-	3.518	4.018	3.318
Pot Cap-1 Maneuver	1622	-	-	-	-	-	1020	250	-	998	250	1084
Stage 1	-	-	-	-	-	-	-	-	-	1022	895	-
Stage 2	-	-	-	-	-	-	1021	895	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1622	-	-	-	-	-	778	175	-	-	175	1084
Mov Cap-2 Maneuver	-	-	-	-	-	-	778	175	-	-	175	-
Stage 1	-	-	-	-	-	-	-	-	-	714	895	-
Stage 2	-	-	-	-	-	-	1020	895	-	-	-	-

Approach	EB	WB	NB	SB
----------	----	----	----	----

HCM Control Delay, s	8.2	0	-	-
HCM LOS	-	-	-	-

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
-----------------------	-------	-------	-----	-----	-----	-----	-----	-----	-------

Capacity (veh/h)	633	-	1622	-	-	-	-	-	-
HCM Lane V/C Ratio	0.386	-	0.302	-	-	-	-	-	-
HCM Control Delay (s)	14.2	-	8.2	-	-	0	-	-	-
HCM Lane LOS	B	-	A	-	-	A	-	-	-
HCM 95th %tile Q(veh)	1.8	-	1.3	-	-	-	-	-	-

APPENDIX E-3

I-10/Sunset Road Traffic Interchange Future LOS

AWSC Analysis

Intersection												
Intersection Delay, s/veh	23.3											
Intersection LOS	C											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	0	220	310	0	50	30	0	0	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	0	239	337	0	54	33	0	0	0	0	0
Number of Lanes	0	0	1	0	0	0	1	0	0	0	0	0

Approach	EB	WB
Opposing Approach	WB	EB
Opposing Lanes	1	1
Conflicting Approach Left	SB	
Conflicting Lanes Left	3	0
Conflicting Approach Right		SB
Conflicting Lanes Right	0	3
HCM Control Delay	31.6	10.8
HCM LOS	D	B

Lane	EBLn1	WBLn1	SBLn1	SBLn2	SBLn3
Vol Left, %	0%	62%	0%	0%	0%
Vol Thru, %	42%	38%	100%	100%	11%
Vol Right, %	58%	0%	0%	0%	89%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	530	80	0	60	280
LT Vol	220	30	0	60	30
Through Vol	310	0	0	0	250
RT Vol	0	50	0	0	0
Lane Flow Rate	576	87	0	65	304
Geometry Grp	7	7	7	7	7
Degree of Util (X)	0.856	0.162	0	0.116	0.487
Departure Headway (Hd)	5.351	6.704	6.394	6.394	5.759
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	680	534	0	560	624
Service Time	3.083	4.455	4.138	4.138	3.503
HCM Lane V/C Ratio	0.847	0.163	0	0.116	0.487
HCM Control Delay	31.6	10.8	9.1	10	13.9
HCM Lane LOS	D	B	N	A	B
HCM 95th-tile Q	9.8	0.6	0	0.4	2.7

Intersection

Intersection Delay, s/veh

Intersection LOS

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	0	90	250
Peak Hour Factor	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	0	98	272
Number of Lanes	0	1	2	0

Approach SB

Opposing Approach

Opposing Lanes 0

Conflicting Approach Left WB

Conflicting Lanes Left 1

Conflicting Approach Right EB

Conflicting Lanes Right 1

HCM Control Delay 13.2

HCM LOS B

Lane

Intersection									
Intersection Delay, s/veh	9.2								
Intersection LOS	A								
Movement	EBU	EBL	EBR	NBU	NBL	NBT	SBU	SBT	SBR
Vol, veh/h	0	220	0	0	80	10	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	239	0	0	87	11	0	0	0
Number of Lanes	0	1	0	0	0	2	0	0	0

Approach	EB	NB
Opposing Approach		
Opposing Lanes	0	0
Conflicting Approach Left		EB
Conflicting Lanes Left	0	1
Conflicting Approach Right	NB	
Conflicting Lanes Right	2	0
HCM Control Delay	9.2	9.1
HCM LOS	A	A

Lane	NBLn1	NBLn2	EBLn1
Vol Left, %	96%	0%	100%
Vol Thru, %	4%	100%	0%
Vol Right, %	0%	0%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	83	7	220
LT Vol	3	7	0
Through Vol	0	0	0
RT Vol	80	0	220
Lane Flow Rate	91	7	239
Geometry Grp	7	7	2
Degree of Util (X)	0.14	0.01	0.293
Departure Headway (Hd)	5.582	5.099	4.417
Convergence, Y/N	Yes	Yes	Yes
Cap	645	704	818
Service Time	3.296	2.813	2.423
HCM Lane V/C Ratio	0.141	0.01	0.292
HCM Control Delay	9.2	7.9	9.2
HCM Lane LOS	A	A	A
HCM 95th-tile Q	0.5	0	1.2

Intersection												
Intersection Delay, s/veh	16.5											
Intersection LOS	C											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	0	310	90	0	40	280	0	0	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	0	337	98	0	43	304	0	0	0	0	0
Number of Lanes	0	0	1	0	0	0	1	0	0	0	0	0

Approach	EB	WB
Opposing Approach	WB	EB
Opposing Lanes	1	1
Conflicting Approach Left	SB	
Conflicting Lanes Left	3	0
Conflicting Approach Right		SB
Conflicting Lanes Right	0	3
HCM Control Delay	19.1	16.2
HCM LOS	C	C

Lane	EBLn1	WBLn1	SBLn1	SBLn2	SBLn3
Vol Left, %	0%	12%	0%	0%	0%
Vol Thru, %	78%	88%	100%	100%	3%
Vol Right, %	23%	0%	0%	0%	97%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	400	320	0	13	207
LT Vol	310	280	0	13	7
Through Vol	90	0	0	0	200
RT Vol	0	40	0	0	0
Lane Flow Rate	435	348	0	14	225
Geometry Grp	7	7	7	7	7
Degree of Util (X)	0.674	0.569	0	0.027	0.373
Departure Headway (Hd)	5.579	5.887	6.662	6.662	5.972
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	648	612	0	537	602
Service Time	3.317	3.627	4.412	4.412	3.721
HCM Lane V/C Ratio	0.671	0.569	0	0.026	0.374
HCM Control Delay	19.1	16.2	9.4	9.6	12.3
HCM Lane LOS	C	C	N	A	B
HCM 95th-tile Q	5.2	3.6	0	0.1	1.7

Intersection

Intersection Delay, s/veh
 Intersection LOS

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	0	20	200
Peak Hour Factor	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	0	22	217
Number of Lanes	0	1	2	0

Approach SB

Opposing Approach	
Opposing Lanes	0
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	12.1
HCM LOS	B

Lane

Intersection									
Intersection Delay, s/veh	16								
Intersection LOS	C								
Movement	EBU	EBL	EBR	NBU	NBL	NBT	SBU	SBT	SBR
Vol, veh/h	0	310	0	0	320	150	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	337	0	0	348	163	0	0	0
Number of Lanes	0	1	0	0	0	2	0	0	0

Approach	EB	NB
Opposing Approach		
Opposing Lanes	0	0
Conflicting Approach Left		EB
Conflicting Lanes Left	0	1
Conflicting Approach Right	NB	
Conflicting Lanes Right	2	0
HCM Control Delay	14.1	17.3
HCM LOS	B	C

Lane	NBLn1	NBLn2	EBLn1
Vol Left, %	86%	0%	100%
Vol Thru, %	14%	100%	0%
Vol Right, %	0%	0%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	370	100	310
LT Vol	50	100	0
Through Vol	0	0	0
RT Vol	320	0	310
Lane Flow Rate	402	109	337
Geometry Grp	7	7	2
Degree of Util (X)	0.657	0.165	0.511
Departure Headway (Hd)	5.885	5.449	5.455
Convergence, Y/N	Yes	Yes	Yes
Cap	607	651	657
Service Time	3.681	3.244	3.521
HCM Lane V/C Ratio	0.662	0.167	0.513
HCM Control Delay	19.4	9.3	14.1
HCM Lane LOS	C	A	B
HCM 95th-tile Q	4.8	0.6	2.9

Intersection												
Intersection Delay, s/veh	27.7											
Intersection LOS	D											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	0	270	190	0	50	40	0	0	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	0	293	207	0	54	43	0	0	0	0	0
Number of Lanes	0	0	1	0	0	0	1	0	0	0	0	0

Approach	EB	WB
Opposing Approach	WB	EB
Opposing Lanes	1	1
Conflicting Approach Left	SB	
Conflicting Lanes Left	3	0
Conflicting Approach Right		SB
Conflicting Lanes Right	0	3
HCM Control Delay	33.4	12
HCM LOS	D	B

Lane	EBLn1	WBLn1	SBLn1	SBLn2	SBLn3
Vol Left, %	0%	56%	0%	0%	0%
Vol Thru, %	59%	44%	100%	100%	7%
Vol Right, %	41%	0%	0%	0%	93%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	460	90	0	60	460
LT Vol	270	40	0	60	30
Through Vol	190	0	0	0	430
RT Vol	0	50	0	0	0
Lane Flow Rate	500	98	0	65	500
Geometry Grp	7	7	7	7	7
Degree of Util (X)	0.844	0.199	0	0.116	0.797
Departure Headway (Hd)	6.077	7.336	6.401	6.401	5.736
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	595	486	0	558	630
Service Time	3.839	5.133	4.167	4.167	3.502
HCM Lane V/C Ratio	0.84	0.202	0	0.116	0.794
HCM Control Delay	33.4	12	9.2	10	27.4
HCM Lane LOS	D	B	N	A	D
HCM 95th-tile Q	9.1	0.7	0	0.4	7.9

Intersection

Intersection Delay, s/veh
 Intersection LOS

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	0	90	430
Peak Hour Factor	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	0	98	467
Number of Lanes	0	1	2	0

Approach SB

Opposing Approach	
Opposing Lanes	0
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	25.4
HCM LOS	D

Lane

Intersection									
Intersection Delay, s/veh	9.8								
Intersection LOS	A								
Movement	EBU	EBL	EBR	NBU	NBL	NBT	SBU	SBT	SBR
Vol, veh/h	0	270	0	0	90	10	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	293	0	0	98	11	0	0	0
Number of Lanes	0	1	0	0	0	2	0	0	0

Approach	EB	NB
Opposing Approach		
Opposing Lanes	0	0
Conflicting Approach Left		EB
Conflicting Lanes Left	0	1
Conflicting Approach Right	NB	
Conflicting Lanes Right	2	0
HCM Control Delay	10	9.4
HCM LOS	A	A

Lane	NBLn1	NBLn2	EBLn1
Vol Left, %	96%	0%	100%
Vol Thru, %	4%	100%	0%
Vol Right, %	0%	0%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	93	7	270
LT Vol	3	7	0
Through Vol	0	0	0
RT Vol	90	0	270
Lane Flow Rate	101	7	293
Geometry Grp	7	7	2
Degree of Util (X)	0.161	0.011	0.363
Departure Headway (Hd)	5.715	5.23	4.454
Convergence, Y/N	Yes	Yes	Yes
Cap	629	686	810
Service Time	3.437	2.952	2.465
HCM Lane V/C Ratio	0.161	0.01	0.362
HCM Control Delay	9.5	8	10
HCM Lane LOS	A	A	A
HCM 95th-tile Q	0.6	0	1.7

Intersection												
Intersection Delay, s/veh	40.6											
Intersection LOS	E											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	0	450	70	0	60	150	0	0	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	0	489	76	0	65	163	0	0	0	0	0
Number of Lanes	0	0	1	0	0	0	1	0	0	0	0	0

Approach	EB	WB
Opposing Approach	WB	EB
Opposing Lanes	1	1
Conflicting Approach Left	SB	
Conflicting Lanes Left	3	0
Conflicting Approach Right		SB
Conflicting Lanes Right	0	3
HCM Control Delay	61.9	16.1
HCM LOS	F	C

Lane	EBLn1	WBLn1	SBLn1	SBLn2	SBLn3
Vol Left, %	0%	29%	0%	0%	0%
Vol Thru, %	87%	71%	100%	100%	2%
Vol Right, %	13%	0%	0%	0%	98%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	520	210	0	13	397
LT Vol	450	150	0	13	7
Through Vol	70	0	0	0	390
RT Vol	0	60	0	0	0
Lane Flow Rate	565	228	0	14	431
Geometry Grp	7	7	7	7	7
Degree of Util (X)	0.995	0.461	0	0.028	0.762
Departure Headway (Hd)	6.47	7.275	7.068	7.068	6.364
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	565	495	0	509	569
Service Time	4.17	5.006	4.778	4.778	4.075
HCM Lane V/C Ratio	1	0.461	0	0.028	0.757
HCM Control Delay	61.9	16.1	9.8	10	26.6
HCM Lane LOS	F	C	N	A	D
HCM 95th-tile Q	14.2	2.4	0	0.1	6.8

Intersection

Intersection Delay, s/veh

Intersection LOS

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	0	20	390
Peak Hour Factor	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	0	22	424
Number of Lanes	0	1	2	0

Approach SB

Opposing Approach

Opposing Lanes 0

Conflicting Approach Left WB

Conflicting Lanes Left 1

Conflicting Approach Right EB

Conflicting Lanes Right 1

HCM Control Delay 26.1

HCM LOS D

Lane

Intersection									
Intersection Delay, s/veh	16								
Intersection LOS	C								
Movement	EBU	EBL	EBR	NBU	NBL	NBT	SBU	SBT	SBR
Vol, veh/h	0	450	0	0	210	30	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	489	0	0	228	33	0	0	0
Number of Lanes	0	1	0	0	0	2	0	0	0

Approach	EB	NB
Opposing Approach		
Opposing Lanes	0	0
Conflicting Approach Left		EB
Conflicting Lanes Left	0	1
Conflicting Approach Right	NB	
Conflicting Lanes Right	2	0
HCM Control Delay	17.5	13.1
HCM LOS	C	B

Lane	NBLn1	NBLn2	EBLn1
Vol Left, %	95%	0%	100%
Vol Thru, %	5%	100%	0%
Vol Right, %	0%	0%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	220	20	450
LT Vol	10	20	0
Through Vol	0	0	0
RT Vol	210	0	450
Lane Flow Rate	239	22	489
Geometry Grp	7	7	2
Degree of Util (X)	0.415	0.035	0.67
Departure Headway (Hd)	6.246	5.764	4.931
Convergence, Y/N	Yes	Yes	Yes
Cap	572	615	729
Service Time	4.042	3.559	2.981
HCM Lane V/C Ratio	0.418	0.036	0.671
HCM Control Delay	13.5	8.8	17.5
HCM Lane LOS	B	A	C
HCM 95th-tile Q	2	0.1	5.2

APPENDIX F

2025 Traffic Simulation Results

APPENDIX F-1
2025 Traffic Simulation Results
AM Peak Hour

SimTraffic Simulation Summary
 2025 3/10/2014

Interval #0 Information Seeding
 Start Time 6:55
 End Time 7:00
 Total Time (min) 5
 Volumes adjusted by Growth Factors.
 No data recorded this interval.

Interval #1 Information Recording
 Start Time 7:00
 End Time 8:00
 Total Time (min) 60
 Volumes adjusted by Growth Factors.

AM PK HR Unsignalized SimTraffic Report
 Page 0

♀
 SimTraffic Performance Report
 2025 3/10/2014

3: WB Frontage Rd & Sunset Rd Performance by movement

Movement	EBL	NBL	NBT	ALL
Denied Del/Veh (s)	0.0	0.1	0.1	0.0
Total Del/Veh (s)	1.1	6.3	7.4	2.5

8: EB Frontage Rd & Sunset Rd Performance by movement

Movement	EBT	EBR	WBL	WBT	SBT	SBR	ALL
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.1	0.3	0.1
Total Del/Veh (s)	2.9	1.8	4.2	1.6	8.8	7.4	5.0

AM PK HR Unsignalized SimTraffic Report
 Page 0

♀
 Queuing and Blocking Report
 2025 3/10/2014

Intersection: 3: WB Frontage Rd & Sunset Rd

Movement	EB	NB	NB
Directions Served	L	LT	T
Maximum Queue (ft)	2	69	27
Average Queue (ft)	0	36	2
95th Queue (ft)	2	59	14
Link Distance (ft)	284	1175	1175
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 8: EB Frontage Rd & Sunset Rd

Movement	EB	WB	SB	SB
Directions Served	TR	LT	T	TR
Maximum Queue (ft)	4	49	68	164
Average Queue (ft)	0	14	35	74
95th Queue (ft)	3	40	57	149
Link Distance (ft)	790	284	715	715
Upstream Blk Time (%)				

Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Network Summary

AM PK HR Unsignalized SimTraffic Report
Page 0

APPENDIX F-2
2025 Traffic Simulation Results
PM Peak Hour

SimTraffic Simulation Summary
 2025 3/4/2014

Interval #0 Information Seeding
 Start Time 4:55
 End Time 5:00
 Total Time (min) 5
 Volumes adjusted by Growth Factors.
 No data recorded this interval.

Interval #1 Information Recording
 Start Time 5:00
 End Time 6:00
 Total Time (min) 60
 Volumes adjusted by Growth Factors.

PM PK HR Unsignalized SimTraffic Report
 Page 0

♀
 SimTraffic Performance Report
 2025 3/4/2014

3: WB Frontage Rd & Sunset Rd Performance by movement

Movement	EBL	NBL	NBT	ALL
Denied Del/Veh (s)	0.0	0.2	0.1	0.1
Total Del/Veh (s)	1.3	10.4	9.9	4.4

8: EB Frontage Rd & Sunset Rd Performance by movement

Movement	EBT	EBR	WBL	WBT	SBT	SBR	ALL
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.1	0.3	0.1
Total Del/Veh (s)	2.0	1.4	4.7	1.9	9.0	6.9	3.9

PM PK HR Unsignalized SimTraffic Report
 Page 0

♀
 Queuing and Blocking Report
 2025 3/4/2014

Intersection: 3: WB Frontage Rd & Sunset Rd

Movement	EB	NB	NB
Directions Served	L	LT	T
Maximum Queue (ft)	4	134	55
Average Queue (ft)	0	64	9
95th Queue (ft)	3	106	37
Link Distance (ft)	284	1175	1175
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 8: EB Frontage Rd & Sunset Rd

Movement	WB	SB	SB
Directions Served	LT	T	TR
Maximum Queue (ft)	70	44	144
Average Queue (ft)	20	16	71
95th Queue (ft)	54	43	114
Link Distance (ft)	284	715	715
Upstream Blk Time (%)			

Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Network Summary

PM PK HR Unsignalized SimTraffic Report
Page 0

APPENDIX G

Signal Warrant Analysis

Eight-Hour Warrant Analysis

	Projected ADT 2018	Projected ADT 2025	Projected 2018 Approach	Projected 2025 Approach	Eight-Hour Factor	Eight-Hour Volumes Year 2018	Eight-Hour Volumes Year 2025
Sunset Rd West of EB Frontage Rd	8,738	10,745	4369	5373	5.72%	400	480
Sunset Rd East of EB Frontage Rd	5,121	6,144	2561	3072			
I-10 EB Frontage Rd	3,463	4,992	1732	2496	5.72%	100	140
Major Street Speed	35	MPH					

Warrant 1, Eight-Hour Analysis

Sunset Rd Number of Lanes	EB Frontage Rd Number of Lanes	Year 2018						
		Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Cond A 100%	Cond A 70%	Cond B 100%	Cond B 70%	Cond A/B 80%
1	1	400	100	No	N/A	No	N/A	No

Condition A 100%		Condition A 80%		Condition A 70%		Condition B 100%		Condition B 80%		Condition B 70%	
Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)
500	150	400	120	350	105	750	75	600	60	525	53

Sunset Rd Number of Lanes	EB Frontage Rd Number of Lanes	Year 2025						
		Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Cond A 100%	Cond A 70%	Cond B 100%	Cond B 70%	Cond A/B 80%
1	1	480	140	No	N/A	No	N/A	No

Condition A 100%		Condition A 80%		Condition A 70%		Condition B 100%		Condition B 80%		Condition B 70%	
Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)
500	150	400	120	350	105	750	75	600	60	525	53

Four-Hour Warrant Analysis

	Projected ADT 2018	Projected ADT 2025	Projected 2018 Approach	Projected 2025 Approach	Four-Hour Factor	Four-Hour Volumes Year 2018	Four-Hour Volumes Year 2025
Sunset Rd West of EB Frontage Rd	8,738	10,745	4369	5373	6.56%	450	550
Sunset Rd East of EB Frontage Rd	5,121	6,144	2561	3072			
I-10 EB Frontage Rd	3,463	4,992	1732	2496	6.56%	110	160

Warrant 2, Four-Hour Analysis

Sunset Rd Number of Lanes	EB Frontage Rd Number of Lanes	Year 2018					
		Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Signal Warrant Met 100%	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Signal Warrant Met 70%
1	1	450	110	No	450	110	N/A

Sunset Rd Number of Lanes	EB Frontage Rd Number of Lanes	Year 2025					
		Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Signal Warrant Met 100%	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Signal Warrant Met 70%
1	1	550	160	No	550	160	N/A

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume

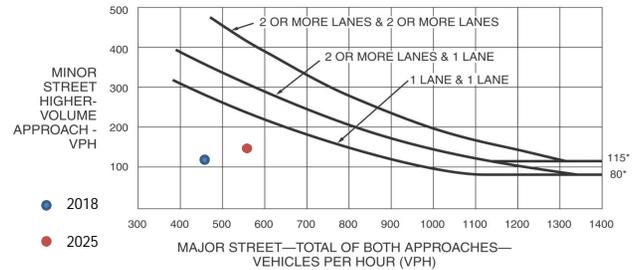
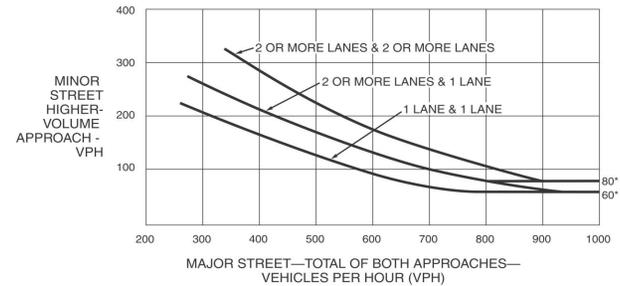


Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor) (COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



Eight-Hour Warrant Analysis

	Projected	Projected	Projected	Projected	Eight-Hour	Eight-Hour	
	ADT 2018	ADT 2025	2018 Approach	2025 Approach			Factor
Silverbell Rd North of Sunset Rd	7,625	7,273	3813	3637	5.72%	490	550
Silverbell Rd South of Sunset Rd	9,424	11,993	4712	5997			
Sunset Rd East of Silverbell Rd	8,738	10,745	4369	5373	5.72%	250	310
Major Street Speed	45	MPH					

Warrant 1, Eight-Hour Analysis

Sunset Rd Number of Lanes	Silverbell Rd Number of Lanes	Year 2018						
		Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Cond A 100%	Cond A 70%	Cond B 100%	Cond B 70%	Cond A/B 80%
2 or more	2 or more	490	250	No	Yes	No	No	N/A

Sunset Rd Number of Lanes	Silverbell Rd Number of Lanes	Year 2025						
		Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Cond A 100%	Cond A 70%	Cond B 100%	Cond B 70%	Cond A/B 80%
2 or more	2 or more	550	310	No	Yes	No	No	N/A

Four-Hour Warrant Analysis

	Projected	Projected	Projected	Projected	Four-Hour	Four-Hour	
	ADT 2018	ADT 2025	2018 Approach	2025 Approach			Factor
Silverbell Rd North of Sunset Rd	7,625	7,273	3813	3637	6.56%	560	630
Silverbell Rd South of Sunset Rd	9,424	11,993	4712	5997			
Sunset Rd East of Silverbell Rd	8,738	10,745	4369	5373	6.56%	290	350

Warrant 2, Four-Hour Analysis

Sunset Rd Number of Lanes	Silverbell Rd Number of Lanes	Year 2018					
		Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Signal Warrant Met 100%	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Signal Warrant Met 70%
2 or more	2 or more	560	290	No	560	290	Yes

Sunset Rd Number of Lanes	Silverbell Rd Number of Lanes	Year 2025					
		Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Signal Warrant Met 100%	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Signal Warrant Met 70%
2 or more	2 or more	630	350	No	630	350	Yes

Condition A 100%		Condition A 80%		Condition A 70%		Condition B 100%		Condition B 80%		Condition B 70%	
Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)
600	200	480	160	420	140	900	100	720	80	630	70

Condition A 100%		Condition A 80%		Condition A 70%		Condition B 100%		Condition B 80%		Condition B 70%	
Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)	Major Street Approach Volumes (vph)	Minor Street Approach Volume (vph)
600	200	480	160	420	140	900	100	720	80	630	70

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume

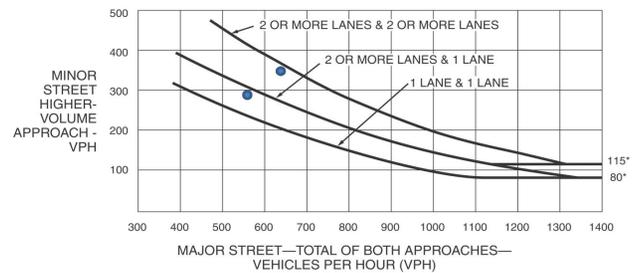
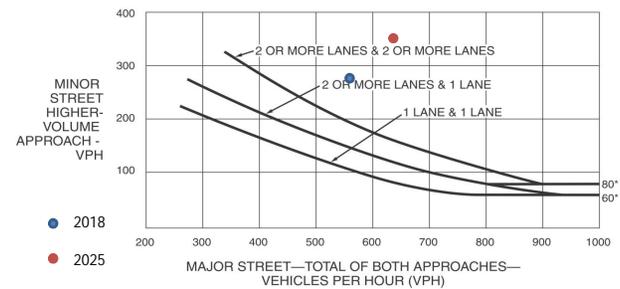


Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



Condition A									
Lanes		VPH on major street				VPH on minor street			
Major	Minor	100%	80%	70%	56%	100%	80%	70%	56%
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Condition B									
Lanes		VPH on major street				VPH on minor street			
Major	Minor	100%	80%	70%	56%	100%	80%	70%	56%
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

APPENDIX H

Turn Lane Warrant Analysis

Sunset Rd/Silverbell Rd - Auxiliary Lane Warrant Analysis

PCDOT Methodology

Maximum Left Turn Volumes in Peak Hour without a Left Turn Lane

Posted Speed (mph)	ADT (2 Way)			
	≤ 2500	2500 - 5000	5000 - 10000	> 10000
≤ 35	75	50	30	15
40-50	75	40	20	10
≥ 55	75	30	10	5

SB Silverbell at New Sunset LT Lane Analysis

Year	AM Left Turn Volume	PM Left Turn Volume	Daily Volume (ADT)	Max Allowable in Peak Hour, No Turn Lane	Condition Met for No Turn Lane?	Result
2018	330	110	7,625	20	No	Turn Lane
2025	220	90	7,273	20	No	Turn Lane

WB New Sunset at Silverbell LT Lane Analysis

Year	AM Left Turn Volume	PM Left Turn Volume	Daily Volume (ADT)	Max Allowable in Peak Hour, No Turn Lane	Condition Met for No Turn Lane?	Result
2018	240	170	8,738	30	No	Turn Lane
2025	410	380	10,745	15	No	Turn Lane

Maximum Right Turn Volumes in Peak Hour without a Right Turn Lane

ADT (2 Way)	Max Rt Turn Volume w/o RT Lane
	2500 - 5000
5000 - 10000	70
> 10000	40

NB Silverbell at New Sunset RT Lane Analysis

Year	AM Right Turn Volume	PM Right Turn Volume	Daily Volume (ADT)	Max Allowable in Peak Hour, No Turn Lane	Condition Met for No Turn Lane?	Result
2018	200	290	9,424	70	No	Turn Lane
2025	240	430	11,993	40	No	Turn Lane

WB New Sunset at Silverbell RT Lane Analysis

Year	AM Right Turn Volume	PM Right Turn Volume	Daily Volume (ADT)	Max Allowable in Peak Hour, No Turn Lane	Condition Met for No Turn Lane?	Result
2018	40	310	8,738	70	No	Turn Lane
2025	60	160	10,745	40	No	Turn Lane

EB New Sunset at EBFR RT Lane Analysis

Year	AM Right Turn Volume	PM Right Turn Volume	Daily Volume (ADT)	Max Allowable in Peak Hour, No Turn Lane	Condition Met for No Turn Lane?	Result
2018	310	90	8,738	70	No	Turn Lane
2025	190	70	10,745	40	No	Turn Lane

I-10/Sunset Rd TI - Auxiliary Lane Warrant Analysis
ADOT Methodology

Maximum Right Turn Volumes in Peak Hour without a Right Turn Lane

Peak Hour Volume on Entire Road in Travel Direction	# of Thru Lanes in Travel Direction				
	1		2		3
	< 45 mph	≥ 45 mph	< 45 mph	≥ 45 mph	All speeds
≤ 200	-	-	-	-	-
201 - 300	-	30	-	-	-
301 - 400	-	19	-	55	-
401 - 500	85	14	-	30	-
501 - 600	58	12	140	25	-
601 - 700	27	9	80	18	-
701 - 800	20	8	53	15	-
801 - 900	12	7	40	12	-
901 - 1000	9	6	30	11	-
etc.	etc.	etc.	etc.	etc.	etc.

EB New Sunset at EBFR RT Lane Analysis

Year	AM Right Turn Volume	PM Right Turn Volume	Overall Peak Hour Vol in Travel Direction, AM	Overall Peak Hour Vol in Travel Direction, PM	Max Allowable in Peak Hour, No Turn Lane	Condition Met for No Turn Lane?	Result
2018	310	90	530	400	58	No	Turn Lane
2025	190	70	460	520	58	No	Turn Lane