Southern Boulevard Reconstruction (Eubank Blvd to Juan Tabo Blvd)

Final Draft Report:
Geometric and Traffic Control Recommendations for the Reconstruction of Southern Boulevard

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Table of Contents

List of Tables

List of Figures

Executive Summary

Southern Boulevard was originally designated as a limited access arterial, but has since been categorized as a collector road due to limitations in available right-of-way (ROW) for future street widening at critical segments. Therefore, Southern Boulevard between Eubank Boulevard and Juan Tabo Boulevard has been identified for reconstruction and realignment. The purpose of this study is to identify design characteristics that are no longer appropriate for the collector designation and to recommend appropriate geometry and traffic control for Southern Boulevard intersections at Eubank Boulevard, Elizabeth Street, and Juan Tabo, which also is to be realigned. Additionally, commercial access for the northeast corner of the Eubank Boulevard intersection and residential/commercial access for the Juan Tabo/Horseshoe Trails intersection just south of Southern Boulevard will be reviewed and assessed.

Southern Boulevard is located approximately a quarter-mile south of Central Avenue with the Project Site bound to the west by Eubank Boulevard and the east by Juan Tabo Boulevard.

Conclusions and Recommendations

Conclusions and recommendations of this study are summarized as follows:

- A review of historical traffic data indicates, Eubank and Juan Tabo actually remained level or reduced traffic demand over the last three years. Generally, the area is developed with most empty parcels in the vicinity of the Project Site either owned by Kirtland Air Force Base or Sandia Laboratories. Therefore, no growth rate has been applied to existing data due to lack of ambient traffic growth and the reclassification of Southern Boulevard from an arterial roadway to a collector street.

- Projected site trips from the Juan Tabo Hills West study have been overlaid with existing count data to produce design peak hour demands.

- Elizabeth Street will satisfy Signal Warrant 2 and Juan Tabo satisfies Signal Warrants 1, 2, and 3. Therefore, signal control is recommend to be maintained at Elizabeth Street and incorporated into the new Juan Tabo intersection. Additionally, since the Elizabeth Street intersection would be considered a crossing along a school walking route for Monzano Mesa Elementary, retaining signalized control will allow students to continue to cross Southern during a pedestrian phase.

- The signalized intersections within the study area operate at LOS D or better under existing conditions.

- Incorporating proposed lane configurations and intersection control all study intersections operate below capacity at LOS D or better. Elizabeth Street was analyzed as Two Way Stop Control (TWSC) and operated at a LOS F for the northbound left-turn movement in both the AM and PM peaks, and except for the left-turn from Horseshoe Trail, which indicates a LOS F in both Am and PM peaks as well. However, this movement is well below capacity with very low demand and the Highway Capacity Manual (HCM) 2000 recognizes that this situation is not an uncommon occurrence for minor street left-turn movement turning onto a major arterial. It is recommended that this movement be permitted as a long a safety or operational issues do not develop.

- Proposed lane configurations and intersection control for study intersections are depicted in **Figure 5** and are summarized as follows:

Eubank Intersection

- The east leg of the Eubank/Southern intersection is recommended to incorporate dual left-turn lanes with the right-most lane a drop lane, one through lane, and a right-turn lane.
- The west leg at a minimum should incorporate one left-turn lane, one shared through-right lane.
- The remaining legs will retain existing lane configurations.
- The eastbound left-turn lane should incorporate protected only phasing due to the wide median and thus unfavorable offset between opposing left-turn lanes and restricted sight distance. Permitted phasing could be used if parallel-Offset left-turn lane geometry were used. An example of this can be found as Exhibit 9-98 of the AASHTO-Geometric Design of Highways and Streets and is included in **Appendix A**.
- Currently, the westbound dual left-turn operates under protected permitted phasing. While this provides some advantage operationally, especially with very light west leg demands, the Highway Capacity Manual recommends that dual left-turns operate under protected phasing. This is due to safety and sight distance concerns that can occur when dual permitted left-turns movements are made.

Elizabeth Intersection

- The west leg will now incorporate a single left-turn lane, two through lanes and one right-turn lane.
- The southbound through lane is currently not aligned with the south leg. Therefore it is recommended that dashed extension lane lines be used to guide southbound through traffic through the intersection.
- It should be noted that the northbound left-turn is anticipated to operate at an LOS E in the AM peak and LOS F in the PM peak under existing lane configuration and traffic control. Left-turn operation would improve by providing an exclusive left-turn lane and green phase. However, the alignment of Elizabeth Street at Southern Boulevard makes proper through lane alignment impossible without major reconstruction of the south leg. An alternative to realignment could be the conversion of the existing northbound right-turn lane to a shared through-right lane using striping. It will not be perfectly aligned with the north leg, but with the inclusion of the bike lane align better than the existing southbound through lane. Since Elizabeth operating speeds are 25 mph, the alignment of Elizabeth through Southern, while not optimal should not present safety issues for through traffic on Elizabeth. A ten-foot wide left-turn lane would then be striped where the current through lane exists. A conceptual drawing of this striping is found as **Figure 8**.
- The east leg will retain the existing lane geometry.
- Consideration should be given to providing pedestrian refuge areas and crossing buttons within the median, due to the extreme pedestrian crossing distances. This would reduce pedestrian flashing don't walk phases and provide younger pedestrians (students) the need to only cross one direction at a time.
- Left-turn demands are such that protected plus permitted left-turn phasing on all legs is recommended.

- Stop control was analyzed and shown to be at LOS F for the northbound left-turn movement during both the Am and PM peak hours. Therefore from an operational point of view, signalized control should be retained at this intersection.

Juan Tabo/Terracina Intersection

- Juan Tabo will now align with Terracina.
- The southeast leg will incorporate one forced left-turn lane and one shared through-right lane and one exclusive right-turn lane. The dual right-turns will prevent extensive queuing due to heavy AM peak demands from Juan Tabo Hills
- The north leg will incorporate existing lane geometry.
- The west leg will incorporate one left-turn lane, two through lanes and an exclusive right-turn lane.
- The east leg will require dual left-turn lanes along with a shared through-right lane and one exclusive through lane. Vehicle turn templates should be run for this intersection to ensure that simultaneous left-turn phases can be incorporated. Additionally, dashed extension lane line striping should be incorporated through the intersection for Southern Boulevard left-turn lanes.
- Due to heavy PM peak right-turn demands at the southeast leg, it is recommended that signal timing use an overlapping right-turn phase for this approach. Additionally, due to the dual right-turn lanes it is recommended that the right-turn lanes are protected only and channelized using a right-turn channelizing median island. This will provide 1-2 vehicle lengths of queue storage for the light through demands.

- Analyses of left-turn queue demands and storage lengths have been calculated. For design purposes, the 95th Percentile queue will be utilized for recommended storage lengths. Design storage lengths for proposed left-turn lanes are summarized in **Table 5**.

- Additionally, based on random arrivals for a 180 second queuing interval, it was calculated that the required left-turn storage for the southbound approach at the Juan Tabo/Horseshoe Trail intersection is 150 feet based on a PM peak demand of 123 vehicles.

- Existing right-turn length at the westbound leg of the Eubank intersection can be retained. Through movements are very low on this approach and are not anticipated to block access to the right-turn lane.

- The right-turn lane at the west leg of the Elizabeth Street intersection is recommended to incorporate 150 feet in storage length, which should accommodate deceleration from 35 mph and is not anticipated to be blocked by through demands.

- Recommended right-turn lanes at the west leg and south leg of the Juan Tabo intersection should incorporate at least 150 feet of storage capacity.

- New construction on Southern boulevard should incorporate plans to maintain most existing transit stops. Route 1 bus stops south of Southern Boulevard will have to be relocated to the west side of the south leg and the south side of the east leg of the new Juan Tabo/Southern Boulevard intersection. ABQ Ride prefers that bus stops be located within 150 feet of the intersection. The southbound bus stop currently serving Route 1 just north of the Juan

Tabo/Southern intersection at Cochiti Street can be maintained, but the northbound stop at this location could be eliminated due to the proposed bus stop approximately 400-500 feet away, just east of the relocated Juan Tabo/Southern intersection.

- Based on the average frequency of accidents at Albuquerque intersections, only the Elizabeth intersection during 2007 would be considered a high accident location. Rear end accidents are the most frequent and could be remedied with the conversion of the right-turn lane to a shared through right lane. It is recommended that school crossing signs be incorporated into the intersection, and if not already done there is a potential to incorporate crossing guards at this location.

- It is recommended that Southern Blvd incorporate signal coordination from Central Avenue to Eubank. Incorporating signal coordination along Southern Blvd will encourage the use of Southern Boulevard over Juan Tabo and area residential streets for commuters to and from Kirtland Air Force Base and Sandia Labs. Offsets are shown in **Table 7** for the Elizabeth and Juan Tabo intersections only and do not include offsets for Eubank Boulevard and Central Avenue intersections, which are coordinated with other signalized intersections along Eubank Boulevard and Central Avenue and is beyond the scope of this study. It is recommended that coordination along Eubank and Central be reviewed to investigate additional mitigation to further improve progression along Southern Boulevard. It should be noted that eastbound PM peak progression along Southern Boulevard will be very difficult as the heaviest demand feeding eastbound Southern Boulevard is the northbound right-turn from Eubank Boulevard.

- Calculated and observed queue demand for entry into the Terracita gated community is 50 feet (2 vehicles). The existing layout of the gated entry incorporates 55 feet to the keypad and over 100 feet (4 vehicles) to the gate itself. Therefore it is concluded that the existing geometry will accommodate queue storage demands.

- It would also be beneficial to allow exiting left-turns at the Costco driveway due to the fact that one must make a more difficult left-turn onto Eubank Boulevard. However, the current alignment creates difficulties for a full movement driveway. Therefore unless realignment is feasible, it is recommended that the current Costco driveway on Southern Boulevard incorporate a 150-foot left-in pocket. The redesigned driveway and median opening should be designed to accommodate a WB-50 design vehicle.

- It is recommended that Horseshoe Trail maintain access to the realigned Juan Tabo by curving the existing Horseshoe Trail alignment into Juan Tabo approximately 500 feet south of the new Southern Blvd/Juan Tabo intersection. A 150-foot southbound pocket is recommended. The Horseshoe Trail approach will be under stop control and the Juan Tabo approaches will be uncontrolled with minor right-turn movements channelized to accommodate turning radii.

1. Introduction

Southern Boulevard was originally designated as a limited access arterial, but has since been categorized as a collector road due to limitations in available right-of-way (ROW) for future street widening at critical segments. Therefore, Southern Boulevard between Eubank Boulevard and Juan Tabo Boulevard has been identified for reconstruction and realignment. The purpose of this study is to identify design characteristics that are no longer appropriate for the collector designation and to recommend appropriate geometry and traffic control for Southern Boulevard intersections at Eubank Boulevard, Elizabeth Street, and Juan Tabo, which is also to be realigned. Additionally, commercial access for the northeast corner of the Eubank Boulevard intersection and residential/commercial access for the Juan Tabo/Horseshoe Trails intersection just south of Southern Boulevard will be reviewed and assessed.

Southern Boulevard is located approximately a quarter-mile south of Central Avenue with the Project Site bound to the west by Eubank Boulevard and the east by Juan Tabo Boulevard. A vicinity map depicting the Site location relative to the regional roadway network and study intersections are presented in **Figure 1**. Southern Boulevard reconstruction is anticipated to be completed toward the middle of 2011.

Adjacent Land Use

The Southern Boulevard Project Site is mostly surrounded by residential development north and south between Eubank Boulevard and Juan Tabo Boulevard. A big box commercial development exists at the northeast quadrant of the Eubank Boulevard intersection including Costco, Home Depot, small pad restaurants, and a convenience store with gas pumps. The remaining corners of the Eubank intersection include industrial use in the northwest, the National Museum of Nuclear Science & History in the southwest quadrant, and undeveloped land in the southeast.

Access to Kirtland Air Force Base and Sandia Labs are located approximately 1-mile south of Eubank/Southern intersection. Therefore much of the demands through this intersection are commuter trips to and from these two facilities.

It should be noted that Manzano Mesa Elementary School is located on Elizabeth Street approximately 1,500 feet south of Southern Boulevard. Also New Mexico School for the Blind is approximately 1,500 feet south of Southern Boulevard on Stephen Moody Street. Both schools, especially the elementary school, will have significant influence on Southern Boulevard traffic patterns. A neighbourhood community center (Monzano Mesa Multigenerational Center) currently resides at the southeast corner of the Elizabeth Street intersection.

Generally, the Juan Tabo intersection is surrounded by a trailer community to the east and undeveloped parcels in the northwest and southwest corners. A small strip mall exists just south of the Juan Tabo intersection at Horseshoe Trail.

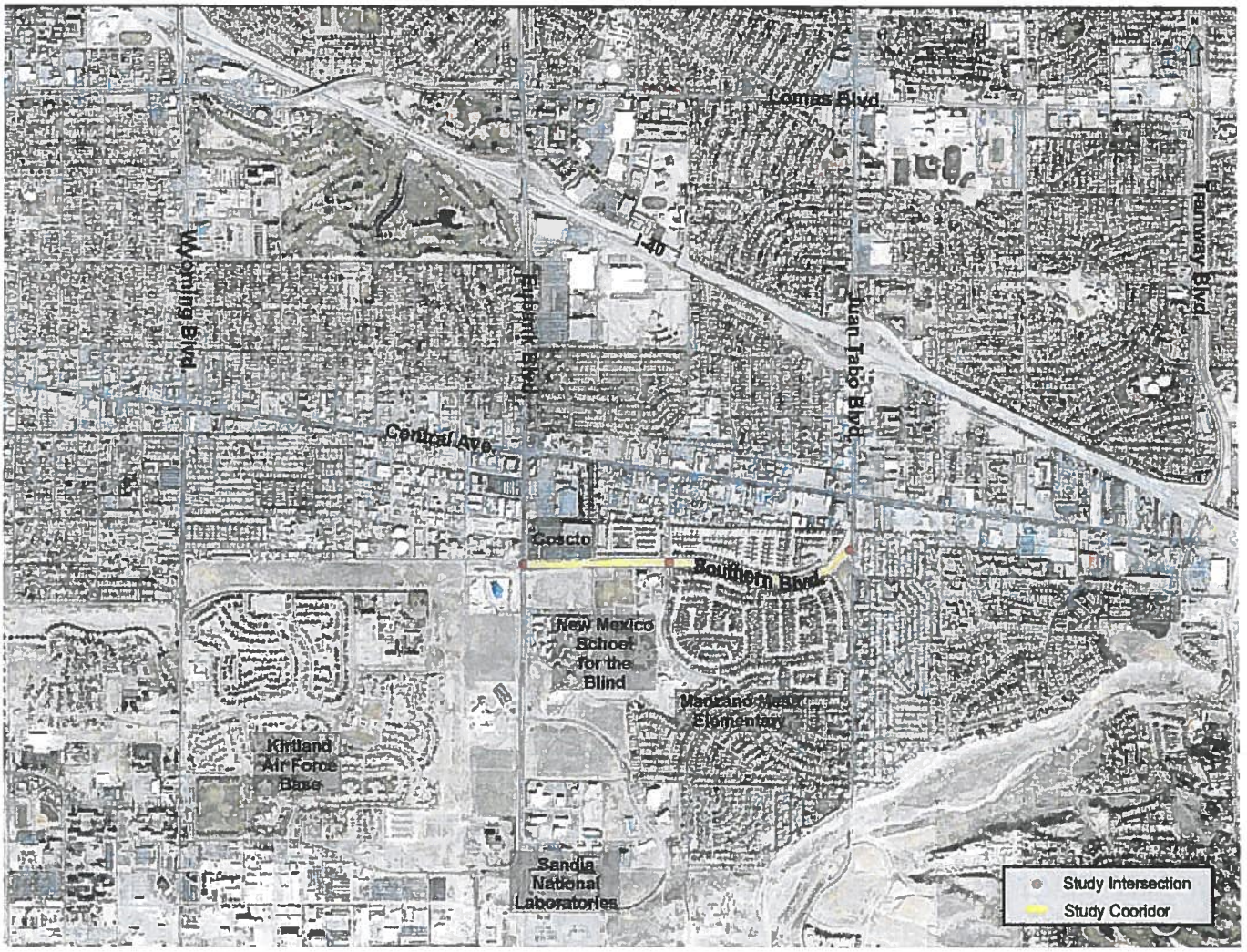

Figure 1. Vicinity Map

Area Roadways

Study intersections are located on the following streets:

- **Southern Boulevard** is approximately a 156-foot ROW east-west collector incorporating two travel lanes and a bike lane westbound. One lane and a bike lane are incorporated eastbound between Eubank Boulevard and Stephen Moody Street, and between Elizabeth Street and Pike Street. Two eastbound travel lanes and a bike lane exist between Stephen Moody Street and Elizabeth Street, and between Pike Street and Juan Tabo Boulevard. A wide (up to 74 feet) raised median is present throughout the length of Southern Boulevard. Generally, full curb and gutter improvements exist, except adjacent to the undeveloped parcel at the southeast corner of the Eubank Boulevard intersection. Southern Boulevard is currently posted for a 35 mph speed limit.
- **Eubank Boulevard** is a 95 to 140-foot north-south major arterial currently incorporating three through lanes in each direction. Raised median and bike lanes are present south of Southern Boulevard, and a two-way left-turn lane (TWLTL) with no bike lanes are present north of Southern Boulevard. Full curb and gutter improvements exist north and south of Southern Boulevard. A 40 mph speed limit is currently in force for Eubank Boulevard.
- **Juan Tabo Boulevard** is approximately a 120-foot ROW north-south minor arterial currently incorporating two through lanes in each direction with raised median. Bike lanes in each direction are present south of Southern Boulevard. Full curb and gutter improvements are present throughout and is currently posted at a 35 mph speed limit.
- **Elizabeth Street** is an approximately 80-foot ROW residential collector street with one lane and a bike lane in each direction. A TWLTL is incorporated north of Southern Boulevard. Elizabeth Street is posted at 25 mph.
- **Horseshoe Trail** is a private residential street providing access from Juan Tabo to the Four Hills trailer community and to the small strip mall at the southeast corner of the intersection. Horseshoe Trail is located approximately 290 feet south of Southern Boulevard.

Realignment of the Southern Boulevard/Juan Tabo Intersection

As part of reconstruction of Southern Boulevard, the Southern Boulevard/Juan Tabo intersection will be realigned to encourage Southern Boulevard as the main through route to Eubank Boulevard. The intent is to discourage cut-through traffic through the adjoining neighborhoods to Kirtland Air Force Base and Sandia Laboratories, by providing a more direct route to Eubank Boulevard. A conceptual design of the realigned intersection is shown in **Figure 2**. As indicated, the proposed intersection will now realign Juan Tabo Boulevard (southeast leg) into Terracina Place (northwest leg). Horseshoe trail will be realigned with Juan Tabo in order to maintain access to the Four Hills trailer community and adjacent strip mall.

Additionally, Southern Boulevard will incorporate two through lanes eastbound and westbound the entire length between Eubank Blvd and Juan Tabo Blvd. This should reduce through queuing at the west leg of the Southern /Elizabeth intersection. Traffic observations showed extensive queuing at this approach with queue length extending almost to Eubank Blvd.

Figure 2. Proposed Relocated Juan Tabo/Southern Intersection

2. Traffic Data

Existing Traffic

Peak hour traffic data and 12-hour counts were collected at Juan Tabo June 29, 2010, Eubank June 30, 2010, and at Elizabeth August 24, 2010 for operational and signal warrant analyses. Data was collected at Elizabeth during the fall to insure that Elementary School traffic was included. Peak hours were then determined from the data with AM peak occurring at 7:00 – 8:00 AM at Eubank & 7:15 – 8:15 AM at Juan Tabo, mid-day peak at 11:30 AM – 12:30 PM at Eubank & 11:45 AM – 12:45 PM at Juan Tabo, and PM peak occurring at 4:30 – 5:30 PM for all locations. Peak hour counts were also collected on August 17, 2010 at both Horseshoe Trail and Terracita Lane to observe potential reconstruction impacts to these driveways. Existing peak hour turning movements for all study intersections are presented in **Figure 3.**

Design Traffic

In addition, Mid-Region Council of Governments (MRCOG) traffic flow maps from the year 2006 to 2008 have been reviewed for growth trends. MRCOG flow maps are included within **Appendix A** (see disk) and observed growth trends are summarized in **Table 1.**

Table 1. Annual Traffic Growth

	ADT			Average Yearly Growth
Street Name	**2006**	**2007**	**2008**	
Eubank Blvd	25,700	25,400	26,100	0.78%
Juan Tabo Blvd	16,800	16,600	1,5600	-3.64%

As indicated, Eubank and Juan Tabo actually remained level or reduced traffic demand. Generally, the area is developed with most empty parcels in the vicinity of the Project Site either owned by Kirtland Air Force Base or Sandia Laboratories. Therefore, no growth rate has been applied to existing data due to lack of ambient traffic growth and the reclassification of Southern Boulevard from an arterial roadway to a collector street.
With the proposed realignment of Juan Tabo and the relocation of the Southern/Juan Tabo intersection, turning movements for this intersection will change. Updated turn movements are indicated in **Figure 4**.

Residential development continues on Juan Tabo south of the Tijeras Arroyo. Recently a traffic impact analysis was conducted for the Juan Tabo Hills West residential development. The study projected trips not only for Juan Tabo Hills West, but also for the undeveloped remainder of the Juan Tabo Hills and Volterra Village developments. Excerpts from the study indicating trip generation, trip distribution and assign development trips are included in **Section A** of the Appendix. Site trips from the Juan Tabo Hills West study are also depicted as **Figure 5**. The Juan Tabo West trips were then overlaid onto the existing count data (**Figures 3 & 4**). to produce final design volumes. Final design volumes are shown as **Figure 6**.

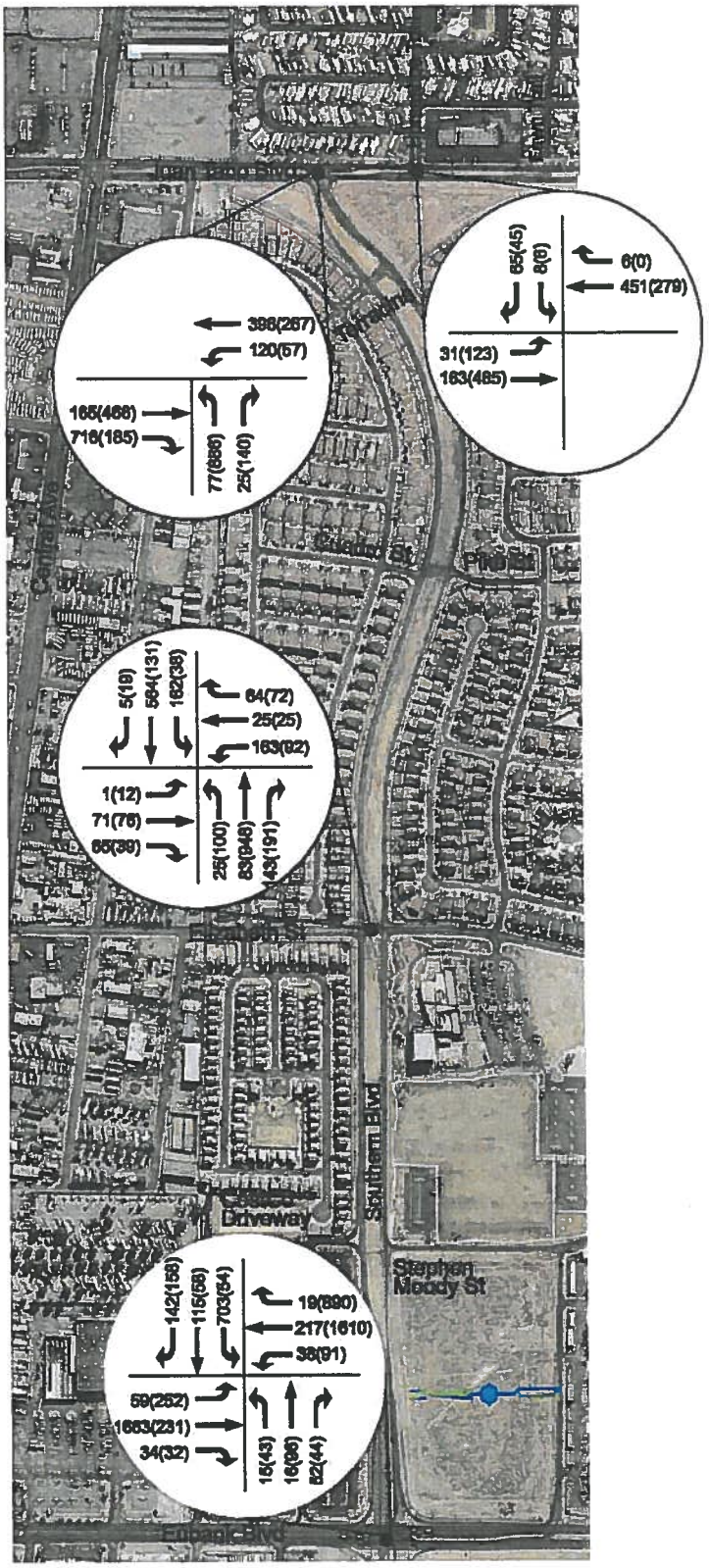

Figure 3. Existing Peak Hour Turning Movements

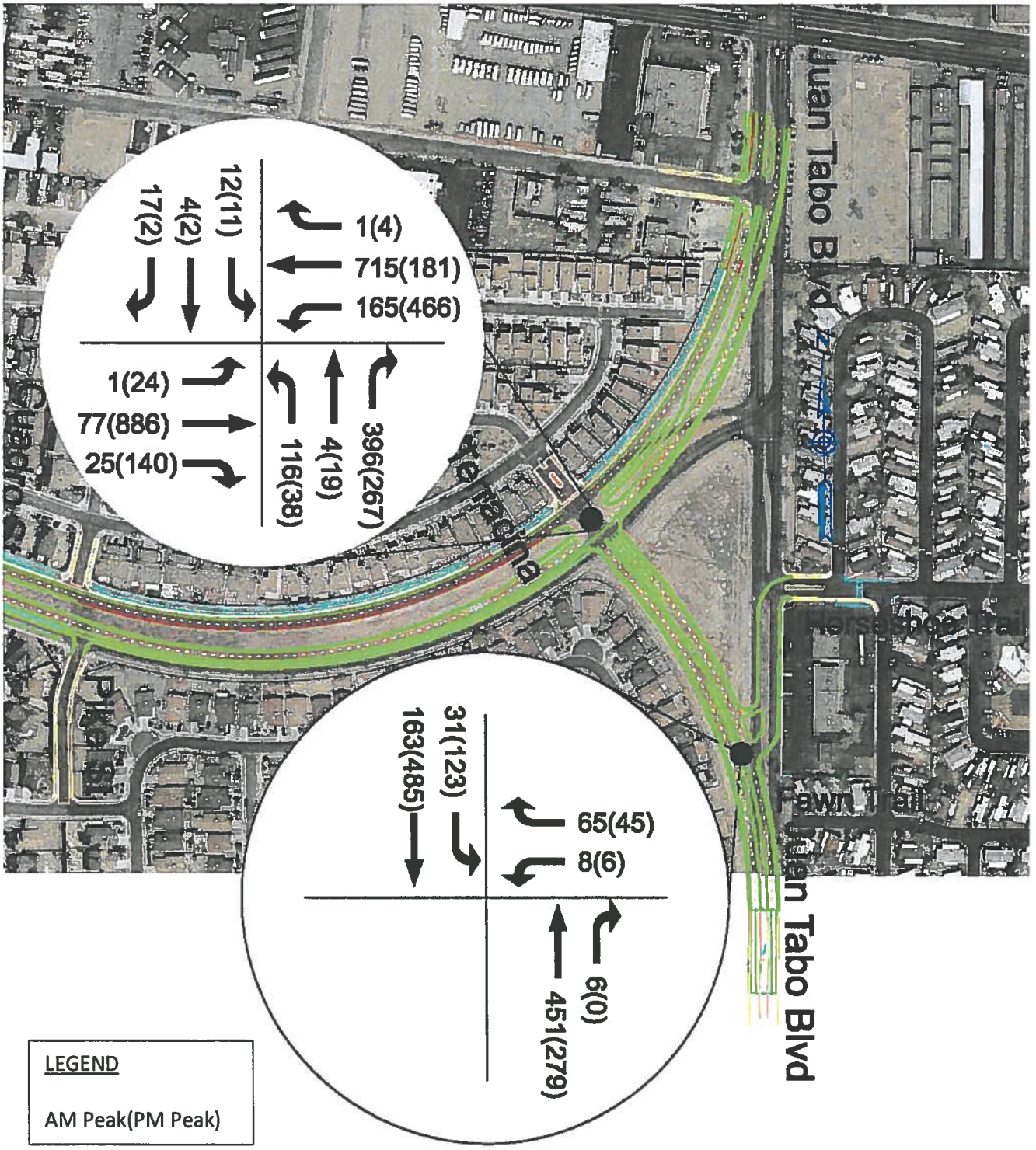

Figure 4. Adjusted Peak Hour Turning Movements at the Southern /Juan Tabo Intersection

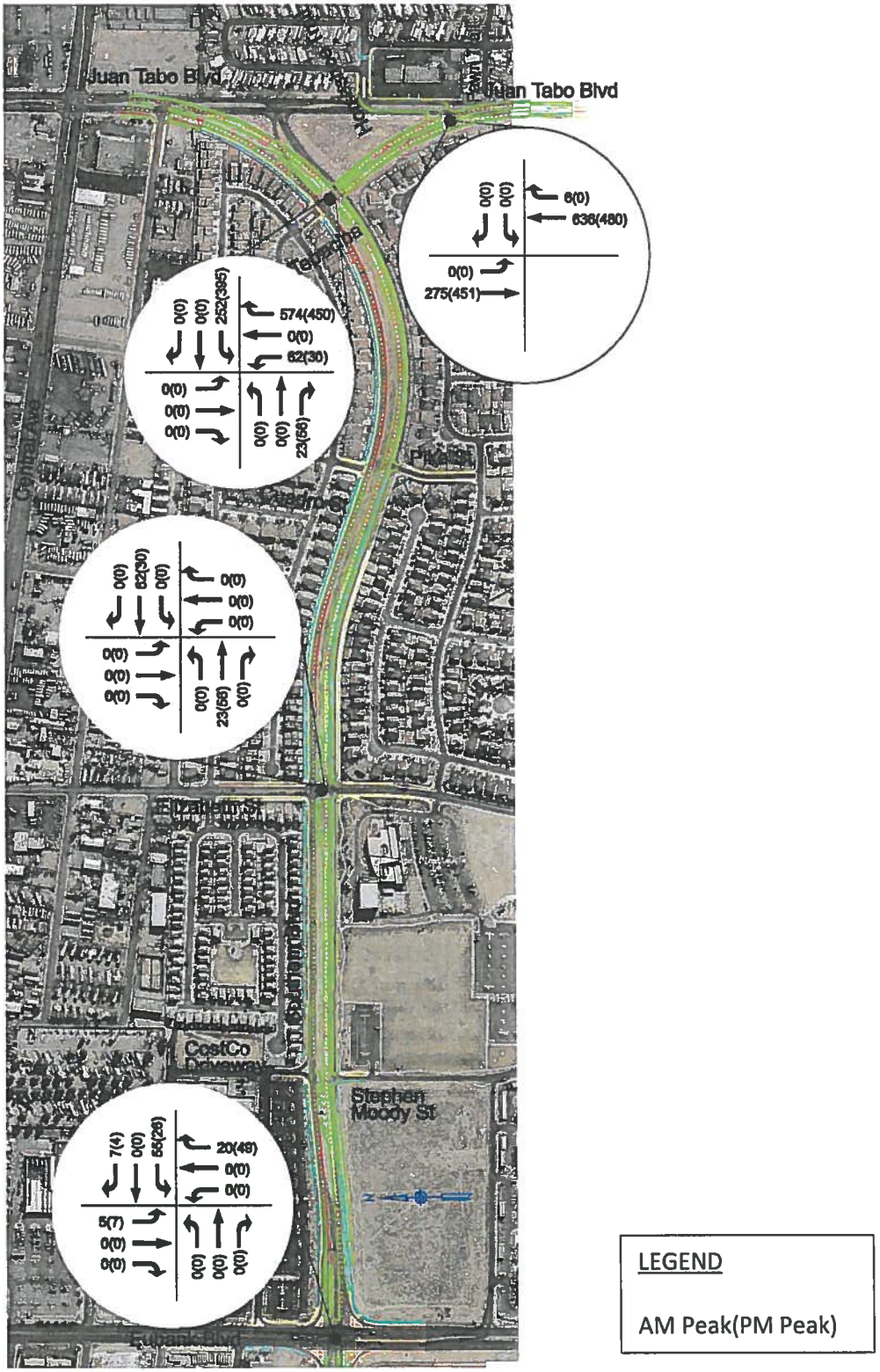

Figure 5. Projected Peak Hour Demands from Juan Tabo Hills West Study

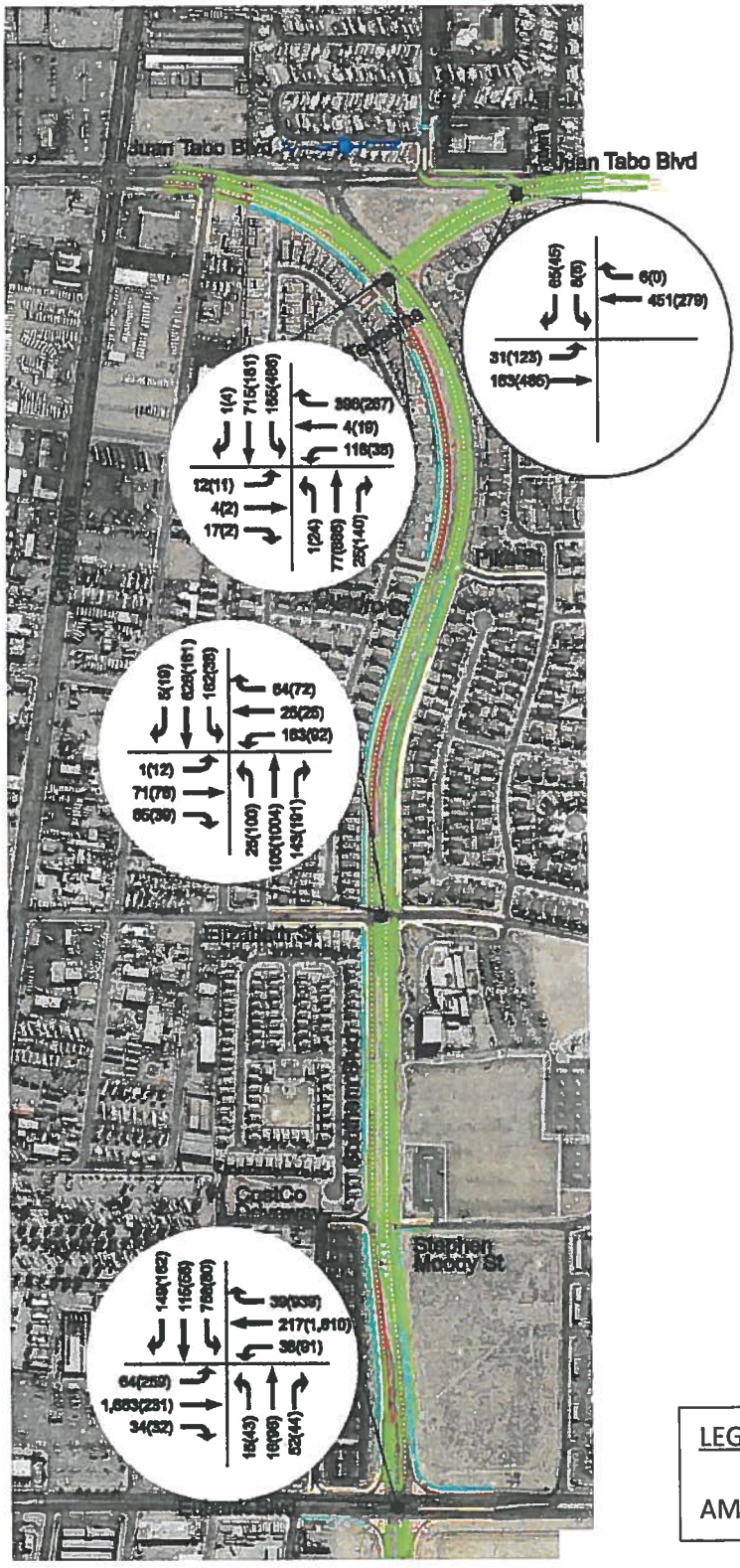

Figure 6. Final Peak Hour Design Demands

3. Operational Analysis

Warrant Analysis

Traffic signal warrant numbers 1, 2, 3, 4, and 7 have been calculate and applied to both the Elizabeth Street and Juan Tabo Boulevard intersections for 12-hour (6:30 AM to 6:30 PM) observed traffic demands. Also, for Juan Tabo, the proposed relocated intersection geometry was applied. Calculation sheets are included in **Appendix B** and the results are summarized in **Table 2**. As indicate, Elizabeth Street will satisfy Signal Warrant 2, and Juan Tabo satisfies Signal Warrants 1, 2 and 3. Therefore, signal control is recommend to be maintained at Elizabeth Street and incorporated into the new Juan Tabo intersection. Additionally, since the Elizabeth Street intersection would be considered a crossing along a school walking route for Monzano Mesa Elementary, retaining signalized control will continue to allow students as well as community center patrons to continue to cross southern during a pedestrian phase.

Table 2. Summary of Warrant Analyses

Intersection	Warrants Satisfied							
	1	2	3	4	5	6	7	8
Southern Blvd/ Elizabeth St	No	Yes	No	No	NA	NA	No	NA
Southern Blvd/ Juan Tabo Blvd	Yes	Yes	Yes	NA	NA	NA	No	NA

Intersection Capacity/LOS Analysis

In accordance with the Highway Capacity Manual Update (HCM 2000) procedures, level of service (LOS) has been determined for all study intersections by estimating the average vehicle delay of all approaches. The ranges of traffic delay associated with each LOS are presented in **Table 3** with LOS calculation sheets included in **Appendix B.**

Table 3. Level of Service Criteria

LOS	Signalized Intersections Control Delay (sec/veh)	Unsignalized Intersections Average Delay (sec/veh)
A	≤ 10	≤ 10
B	>10 and ≤20	>10 and ≤15
C	>20 and ≤35	>15 and ≤25
D	>35 and ≤55	>25 and ≤35
E	>55 and ≤80	>35 and ≤50
F	>80	>50

Incorporating existing and proposed lane configurations and intersection control shown in **Figures 7**, LOS analyses of all study intersections are summarized in **Table 4**. As indicated, under existing conditions all study intersections operate below capacity and at LOS D or better.

Also as indicated in **Table 4**, under proposed lane configurations and intersection control, all study intersections will operate below capacity and at LOS D or better, except when Elizabeth Street was analyzed as Two Way Stop Control (TWSC) which indicates a LOS F for the northbound left-turn movement in both the AM and PM peaks, and except for the left-turn from Horseshoe Trail, which indicates a LOS F in both Am and PM peaks as well. However, this movement is well below capacity with very low demand and the Highway Capacity Manual (HCM) 2000 recognizes that this situation is not an uncommon occurrence for minor street left-turn movement turning onto a major arterial. It is recommended that this movement be permitted as long as safety or operational issues do not develop.

Table 4. Summary of Capacity Analysis

Intersection	Condition (Control)	Worst-Case Movement or Intersection	AM Peak					PM Peak				
			Volume	Capacity	X_c	Delay	LOS	Volume	Capacity	X_c	Delay	LOS
Southern Blvd/ Eubank Blvd	Existing (Signal)	Intersection	-	-	0.71	39.9	D	-	-	0.78	48.7	D
	Future Optimized (Signal)	Intersection	-	-	0.69	27.1	C	-	-	0.85	40.2	D
Southern Blvd/ Elizabeth St	Existing (Signal)	Intersection	-	-	0.47	10.1	B	-	-	0.81	15.3	B
	Future Optimized (Signal)	Intersection	-	-	0.39	23.7	C	-	-	0.48	17.6	B
	Future Optimized (Stop Control)	NBL	274	216	1.27	197.6	F	20S	220	0.93	82.2	F
Southern Blvd/ Juan Tabo Blvd	Existing (Signal)	Intersection	-	-	0.43	5.6	A	-	-	0.55	38.2	D
	Future Optimized (Signal)	Intersection	-	-	0.46	26.2	C	-	-	0.75	42.8	D
Juan Tabo Blvd/ Horseshoe Tr	Existing (Stop Control)	WBL	9	391	0.02	14.4	B	7	299	0.02	17.3	C
	Future Optimized (Signal)	SWBL	9	108	0.08	41.3	E	7	80	0.08	53.6	F

X_c = Critical Volume to Capacity Ratio

Existing

Proposed

Figure 7. Existing and Proposed Geometry and Traffic Control

Proposed lane configurations and intersection control for study intersections are depicted in **Figure 7** and are summarized as follows:

Eubank Intersection

- The east leg of the Eubank/Southern intersection is recommended to incorporate dual left-turn lanes with the right-most lane a drop lane, one through lane, and a right-turn lane.
- The west leg at a minimum should incorporate one left-turn lane, one shared through-right lane.
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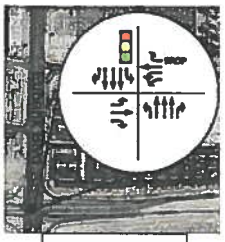

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Elizabeth Intersection

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- The southbound through lane is currently not aligned with the south leg. Therefore it is recommended that dashed extension lane lines be used to guide southbound through traffic through the intersection.
- It should be noted that the northbound left-turn is anticipated to operate at an LOS E in the AM peak and LOS F in the PM peak under existing lane configuration and traffic control. Left-turn operation would improve by providing an exclusive left-turn lane and green phase. However, the alignment of Elizabeth Street at Southern Boulevard makes proper through lane alignment impossible without major reconstruction of the south leg. An alternative to realignment could be the conversion of the existing northbound right-turn lane to a shared through-right lane using striping. It will not be perfectly aligned with the north leg, but with the inclusion of the bike lane align better than the existing southbound through lane. Since Elizabeth operating speeds are 25 mph, the alignment of Elizabeth through Southern, while not optimal should not present safety issues for through traffic on Elizabeth. A ten-foot

wide left-turn lane would then be striped where the current through lane exists. A conceptual drawing of this striping is found as **Figure 8**.

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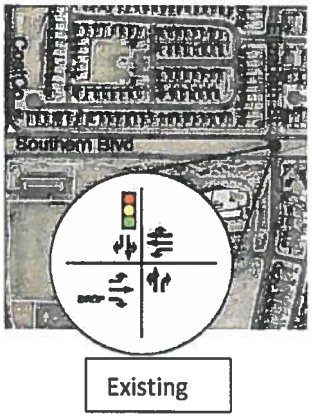

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Juan Tabo/Terracina Intersection

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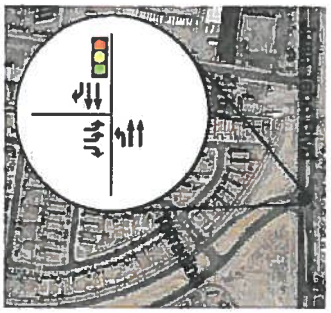
- Due to heavy PM peak right-turn demands at the southeast leg, it is recommended that signal timing use an overlapping right-turn phase for this approach. Additionally, due to the dual right-turn lanes it is recommended that the right-turn lanes are protected only and channelized using a right-turn channelizing median island. This will provide 1-2 vehicle lengths of queue storage for the light through demands.



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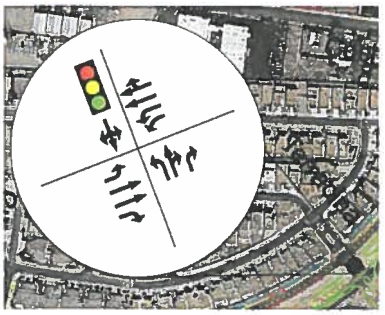

Proposed

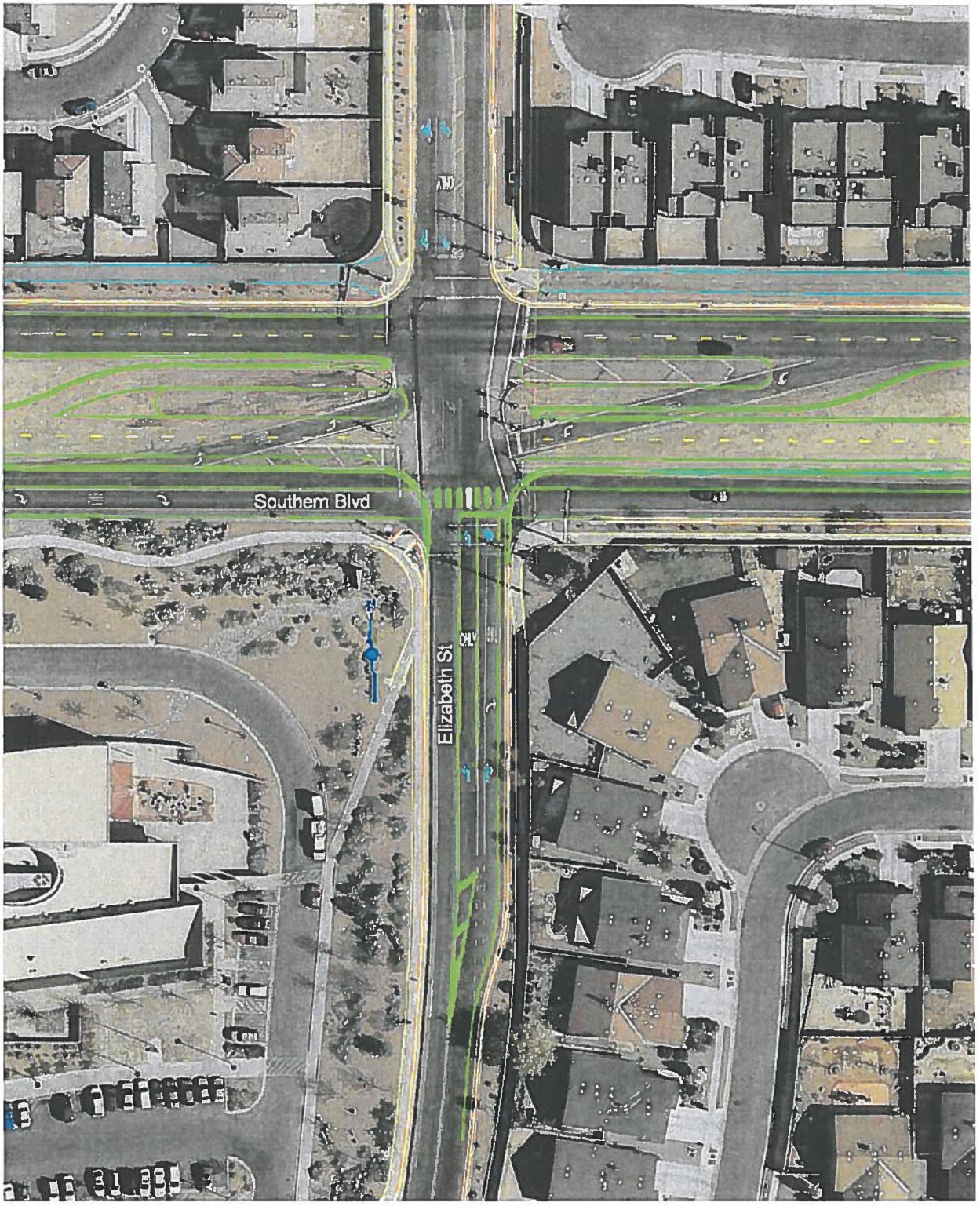

Figure 8. Striping Concept for Elizabeth Street Legs

Auxiliary Lane Storage Analysis

Analyses of left-turn queue demands and storage lengths have been calculated. For design purposes, the 95th Percentile queue will be utilized for recommended storage lengths. Design storage lengths for proposed left-turns are summarized in **Table 5**.

Table 5. Auxiliary Lane Storage Analysis

Intersection	Approach	Period-Condition	Cycle Length	Volume (vph) Design	Design Queue (ft)[1]	Existing Storage (ft)			Proposed Storage (ft)		
						Lane 1	Lane 2	Total	Lane 1	Lane 2	Total
Eubank Blvd/ Southern Blvd	NB	PM	120	65	115	285	-	285	**SAME**		
	SB	PM	120	235	311	TWLT	-	TWLT	**SAME**		
	EB	PM	120	35	74	125	-	125	**SAME**		
	WB	AM	110	758	777	500	500	1000	**360**	**985[2]**	**1345**
Elizabeth St/ Southern Blvd	SB	PM	120	12	36	100	-	100	**SAME**		
	EB	PM	120	100	158	120	-	120	**200**	**-**	**200**
	WB	AM	110	162	215	175	-	175	**250**	**-**	**250**
Juan Tabo Blvd/ Southern Blvd	NB	PM	120	178	249	NA			**250**	**-**	**250**
	EB	PM	120	24	57	NA			**150**	**-**	**150**
	WB	PM	120	861	938	NA			**450**	**525**	**975**

[1]95th % Queue = [(vehicle/interval)+Z(vehicle/interval)^0.5]*25 ft/veh
where,

(vehicle/interval) = VPH/3600 sec/hr x cycle length,
Z = 1.645 for 95% confidence level (one-tailed test),
25 feet = assumed vehicle length.

[2]Left-turn drop lane.

Note: For dual left-turn lanes, Lane 1 is left-most turn lane and lane 2 is right-most turn lane.

Additionally, based on random arrivals for a 180 second queuing interval, it was calculated that the required left-turn storage for the southbound approach at the Juan Tabo/Horseshoe Trail intersection is 150 feet based on a PM peak demand of 123 vehicles.

Existing right-turn length at the westbound leg of the Eubank intersection can be retained. Through movements are very low on this approach and are not anticipated to block access to the right-turn lane. The length will also accommodate deceleration from the 35 mph speed limit on Southern Boulevard.

The right-turn lane at the west leg of the Elizabeth Street intersection is recommended to incorporate 150 feet in storage length, which should accommodate deceleration from 35 mph and is not anticipated to be blocked by through demands.

Recommended right-turn lanes at the west leg and south leg of the Juan Tabo intersection should incorporate at least 150 feet of storage capacity.

Transit Stops and Turnouts

ABQ Ride routes 1 and 2 currently serve the Project Site, with Route 1 bus stops located on both sides of Juan Tabo at Horseshoe Trail and bus stops located on both sides of Juan Tabo just north of the existing Southern Blvd intersection. Route 2 incorporates a bus stop at the Manzano Mesa Multigenerational Center at the southwest quadrant of the Elizabeth Street intersection.

New construction on Southern boulevard should include plans to maintain all of these stops except one. Route 1 bus stops south of Southern Boulevard will have to be relocated to the west side of the south leg and the south side of the east leg of the new Juan Tabo/Southern Boulevard intersection. ABQ Ride prefers that bus stops be located within 150 feet of the intersection.
The southbound bus stop currently serving Route 1 just north of the Juan Tabo/Southern intersection at Cochiti Street can be maintained, but the northbound stop at this location could be eliminated due to the proposed bus stop approximately 400-500 feet away, just east of the relocated Juan Tabo/Southern intersection.

The Route 2 bus stop should not be impacted by construction since it is located onsite of the Manzano Mesa Multigenerational Center.

Existing and proposed transit stops are summarized in **Figure 9**.

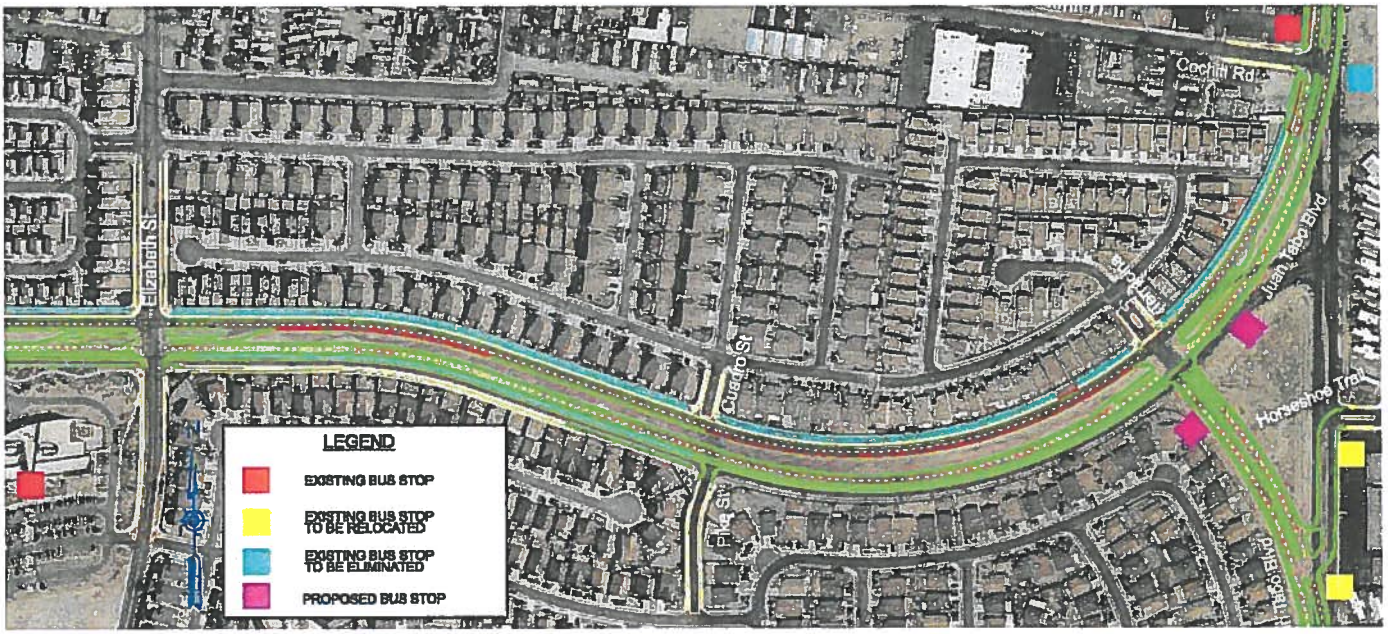

Figure 9. Existing and Proposed Transit Stops

Accident History Evaluation

Accident data for all study intersections for the past three years were obtained from GIS data provided by the MRCOG, which is included in **Appendix B**. Accidents occurrences and their causes are summarized in **Table 6**. Based on the average frequency of accidents at Albuquerque intersections, only the Elizabeth intersection during 2007 would be considered a high accident location.

Rear end accidents are the most frequent. Many of the rear end accidents on Elizabeth were on the eastbound approach, which could be due to the lack of capacity and the drop right-turn lane. This could be remedied with the conversion of the right-turn lane to a shared through right.

Two of the Elizabeth single car accidents (2008) were to avoid hitting a pedestrian with one occurring at 3:30 PM. It is recommended that school crossing signs be incorporated into the intersection, and if not already in practice there is a potential to incorporate crossing guards at this location.

Table 6. Accident Summary

Intersection	Year	Accident Rate Acc/MEV	High Crash Location[1]	Accident Type	Accident Type %	Potential Mitigation	Cause	Cause %
Southern/ Eubank	2006	1.18	No	Rear End Single Car	63% 19%		Failure to Yield Follow too Closely	25% 25%
	2007	1.11	No	Rear End Single Car	60% 20%		Driver Inattention Failure to Yield	47% 20%
	2008	0.42	No	Rear End Single Car	43% 29%		Follow too Closely Failure to Yield	14% 14%
Total	**2006-2009**	**0.87**	**No**	**Rear End Single Car**	**58% 13%**	**Improve Signing for Drop Lane NA**	**Driver Inattention Failure to Yield**	**32% 21%**
Southern/ Elizabeth	2006	0.98	No	Single Car Rear End	66% 34%		Failure to Yield Follow too Closely	33% 33%
	2007	1.98	Yes	Angle Rear End	67% 33%		Failure to Yield Driver Inattention	50% 33%
	2008	0.7	No	Single Car Rear End or Sideswipe	67% 33%		Speed Driver Inattention	33% 33%
Total	**2006-2009**	**1.15**	**No**	**Single Car Rear End**	**33% 33%**	**Provide School Crossing Signs/Crossing Guard Removal of Drop Lane**	**Failure to Yield Driver Inattention**	**25% 25%**
Southern/ Juan Tabo	2006	0	No	NA NA	NA NA		NA NA	NA NA
	2007	0.55	No	Sideswipe Single Car	40% 40%		Failure to Yield Other	40% 60%
	2008	0.1	No	Rear End	100%		Driver Inattention	100%
Total	**2006-2009**	**0.21**	**No**	**Sideswipe Rear End**	**33% 33%**	**Addition of Lane Provide Progression**	**Driver Inattention Failure to Yield**	**40% 40%**

1 Based on above average crash rate - 1.31 Acc/MEV
MEV = Million Entering Vehicles

4. Signal Coordination

Currently, only the Eubank intersection is coordinated for traffic north and south, while the other two intersections are operating as semi actuated isolated signals. It is recommended that Southern Blvd incorporate signal coordination from Central Avenue to Eubank. Incorporating signal coordination along Southern Blvd will encourage the use of Southern Boulevard over Juan Tabo and area residential streets for commuters to and from Kirtland Air Force Base and Sandia Labs.

Using the Synchro software, coordination analyses were prepared to determine possible cycle offsets for signal coordination. Calculation sheets and time space diagrams are included in **Appendix C**. Traffic demands are very directional for both the AM and PM peak periods with the westbound direction dominating demands on Southern Boulevard in the AM peak and the eastbound direction dominating the PM demands. Therefore, offsets favored the dominate direction for that peak period. The recommended offsets and resulting bandwidths for both AM and PM plans are summarized in **Table 7**.

Table 7. Summary of Offsets and Bandwidths for Southern Boulevard

Intersection	Bandwidth (seconds)				Offset (seconds)	
	AM Peak		PM Peak			
	EB	WB	EB	WB	AM	PM
Juan Tabo/Southern	0s	34s	23s	0s	47s	18s
Elizabeth/Southern					72s	62s

Offsets are shown for the Elizabeth and Juan Tabo intersections only and do not include offsets for Eubank Boulevard and Central Avenue intersections, which are coordinated with other signalized intersections along Eubank Boulevard and Central Avenue and is beyond the scope of this study. It is recommended that coordination along Eubank and Central be reviewed to investigate additional mitigation to further improve progression along Southern Boulevard. It should be noted that eastbound PM peak progression along Southern Boulevard will be very difficult as the heaviest demand feeding eastbound Southern Boulevard is the northbound right-turn from Eubank Boulevard.

Whenever signalized intersections along Eubank are retimed, it is recommended that the retiming of Eubank Boulevard at Southern Boulevard should look at adjusting the westbound dual left-turn phase so that AM peak platoons will arrive at this beginning of this phase's green, as this is the dominant movement in the AM peak hour.

In the PM peak the dominant movement feeding Southern Boulevard from Eubank Boulevard is the northbound right-turn, which correctly allows right-turns on the red phase. Therefore PM eastbound platoons are less likely and loosely spaced. Corridors with fewer platoons are more difficult to coordinate and generally achieve smaller bandwidths. This fact accounts for the smaller band width provided for in the PM peak hour (23 S) due to what is essentially random arrivals eastbound at the Elizabeth intersection.

5. Gated Queue Analysis for Terracita

The proposed relocated Juan Tabo intersection will incorporate Terracita as its north leg of the intersection. Currently Terracita is entrance and exit to a gated community. It was observed in the field, that a large majority of the residence had transponders to open the entry gate. However, some residents were observed to utilize the keypad to gain gate access. This would be how any visiting non-residence would be required to enter as well. Generally, those with transponders took around 10 seconds to complete entry, meaning completely pass through the open gate, while keypad entries took around 15 seconds. Additionally, the entry width is approximately 16 feet, and will allow someone with a transponder to pass a vehicle sitting at the keypad. The maximum queue observed at the gate was two vehicles. It should also be noted that a vehicle following close behind another was able to traverse the gate without activating the transponder or keypad again.

Gated queuing storage requirements have been calculated based on 98th percentile confidence levels and an observed peak hour demand of entry at 47 vph. Assuming a conservative typical service time of ≤20 seconds, and a single service position, the required queue storage inclusive of the service position is calculated to be 50 feet (2 vehicles), which is consistent with what was observed in the field. Calculations are shown below:

$$\Delta = \frac{q}{NQ} = \frac{47 \text{ vph}}{(1)\ 180 \text{ vph}} = 0.2611$$

$Q_M =$ 0.2611 (per Table 8-11 of *Transportation and Land Development*)

$$M = \frac{\ln 0.02 - \ln Q_M}{\ln \Delta} - 1 = .91, \text{ Say 1 vehicles}$$

Queue Storage = 25 ft (M + 1) = 50 feet

The existing layout of the gated entry incorporates 55 feet to the keypad and over 100 feet (4 vehicles) to the gate itself. Therefore it is concluded that the existing geometry will accommodate queue storage demands.

It should be noted that a mechanical issue could arise with the gate not allowing vehicles entry. Depending on the repair response time, this could result in a period where vehicle queue could back into the intersection. However, this could occur with the existing geometry and traffic control as well.

6. Access Evaluation for Costco and Horseshoe Trail

Costco Driveway

With Southern Boulevard now reclassified as a collector road, full access driveways are allowed to be more closely spaced together. Costco currently has a right-in/right-out driveway located approximately 1,000 feet east of the Eubank Boulevard intersection. Additionally, the existing Costco driveway is in close proximity to loading piers at the back of the building. Allowing left-in movement access at this driveway will provide an attractive alternative service entrance for trucks accessing Costco from Eubank that will effectively limit truck interaction with customer parking fields onsite.

It would also be beneficial to allow exiting left-turns at this driveway due to the fact that. one must make a more difficult left-turn onto Eubank Boulevard in order to route to the south or east; which with heavier arterial demands and two-way left-turn lane geometry can make for difficult maneuvering during peak hours. However, driveway alignment does not allow for safe full movement access.

Therefore unless realignment is feasible, it is recommended that the current Costco driveway on Southern Boulevard be converted to allow left-in access. The driveway is currently upstream enough from the Eubank Boulevard intersection that a 150-foot left-in pocket can be accommodated without conflicting with the Eubank/Southern westbound dual left-turn pocket. The redesigned driveway and median opening should be designed such that it will accommodate a WB-50 design vehicle. A conceptual design of the median opening and driveway is depicted in **Figure 10**.

It should be noted that redesign of the driveway itself should include removal of the channelizing island, realignment of the pedestrian ramps, and should be restriped with a yellow centerline denoting inbound and outbound traffic.

Horseshoe Trail

Horseshoe Trail currently accesses Juan Tabo Boulevard approximately 350 feet south of Southern Boulevard, and serves a small commercial strip mall. Peak hour traffic counts indicate 37 inbound and 73 outbound vehicles use this access in the AM peak hour and 123 inbound and 51 outbound vehicles in the PM peak hour. It is recommended that Horseshoe Trail maintain access to the realigned Juan Tabo by turning the Horseshoe Trail alignment to the south into Juan Tabo approximately 500 feet south of the new Southern Blvd/Juan Tabo intersection. As mentioned in the queue analysis section, a southbound left-turn pocket of 150 feet is required. The Horseshoe Trail approach will be under stop control and the Juan Tabo approaches will be uncontrolled. Also, the right-turn onto Juan Tabo will be channelized to better accommodate right-turn radii.

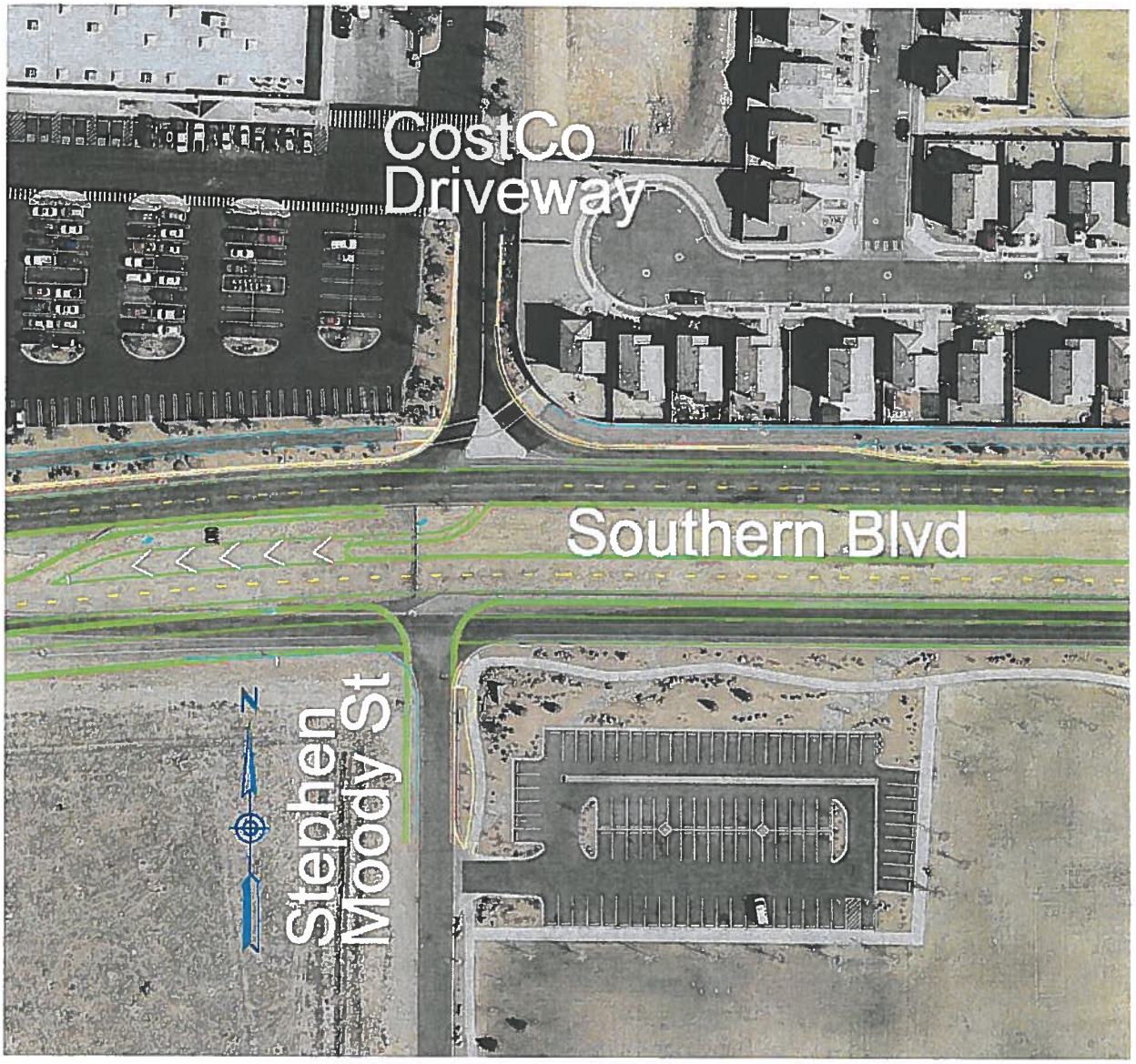

Figure 10. Access at Costco Driveway

Conclusions and recommendations are mentioned throughout each section of the text and are summarized in the Executive Summary.

The Appendices are included herein in pdf format on a data disk.