

Final Transportation Engineering Study

**Traffic Engineering Study for Valencia Road,  
Mountain Eagle Drive to Mark Road  
(4RTVMW and 4RTVWE)**

Tucson, Arizona

**July 2011**

Final Transportation Engineering Study

# Traffic Engineering Study for Valencia Road, Mountain Eagle Drive to Mark Road

Tucson, Arizona

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## 1. Executive Summary

The widening of Valencia Road from a half-mile west of Mountain Eagle Drive to Mark Road is a Regional Transportation Authority (RTA) funded roadway project. This traffic engineering report was prepared as part of the design process for the section of Valencia Road from Mountain Eagle Drive to Mark Road. Study area maps are provided in Exhibits 1 and 2. The study area on Valencia Road is exclusive of the Mark Road intersection. The Mark Road Intersection was evaluated and reconstructed as a part of the Valencia Road Mark Road to Camino de la Tierra project.

This traffic engineering report was prepared in accordance with the guidelines set forth by Pima County Roadway Design Manual (Third Edition). The purpose of this traffic report is to evaluate existing and future (2030) traffic conditions and provide specific recommendations to be used for the design of improvements on Valencia Road. These recommendations include the need for additional signalized intersections, lane configuration at signalized intersections, turn lane storage requirements, traffic control requirements, location and configuration of median openings, pedestrian and bicycle features, and the need for roadway lighting.

### Conclusions of the Report

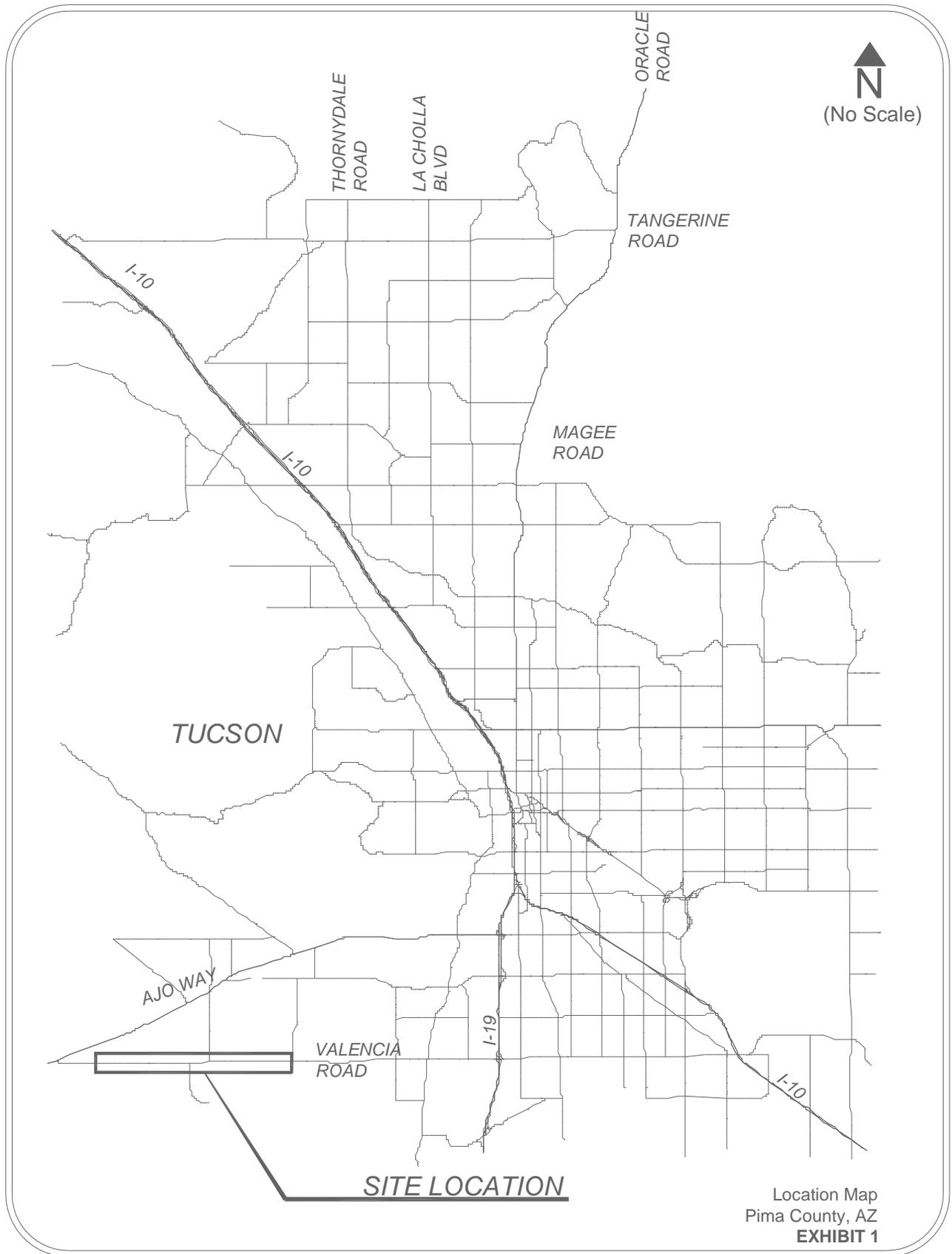
Conclusions and improvement needs for opening year of the Valencia Road from Mountain Eagle to Mark Road improvement project include:

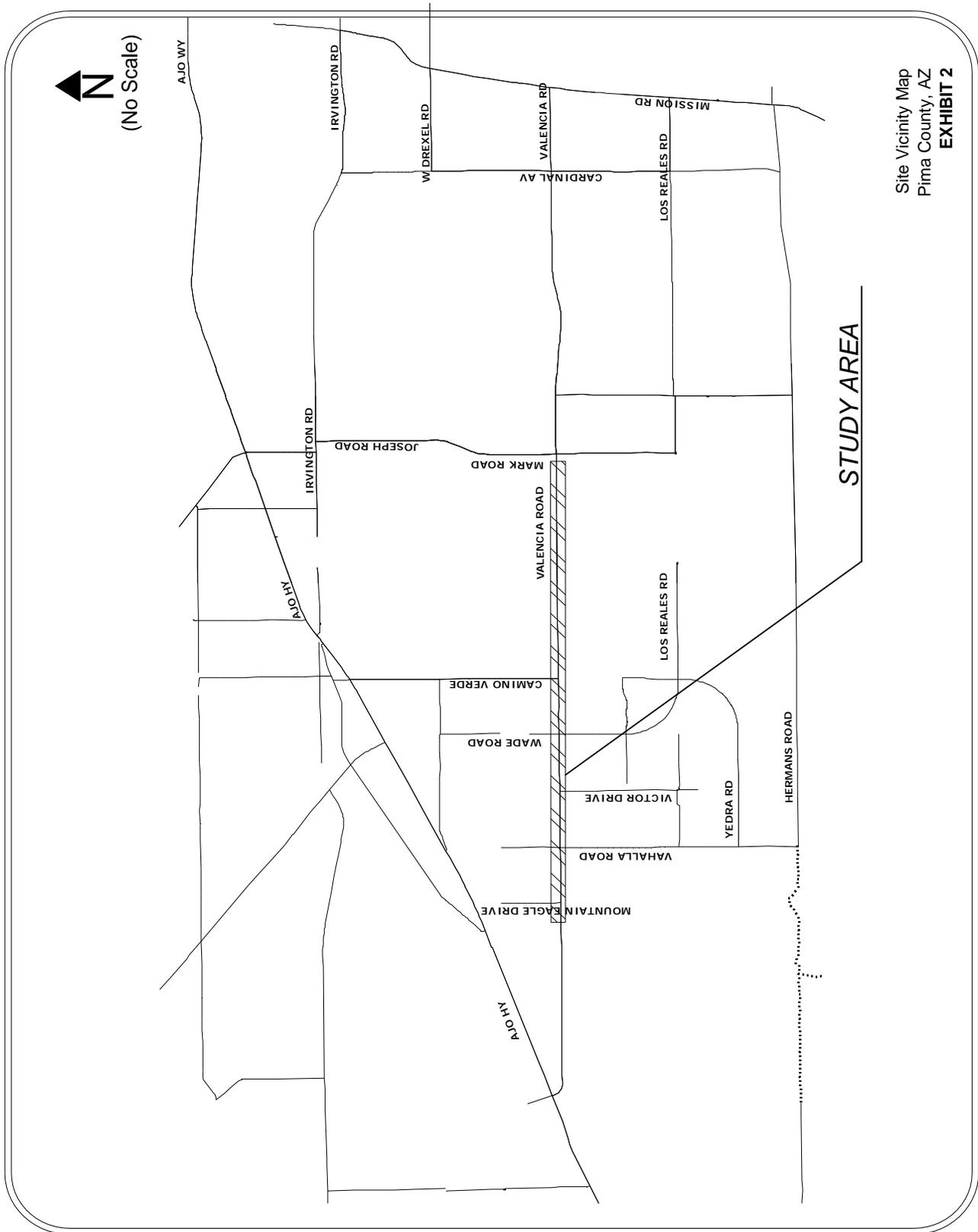
- Traffic flow on Valencia Road is clearly directional with heavy eastbound traffic during the a.m. and heavy westbound traffic during the p.m. peak periods. As such, the additional signalized intersections provided in Exhibit 15 should be added; and different signal timing strategies should be implemented for different peak periods.
- To accommodate the projected 2030 traffic demands, a 4-lane roadway is needed for the entire section of Valencia Road, from Mountain Eagle to Mark Road.
- Based on the 2030 traffic projections, the turn lane storage lengths provided in Exhibit 18 are recommended for signalized intersections.
- A review of crash data covering the last three years showed signalized intersections' crash rates are higher than average for signalized intersections within Pima County. The addition of through lanes and proposed raised median to control access should improve the overall safety on Valencia Road

## 2. Introduction

The corridor under study is Valencia Road from Mountain Eagle Drive to Mark Road. This project is located in southwest Tucson, Arizona as shown in Exhibit 1. A more descriptive map of the study area is illustrated in Exhibit 2. The widening of Valencia Road from Mountain Eagle Drive to Mark Road is a RTA funded project. This project will widen the western three-and-a-half miles of existing two-lane roadway to a four-lane divided arterial, and the eastern one mile to a five-lane arterial. This project is to be completed in two phases. Pima County Department of Transportation will lead the preliminary roadway design for the entire corridor. During Phase I of the project Pima County Department of Transportation will design and construct the roadway improvements from Wade Road to just west of the Mark Road intersection. During Phase II, the roadway improvements will be designed and constructed from Mountain Eagle Drive to Wade Road.

The proposed widening of Valencia Road from Mountain Eagle Drive to Mark Road aims to provide capacity for future traffic demands, improve traffic safety and operations, reduce congestion, and increase mobility. The purpose of this traffic engineering report is to address capacity, safety, access, and multi-modal requirements. More specifically, the report presents results from the evaluation of the existing conditions as well as analyses of the future traffic conditions; then it presents recommendations for improvements. The following potential improvements have been considered and evaluated: additional travel lanes and turning lanes, turn lane storage requirements, intersection operational analysis, access control, pedestrian, transit, and bicycle facilities.





Site Vicinity Map  
Pima County, AZ  
**EXHIBIT 2**

### 3. Existing Conditions

This section provides an inventory of existing features and conditions within the roadway corridor.

#### 3.1 Land Use

Much of the property along this section of Valencia Road is currently developed and many of the vacant lots have approved development plans. Zoning of the property adjacent to the corridor includes residential and business/commercial land uses. Zoning along Valencia Road includes CB-1, CR-1, CR-3, CR-4, CR-5, CMH-1, GR-1, RH, SH, SR and TR under Pima County zoning ordinances. CB-1 is zoned as local business zone, CR-1 is zoned as single residence, CR-3 as single residence, CR-4 as mixed dwelling type zoning, and CR-5 is zoned as multiple residences. CMH-1 as County manufactured and mobile home, GR-1 is zoned rural residential, RH is zoned rural homestead, SH as suburban homestead, SR is zoned as suburban ranch and TR is zoned as transitional.

#### 3.2 Physical Conditions

##### 3.2.1 Roadway

Valencia Road has one through travel lane in each direction between Mountain Eagle Drive and Mark Road. The roadway lies within Pima County. The existing horizontal alignment consists of tangent sections and curves.

The roadway consists of a 3-lane cross section from Mountain Eagle Drive to approximately 3500 feet west of the Mark Road intersection. This roadway project does not include the Mark Road intersection. This cross section includes 12-foot wide through lanes, 12-foot wide two-way left turn lane and one-foot wide paved shoulders with exclusive left and right turn lanes at the major intersection with Camino Verde.

The corridor has one signalized intersection and 13 unsignalized intersections. Refer to Exhibit 3.

##### 3.2.2 Speed Limits

The existing posted speed limits on the roadways within the study area are as follows. All other side streets have a 25 mile per hour (mph) posted speed limit.

- Valencia Road from Mountain Eagle Drive to Camino Verde – 50 mph
- Valencia Road from Camino Verde to Mark Road - 45 mph
- Vahalla Road south of Valencia Road – 45 mph
- Wade Road south of Valencia Road – 45 mph
- Camino Verde - 45 mph
- Ignacio Baumea – 35 mph
- Mark Road – 45 mph

##### 3.2.3 Intersections

The roadway corridor lies within unincorporated Pima County. Currently there is one signalized intersection and 13 unsignalized intersections within the study corridor. Existing lane configurations and traffic control devices for major intersections along the corridor are shown in Exhibit 4.

### 3.3 Traffic Data and Analysis

#### 3.3.1 Traffic Counts

The following traffic counts were collected for the project between November 17, 2010 and February 7, 2011.

- Morning and evening peak period turning movement counts at the signalized intersections at Camino Verde and at Mark Road.
- Morning and evening peak period turning movement counts at stop-controlled intersections at Mountain Eagle Drive, Vahalla Road, Iberia Avenue, Wade Road and Ignacio Baumea.
- Vehicle Classification on eastbound and westbound Valencia Road.
- Directional daily traffic at the following locations: Valencia Road, Mountain Eagle Drive, Vahalla Road, Iberia Road, Wade Road, Camino Verde, Casino del Sol, Ignacio Baumea and Mark Road.
- Additional directional daily traffic at the following locations: Via Molino De Viento, Via Diego De Riveria, Bullfinch Drive, Giuliani Avenue, De Concini Drive, Eagle's Talon Parkway, Victor Drive, Star Ridge Place, Star Diamond Place, South Arrow, Mardick Avenue, Viviana Road, and Valencia Road.

To complement the counts collected above, historical traffic counts were also obtained from Pima Associations of Governments (PAG) and Pima County Department of Transportation (PCDOT), Traffic Division. Directional daily traffic counts are summarized in Exhibit 5 and peak-hour turning movement counts are summarized in Exhibit 6 and 7. Raw counts and any additional directional daily traffic counts are included in Appendix A for reference. Based on the counts, the peak hours were found to occur between 7:15 AM – 8:15 AM in the morning and 5:00 PM – 6:00 PM in the evening.

BEGIN PROJECT



MATCHLINE A

MATCHLINE A



MATCHLINE B

MATCHLINE B



MATCHLINE C

- Ⓢ Signalized Intersection
- Ⓤ Unsignalized Intersection
- Ⓣ Driveway

MATCHLINE C



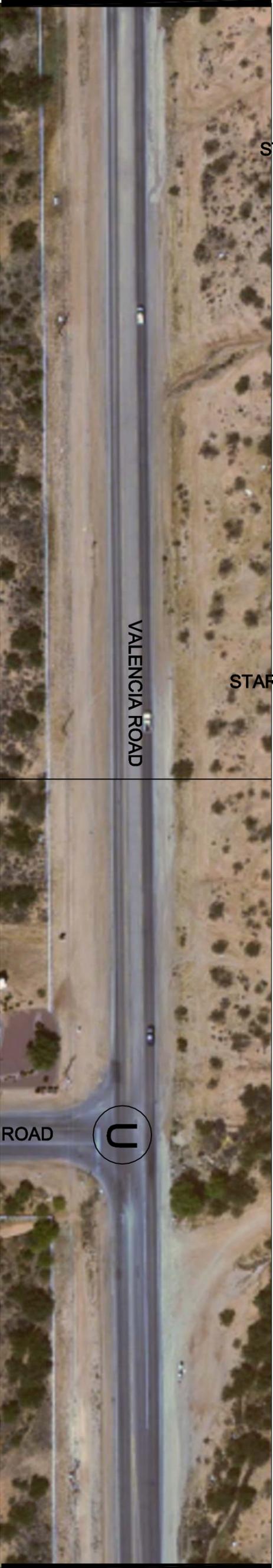
MATCHLINE D

MATCHLINE D



MATCHLINE E

MATCHLINE E



MATCHLINE F

- Ⓢ Signalized Intersection
- Ⓤ Unsignalized Intersection
- Ⓣ Driveway

MATCHLINE F



MATCHLINE G

MATCHLINE G



MATCHLINE H

MATCHLINE H



MATCHLINE I

- Ⓢ Signalized Intersection
- Ⓤ Unsignalized Intersection
- ⓓ Driveway

MATCHLINE I



MATCHLINE J

MATCHLINE J



MATCHLINE K

MATCHLINE K



MATCHLINE L

- Ⓢ Signalized Intersection
- Ⓤ Unsignalized Intersection
- ⓓ Driveway

CAMINO RANCHO

Ⓤ

VALENCIA ROAD

CASINO DEL SOL

ⓓ

VIVIANA ROAD

Ⓤ

VALENCIA ROAD



MATCHLINE N



MATCHLINE M



MATCHLINE L



- Ⓢ Signalized Intersection
- Ⓤ Unsignalized Intersection
- Ⓣ Driveway

VALENCIA ROAD

Ⓤ

Ⓢ

MARK ROAD

VALENCIA ROAD

IGNACIO BAUMEA

Ⓤ

VALENCIA ROAD

CASINO DEL SOL

Ⓣ

VALENCIA ROAD

Ⓣ

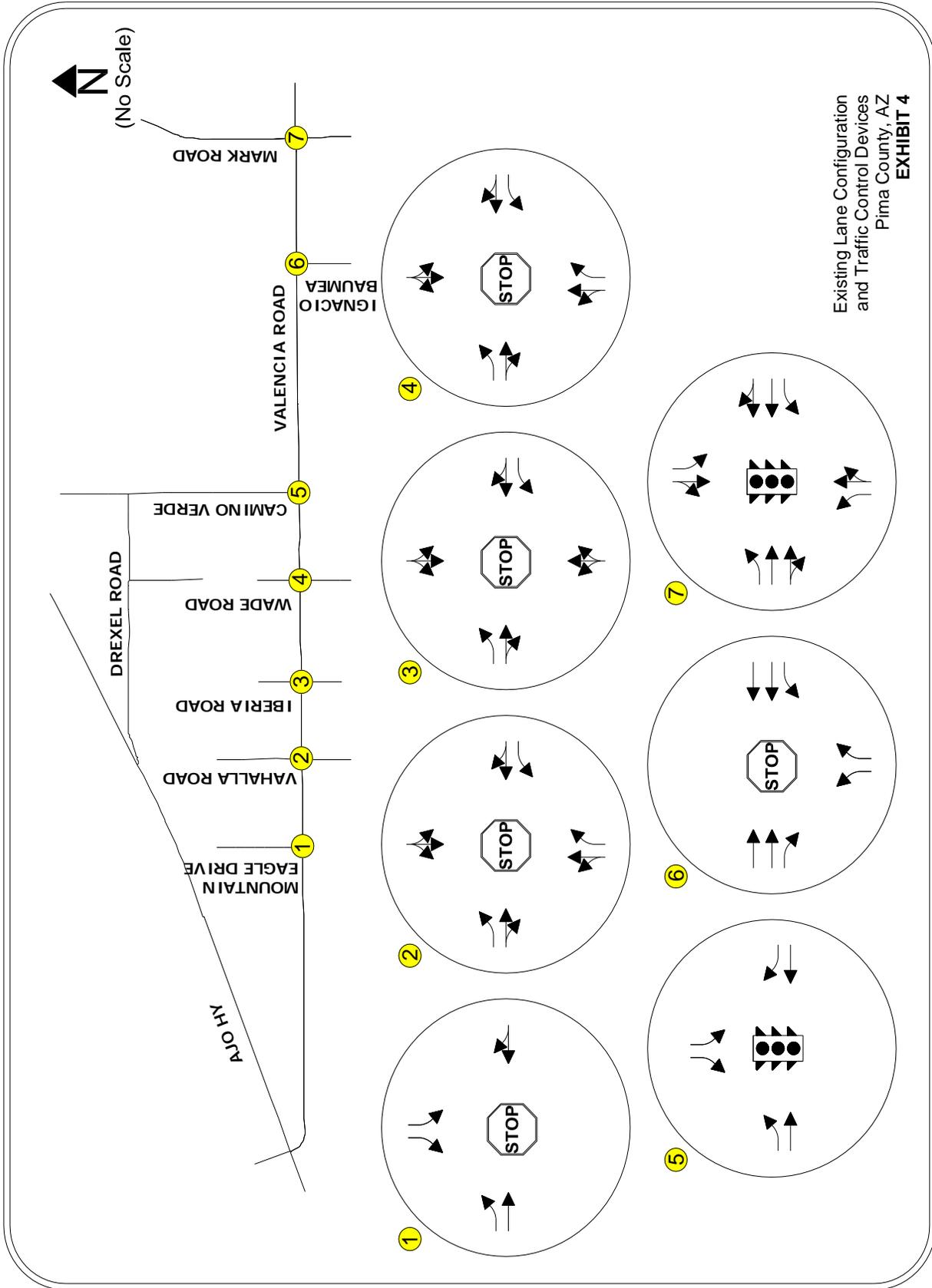
Ⓣ



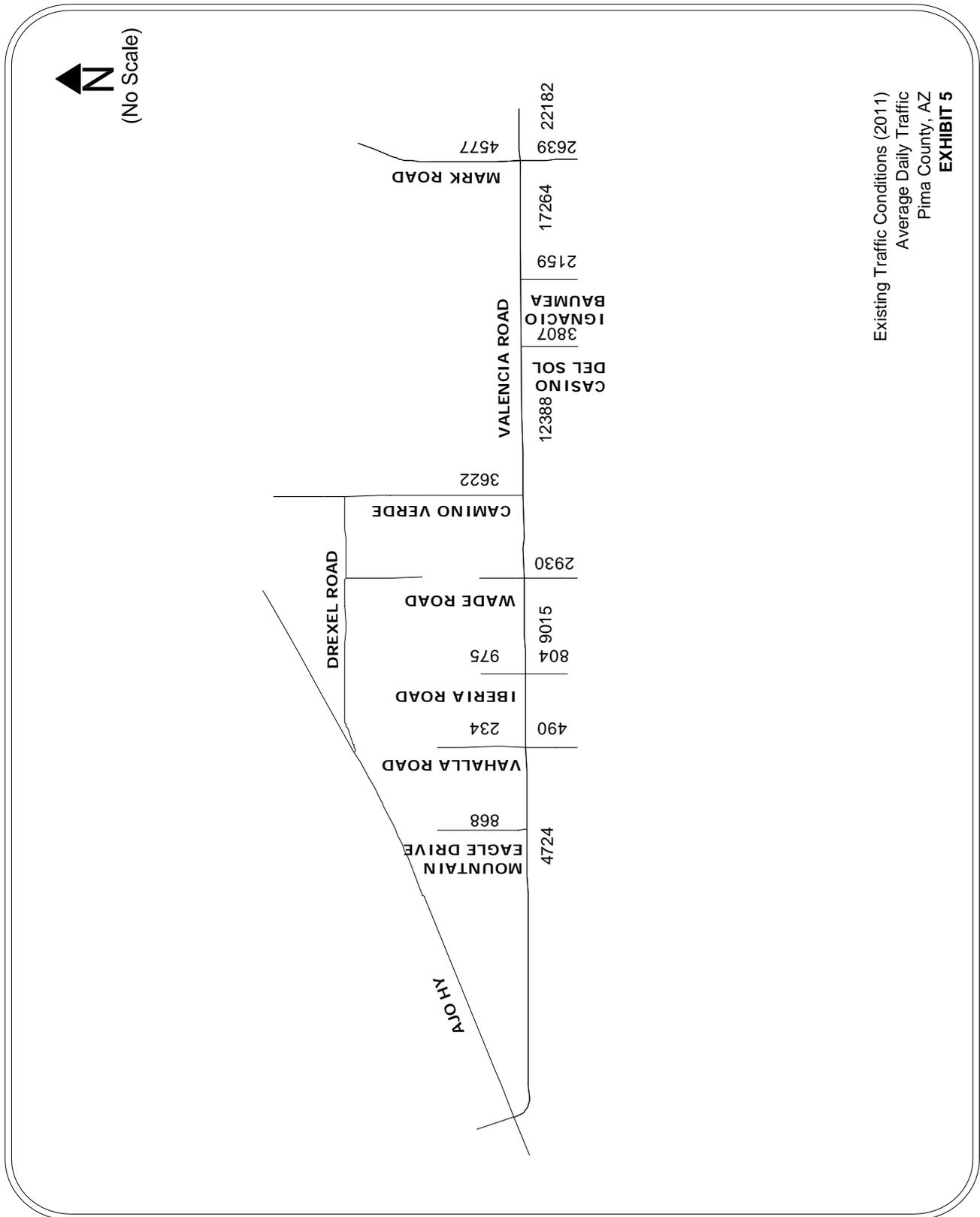
(No Scale)

MATCHLINE N

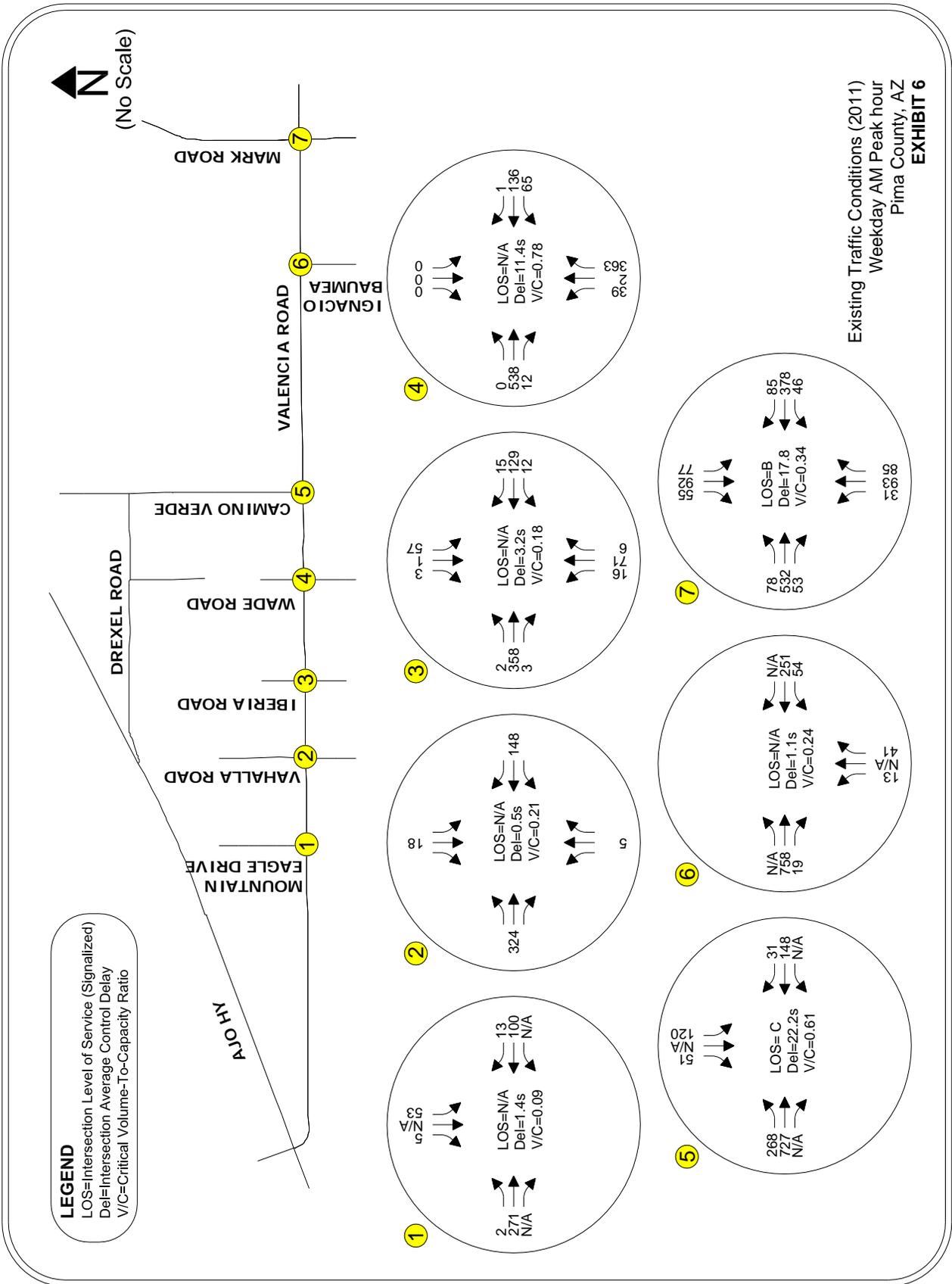
MATCHLINE M

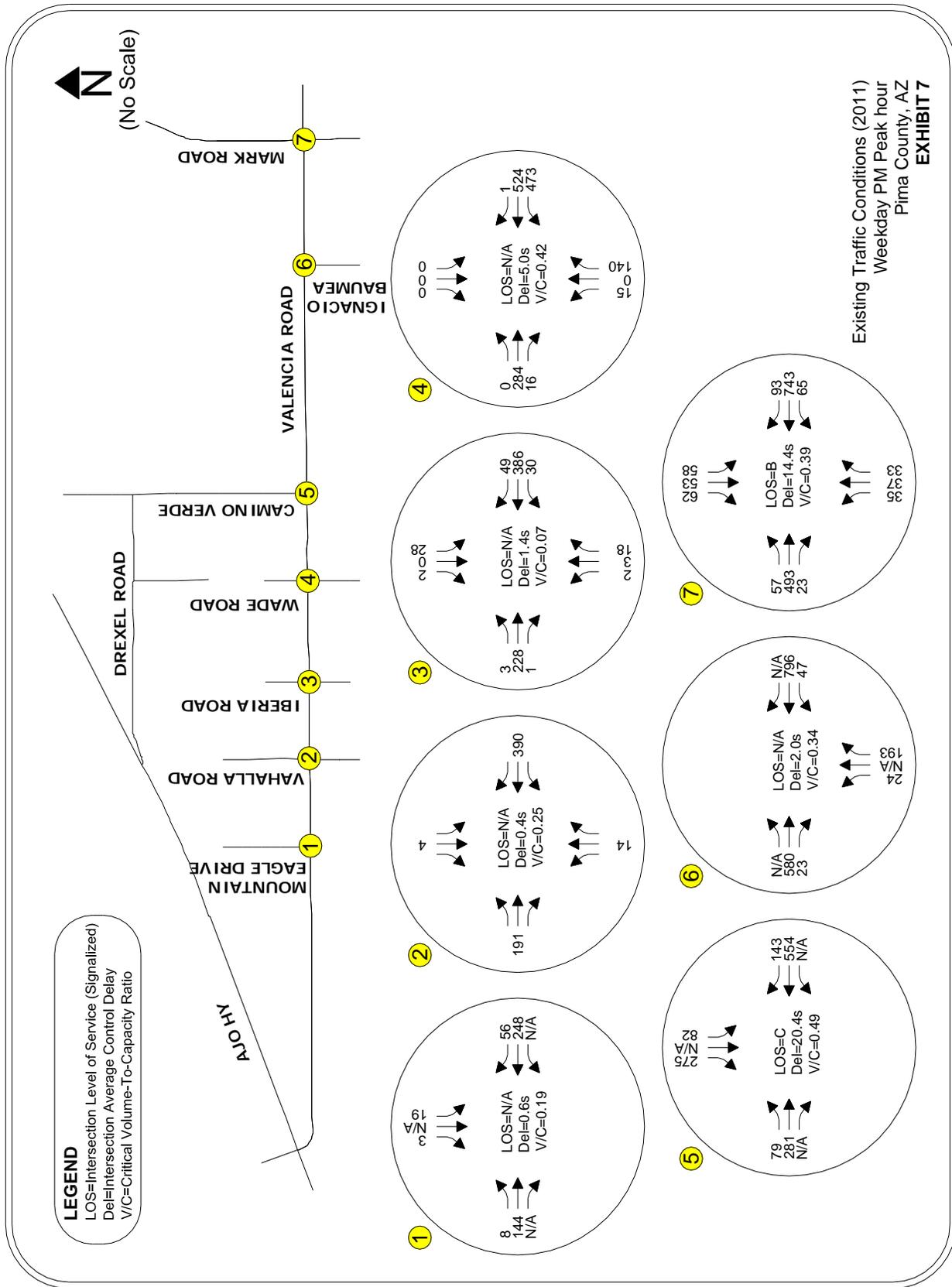


Existing Lane Configuration  
and Traffic Control Devices  
Pima County, AZ  
**EXHIBIT 4**



Existing Traffic Conditions (2011)  
Average Daily Traffic  
Pima County, AZ  
**EXHIBIT 5**





### 3.3.2 Traffic Factors

Traffic factors listed in Exhibit 8 were calculated from the 24-hour roadway counts. The K-factor (K), which represents the percentage of daily traffic that occurs during the peak hour, and the directional split (D) are based on traffic flow during the morning and evening peak hours.

Exhibit 8 Traffic Factors

Valencia Road	K		D	
	AM	PM	AM	PM
Ajo Road to Vahalla Road	0.03	0.03	0.69	0.62
Vahalla Road to Wade Road	0.04	0.04	0.78	0.61
Wade Road to Camino Verde	0.01	0.05	0.53	0.73
Camino Verde to Viviana Road	0.04	0.04	0.82	0.65
Viviana Road to Mark Road	0.03	0.04	0.74	0.51

The directional split indicates unbalanced directional traffic flow during the peak traffic period. Eastbound traffic is heavier during the a.m. peak hour and westbound traffic is heavier during the p.m. peak hour.

### 3.3.3 Heavy Vehicle Percentage

Three-hour vehicle classification counts were taken on February 1 and 3, 2011. The results of the classification study are summarized in Exhibit 9. In general, the observed heavy vehicle percentage for eastbound traffic is about 3% which is consistent with other major arterials in the metropolitan area where 3-5% is typical. Westbound traffic is about 8% which is higher than other major arterials. (It should be noted that FHWA defines heavy vehicles as those in the Categories "2 Axle 6 Tire" through ">6 Axle Multi.")

Exhibit 9 Vehicle Classification Data

Motorcycles	Cars & Trailers	2 Axle Light Goods	Bus	2 Axle Single	3 Axle Single	4 Axle Single	<5 Axle ST	5 Axle ST	>6 Axle ST	5 Axle Multi	6 Axle Multi	>6 Axle Multi	Not Class.
<b>Valencia Road Eastbound</b>													
1	587	139	0	18	2	0	2	0	0	0	0	0	1
0.1%	78.3%	18.5%	0.0%	2.4%	0.3%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
<b>Valencia Road Westbound</b>													
9	943	70	0	16	6	9	31	4	10	1	2	7	12
0.8%	84.2%	6.3%	0.0%	1.4%	0.5%	0.8%	2.8%	0.4%	0.9%	0.1%	0.2%	0.6%	1.1%

### 3.3.4 Traffic Analysis

Intersection level of service analyses were performed using the Synchro (version 7) software package, which utilizes the Highway Capacity Manual (HCM) analysis procedures. The analyses were performed for the peak 15 minute using the following criteria and assumptions.

- A 3.00% of heavy vehicles for eastbound traffic and 8.00% of heavy vehicles for westbound traffic were used for analyses of existing conditions and were assumed to remain the same for future conditions.
- Existing timing plans were obtained from PCDOT and entered into Synchro.
- A peak-hour factor (PHF) of 1.00 for each movement was applied to the Synchro model.

Level of service (LOS) is a qualitative measure that describes the operating conditions of an intersection or roadway. For a signalized intersection, the level of service is defined by the average control delay that a driver experiences at the intersection. LOS A equated to ideal conditions with little or no delay, while LOS F represents congested conditions with average vehicle control delays exceeding 80 seconds. LOS D is defined as the threshold for acceptable operation in the PAG region. The intersection analysis results are summarized in Exhibits 6 and 7. The results are discussed below and corresponding Synchro output pages are included in Appendix B.

#### 3.3.4.1 Intersection of Valencia Road and Camino Verde

During the a.m. peak hour, the intersection LOS is C, and all movements have LOS of D or better. During the p.m. peak hour, the intersection LOS is C, and all movements have LOS D or better.

#### 3.3.4.2 Intersection of Valencia Road and Mark Road

During the a.m. peak hour, the intersection LOS is B, and all movements have LOS D or better. During the p.m. peak hour, the intersection LOS is B, and all movements have LOS D or better.

### **3.4 Crash Summary**

Crash data for the period of July 1, 2007 to June 30, 2010 was obtained from PCDOT. The intersection and crash data was reviewed and is summarized in Exhibits 10 and 11, respectively. Crash Data is included in Appendix C.

**Exhibit 10 Intersection Crash Data Summary (July 1, 2007 - June 30, 2010)**

	Intersections											
	Valencia Road at Mountain Eagle Avenue		Valencia Road at Vahalla Road		Valencia Road at Iberia Avenue		Valencia Road at Wade Road		Valencia Road at Camino Verde		Valencia Road at Mark Road	
Crash Type	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Rear-end	0	0	0	0	0	0	4	44	14	61	25	64
Turning	0	0	0	0	1	100	0	0	1	4	4	10
Angle	1	100	1	100	0	0	2	22	7	30	4	10
Out of Control	0	0	0	0	0	0	0	0	0	0	0	0
Sideswipe	0	0	0	0	0	0	0	0	0	0	1	3
Miscellaneous	0	0	0	0	0	0	2	22	1	4	2	5
Fixed Object	0	0	0	0	0	0	1	11	0	0	0	0
Backing	0	0	0	0	0	0	0	0	0	0	2	5
Head on	0	0	0	0	0	0	0	0	0	0	1	3
Animal	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrian	0	0	0	0	0	0	0	0	0	0	0	0
Total Crashes	1	N/A	1	N/A	1	N/A	9	N/A	23	N/A	39	N/A
Daily ADT	5963	N/A	7457	N/A	8829	N/A	15013	N/A	17833	N/A	24890	N/A
Crash Rate	0.15	N/A	0.12	N/A	0.10	N/A	0.55	N/A	1.18	N/A	1.43	N/A
Average Crash Rate	0.39	N/A	0.39	N/A	0.39	N/A	0.39	N/A	0.96	N/A	0.96	N/A
Severity												
Fatal	0	0	0	0	0	0	0	0	0	0	0	0
Class 4 Injury	0	0	0	0	0	0	0	0	1	4	0	0
Bodily Injury	0	0	1	100	0	0	4	44	10	43	16	41
PDO	1	100	0	0	1	100	5	56	12	52	23	59
Severity Index	1.00	N/A	2.00	N/A	1.00	N/A	1.44	N/A	1.64	N/A	1.41	N/A
Average Severity Index	1.50	N/A	1.50	N/A	1.50	N/A	1.50	N/A	1.40	N/A	1.40	N/A

Intersection Crash Rates refer to the number of crashes per million vehicles entering the intersection.  
Rate=(number of 3-year crashes x 10<sup>6</sup>)/(3 years x weekday entering volume x 365 days)

Severity Index is calculated based on crash severity parameters developed by the National Safety Council. Index =  
[5.8 (Fatality&Class 4 Injury) + 2(Class2&3 Bodily Injury) + Property Damage]/(Total No. of Crashes)

**Exhibit 11 Segment Crash Data Summary (July 1, 2007 -- June 30, 2010)**

	Segments							
	Valencia Road from Mountain Eagle Drive to Iberia Avenue (8200-7400)		Valencia Road from Iberia Avenue to Camino Verde (7399-6600)		Valencia Road from Camino Verde to Camino Rancho (6599-5800)		Valencia Road from Camino Rancho to Mark Road (5799-5000)	
Crash Type	Number	%	Number	%	Number	%	Number	%
Rear-end	0	0	8	53	7	47	7	32
Turning	0	0	0	0	0	0	2	9
Angle	0	0	0	0	0	0	2	9
Sideswipe	0	0	1	7	2	13	2	9
U-Turn	0	0	3	20	1	7	0	0
Out of Control	0	0	1	7	1	7	4	18
Miscellaneous	0	0	0	0	1	7	2	9
Fixed Object	0	0	1	7	2	13	2	9
Backing	0	0	0	0	0	0	0	0
Head on	0	0	0	0	0	0	0	0
Pedestrian	0	0	0	0	0	0	0	0
Animal	0	0	1	7	1	7	1	5
Total Crashes	0	N/A	15	N/A	15	N/A	22	N/A
Daily ADT	12895	N/A	12895	N/A	13244	N/A	13244	N/A
Crash Rate	0.00	N/A	1.06	N/A	0.69	N/A	1.00	N/A
Average Crash Rate	1.32	N/A	1.32	N/A	1.32	N/A	1.32	N/A
Severity								
Fatal	0	0	0	0	0	0	0	0
Class 4 Injury	0	0	1	7	0	0	3	14
Bodily Injury	0	0	5	33	4	27	7	32
PDO	0	0	9	60	11	73	12	55
Severity Index	0.00	N/A	1.65	N/A	1.27	N/A	1.97	N/A
Average Severity Index	1.58	N/A	1.58	N/A	1.58	N/A	1.58	N/A

Segment Crash Rates refer to the number of crashes per million vehicle miles of travel. Rate=(number of 3-year crashes x 10<sup>6</sup>)/(segment length x 3 years x weekday volume x 365 days)

Severity Index is calculated based on crash severity parameters developed by the National Safety Council. Index = [5.8 (Fatality&Class 4 Injury) + 2(Class 2&3 Bodily Injury) + Property Damage]/(Total No. of Crashes)

### 3.4.1 Intersection Crash Analysis

The signalized intersections of Camino Verde and Mark Road had crash rates higher than the three-year average crash rate of 0.96 crashes per million entering vehicles for all signalized intersections within Pima County (based on data from 01/2006 to 12/2008) (*Reference 7*). For the signalized intersection at Camino Verde, the severity index was higher than the average severity index for all signalized intersections within Pima County (based on data from 01/2006 to 12/2008).

#### 3.4.1.1 Valencia Road and Mountain Eagle Drive

This unsignalized intersection had a crash rate of 0.16 crashes per million entering vehicles and a severity index of 1.0. The single crash for this was an angle type crash.

#### 3.4.1.2 Valencia Road and Vahalla Road

This unsignalized intersection had a crash rate of 0.13 crashes per million entering vehicles and a severity index of 2.0. The single crash for this intersection was an angle type crash.

#### 3.4.1.3 Valencia Road and Iberia Avenue

This unsignalized intersection had a crash rate of 0.11 crashes per million entering vehicles and a severity index of 1.0. The single crash for this intersection was a turning type crash.

#### 3.4.1.4 Valencia Road and Wade Road

This unsignalized intersection had a crash rate of 0.56 crashes per million entering vehicles and a severity index of 1.44. The predominant crash type for this intersection was rear-end, representing 44% of all crashes. No definitive probable causes have been identified at this location.

#### 3.4.1.5 Valencia Road and Camino Verde

This signalized intersection had a crash rate of 1.21 crashes per million entering vehicles and a severity index of 1.64. The predominant crash type was rear-end, representing 61% of all crashes. No definitive probable causes have been identified at this location.

#### 3.4.1.6 Valencia Road and Mark Road

This signalized intersection had a crash rate of 1.47 crashes per million entering vehicles and a severity rate of 1.41. The predominant crash type for this intersection is rear-end, representing 64% of all crashes. No definitive probable causes have been identified at this location.

### 3.4.2 Segment Crash Analysis

The crash rate on all segments of the roadway were below the three year average crash rate of 1.32 crashes per million vehicle-miles for all roadway segments within Pima County (based on data from 01/2006 to 12/2008) (*Reference 7*). One segment, from Camino Rancho to Mark Road, had a severity index that was higher than the average severity index of 1.58 for all roadway segments within Pima County (based on data from 01/2006 to 12/2008). A majority of the crashes were rear-end crashes. No fatalities were reported during the study period.

#### 3.4.2.1 Valencia Road from Mountain Eagle Drive to Iberia Avenue (8200 W. -7400 W.)

This segment of the corridor had a crash rate of 0.0, indicating zero crashes during the investigation period.

#### 3.4.2.2 Valencia Road from Iberia Avenue to Camino Verde (7399 W.-6600 W.)

This segment of the corridor had a crash rate of 1.06 and a severity index of 1.65. Rear-end is the most predominant type of crash in this segment, representing 53% of all crashes for this segment. No definitive probable cause has been identified at this location.

#### 3.4.2.3 Valencia Road from Camino Verde to Camino Rancho (6599 W. -5800 W.)

This segment of the corridor had a crash rate of 0.69 and a severity index of 1.27. The predominant type of crash was rear-end, representing 47% of all crashes for this segment.

#### 3.4.2.4 Valencia Road from Camino Rancho to Mark Road (5799-5000)

This segment of the corridor had a crash rate of 1.0 and a severity index of 1.97. The predominant type of crash was rear-end, representing 32% of all crashes for this segment.

### 3.5 Summary of Signal Warrant Studies

A signal warrant study was performed at the following four unsignalized intersections with Valencia Road: Mountain Eagle Drive, Vahalla Road, Iberia Avenue, and Wade Road. The existing peak hour traffic volumes were evaluated in relation to Warrant 1, Condition A. Minimum Vehicular Volume and Warrant 1, Condition B Interruption of Continuous Traffic in the *Manual on Uniform Traffic Control Devices*. The analysis of the warrants for the installation of a traffic signal is included in Appendix D.

#### 3.5.1 Valencia Road at Mountain Eagle Drive

This intersection does not meet the warrant for a traffic signal under existing conditions.

#### 3.5.2 Valencia Road at Vahalla Road

This intersection does not meet the warrant for traffic signal under existing conditions.

#### 3.5.3 Valencia Road at Iberia Avenue

This intersection does not meet the warrant for a traffic signal under existing conditions.

#### 3.5.4 Valencia Road at Wade Road

This intersection currently meets the warrant for a traffic signal. Valencia Road and Wade Road intersection meets the minimum 8-hour vehicular volumes, and it is recommended that a signal be installed at this intersection. The north leg of Wade Road is currently an unmaintained, dirt road and should be realigned to meet the signalized intersection for continued vehicle access.

### 3.6 Alternative Transportation Modes

This section describes existing transit services along and in the vicinity of the corridor study and pedestrian, bicycle, and equestrian activities and facilities within the project area.

Currently SunTran Route 27 runs along Valencia Road through the project from Mark Road to Casino del Sol, a distance of approximately 1.5 miles. This route runs approximately every 15 minutes Monday through Friday from 6:00 AM until 10:30 PM, Saturday approximately every one hour from 7:30 AM until 9:45 PM, and Sunday every one hour from approximately 6:30 AM until 7:45 PM. There is a Park & Ride lot at the Casino del Sol for commuter use. There are no future plans to provide additional bus service to this area.

There are no existing bicycle facilities along the project corridor from Mountain Eagle Drive to Mark Road. Bicyclists currently share the lane with motorists for this length of the roadway.

There are no existing pedestrian facilities in the project area.

Marked pedestrian crosswalks are limited to signalized intersections.

There are no designated equestrian trails in the area.

### **3.7 Lighting and ITS**

The project corridor area is under lighting code E1c per the City of Tucson/Pima County Outdoor Lighting Code, which is defined as inclusive of the circular area thirty-five miles in radius the center of which is the summit of Kitt Peak in Section 4.9.4. The codes that are applicable restrict the permitted lighting installations as indicated in the City of Tucson/Pima County Outdoor Lighting Code. Currently there is intersection lighting at all the signalized intersections along the project corridor.

Pima County does not typically provide continuous street lighting except in areas with relatively high density of access points/activity and/or pedestrian activity. Since neither of these conditions will likely exist along this corridor, lighting at signalized intersections will provide appropriate roadway illumination. Intersection lighting currently exists at all signalized intersections.

All the traffic signals along the corridor are equipped with Emergency Vehicle Preemption detectors and beacons.

## 4. Future Conditions

The following subsections provide a summary of upcoming developments along the Valencia Road corridor, planned transportation improvements, and the estimation of the 2030 traffic demand.

### 4.1 Planned Developments

Several developments are proposed along the corridor. Star Valley Block 13 is a 67.64 acre residential subdivision consisting of 302 single family residential lots south of Valencia Road and Wade Road. Star Valley Commercial Center is a 9.53 acre commercial development at the southwest corner of Wade Road and Valencia Road. Star Valley Block 4 is a 126.36 acre residential subdivision consisting of 572 single family residential homes. Star Valley Block 7 is a 56.30 acre residential subdivision consisting of 368 single family residential lots. Star Valley Block 8 is a 58.86 acre residential subdivision consisting of 239 single family residential lots.

### 4.2 Planned Transportation Improvements

There exist a number of recently constructed or planned transportation improvements within the project area. Many of these improvements are funded by public agencies while others are required improvements as part of a development. The improvements are summarized below.

- Ajo Way widening from Valencia Road to Kinney Road.
- Ajo Way and Kinney Road intersection reconstruction.
- Valencia Road from Mark Road to Camino de la Tierra widening completed in May 2008.
- Valencia Road and Camino Verde intersection reconstruction completed in early 2010.
- Ignacio Baumea from Valencia Road to Los Reales construction completed in 2010.
- Addition of bike lanes on Valencia Rd from Camino de la Tierra to Cardinal Avenue and Westover to Mission Road
- La Luna Subdivision
- Sonoran Ranch Estates II Subdivision
- Star Valley Subdivision

### 4.3 Traffic Projections

The 2030 traffic volumes were developed by first obtaining the 2030 projections produced by the Pima Association of Governments (PAG) regional model. The PAG volumes were then compared to historical counts and 2010-2011 counts. The PAG 2040 regional model was also taken into consideration as annual growth was reduced considerably in some areas between the 2030 and 2040 models. Some of the 2030 PAG projected volumes appear unusual when considering the latest 2040 projections and were decreased somewhat to account for this variation. The traffic projections are summarized in Exhibit 12.

Once the 2030 average daily traffic (ADT) volumes were established, 2030 peak hour volumes for the major study intersections were developed. The 2030 peak hour turning volumes were derived from the 2011 turning movement counts, 2011 K and D factors and the 2030 estimated ADT volumes.

**Exhibit 12 Traffic ADT Projections**

Roadway	Segment	Existing (2011)	PAG				Assumed for This Study	
			2030	Annual Growth	2040	Annual Growth	2030	Annual Growth
Valencia Road	Mark Road to Camino de Oeste	22182	52000	4.6%	66000	6.0%	46734	4.0%
Ignacio Baumea	Ignacio Baumea South	2159	15000	10.7%	--	0.0%	6532	6.0%
Camino Verde	Camino Verde North	3622	25000	10.7%	12000	6.0%	10959	6.0%
Mark Road	Mark Road North	4577	11000	4.7%	24000	5.9%	11992	5.2%
	Mark Road South	2636	20000	11.3%	37000	9.5%	13553	9.0%
Valencia Road	Ajo Road to Vahalla Road	4724	13000	5.5%	33000	6.0%	11937	5.0%
	Vahalla Road to Wade Road	9015	36000	7.6%	33000	4.1%	24932	5.5%
	Wade Road to Camino Verde	14783	36000	4.8%	33000	2.5%	28420	3.5%
	Camino Verde to Vivianna Road	12388	33000	5.3%	33000	3.1%	23785	3.5%
	Vivianna Road to Mark Road	17264	42000	4.8%	33000	2.0%	33147	3.5%

#### 4.3.1 Projections for Vahalla Road

The PAG model does not include what it does not consider to be a major roadway, so Vahalla Road is not shown on the PAG 2030 regional model. Counts were taken at this currently unsignalized intersection and a conservative 3% linear annual growth rate was assumed for this study.

#### 4.3.2 Projections for Iberia Avenue

Iberia Avenue is also not considered a major roadway within the PAG 2030 regional model and it is not shown. Counts were taken at this intersection and a 3% linear growth rate was assumed for this study.

#### 4.3.3 Projections for Wade Road

Wade Road is also not considered a major roadway within the PAG 2030 regional model and it is not shown. Counts were taken at this intersection and a 3% linear growth rate was assumed for this study.

#### 4.3.4 Projections for Camino Verde

Camino Verde is a major local road. Based on current use and proposed development, a 6% annual growth rate was assumed for this study.

#### 4.3.5 Projections for Ignacio Baumea

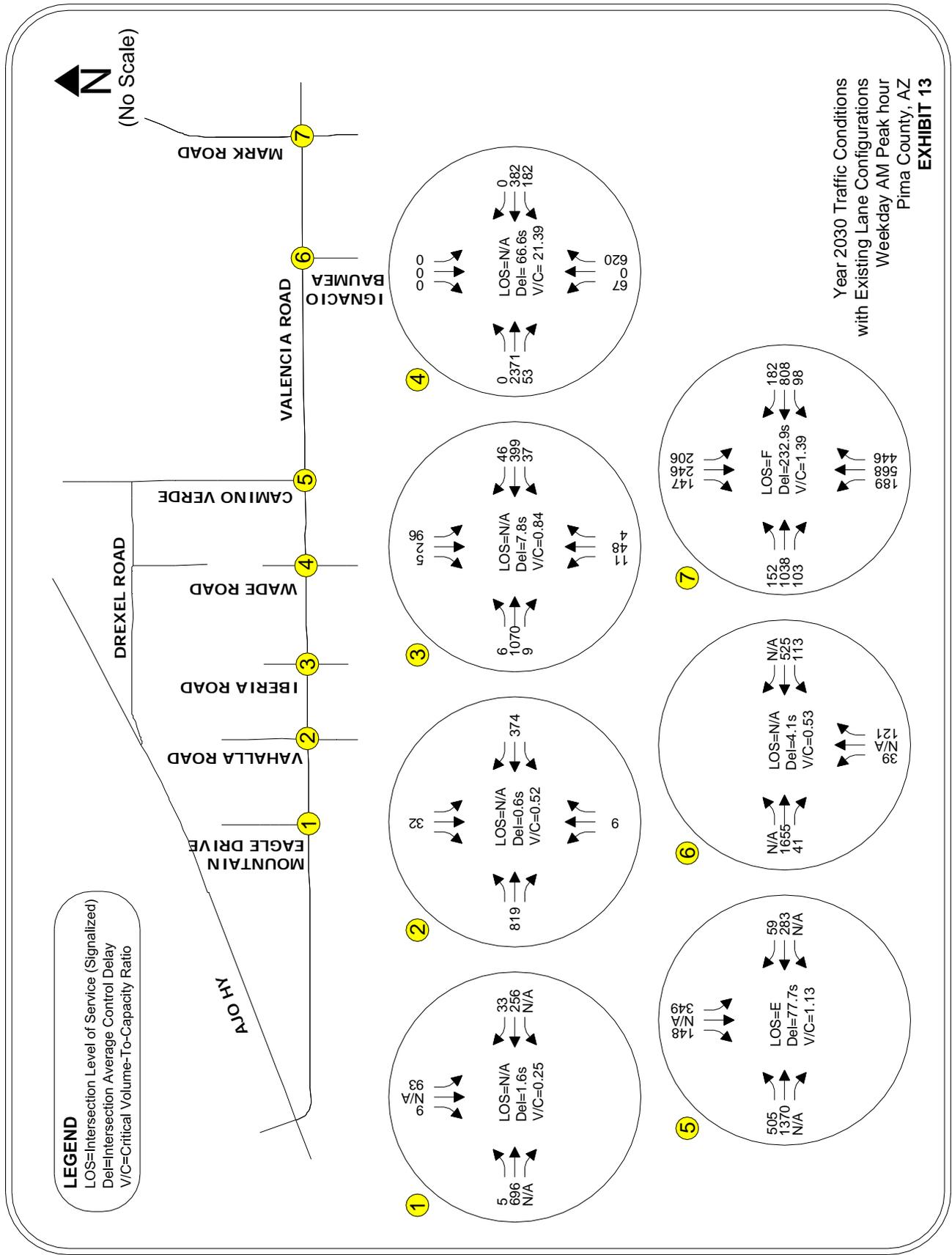
Ignacio Baumea was considered a significant new roadway per the 2030 PAG regional model but left off the 2040 model entirely. A reduced annual growth rate of 6% was assumed for this study.

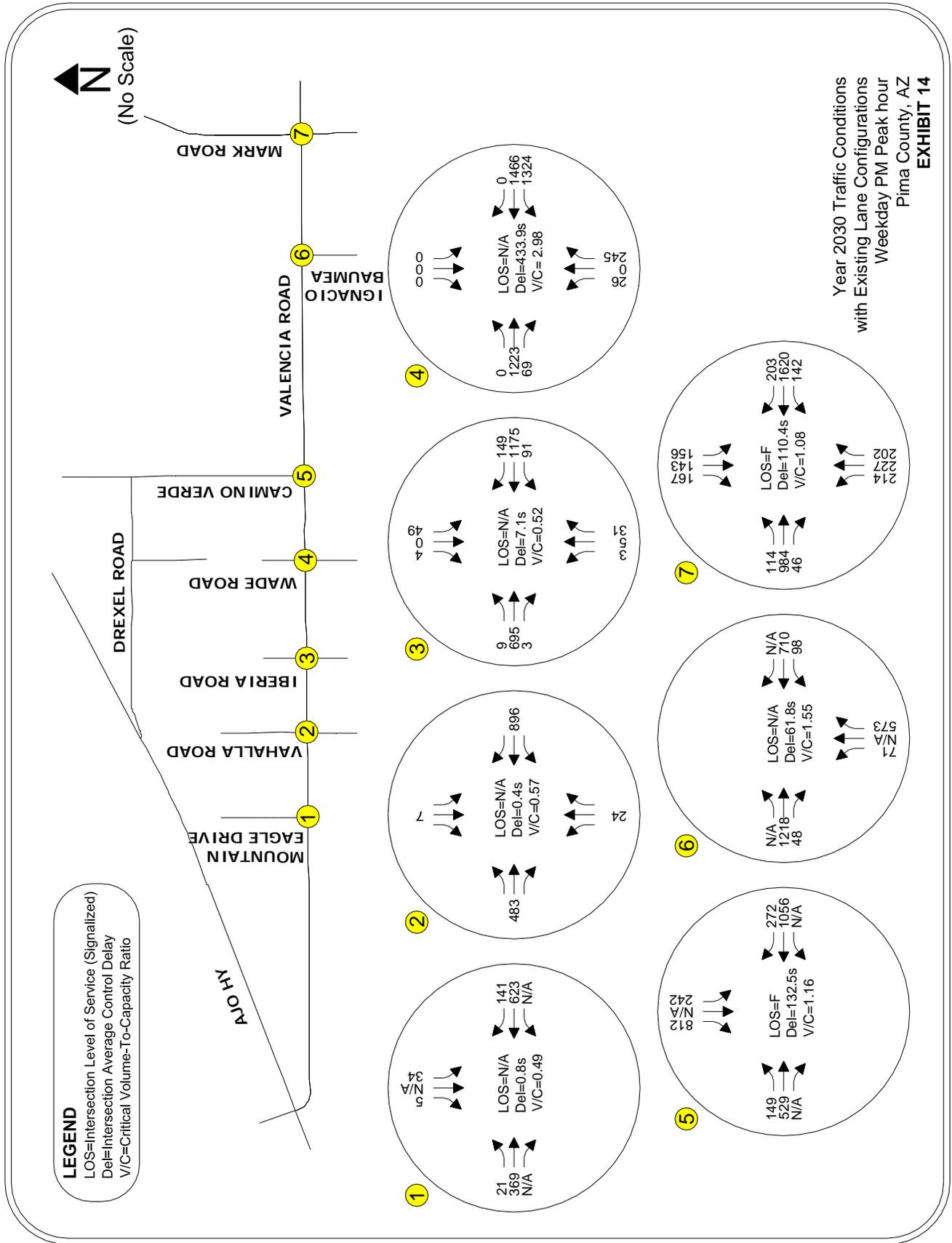
#### 4.4 Capacity and Level of Service

This section presents capacity analysis results for the Valencia Road roadway from Mountain Eagle Drive to Mark Road and the study intersections. Relevant discussions are provided regarding capacity requirements to accommodate 2030 traffic demand.

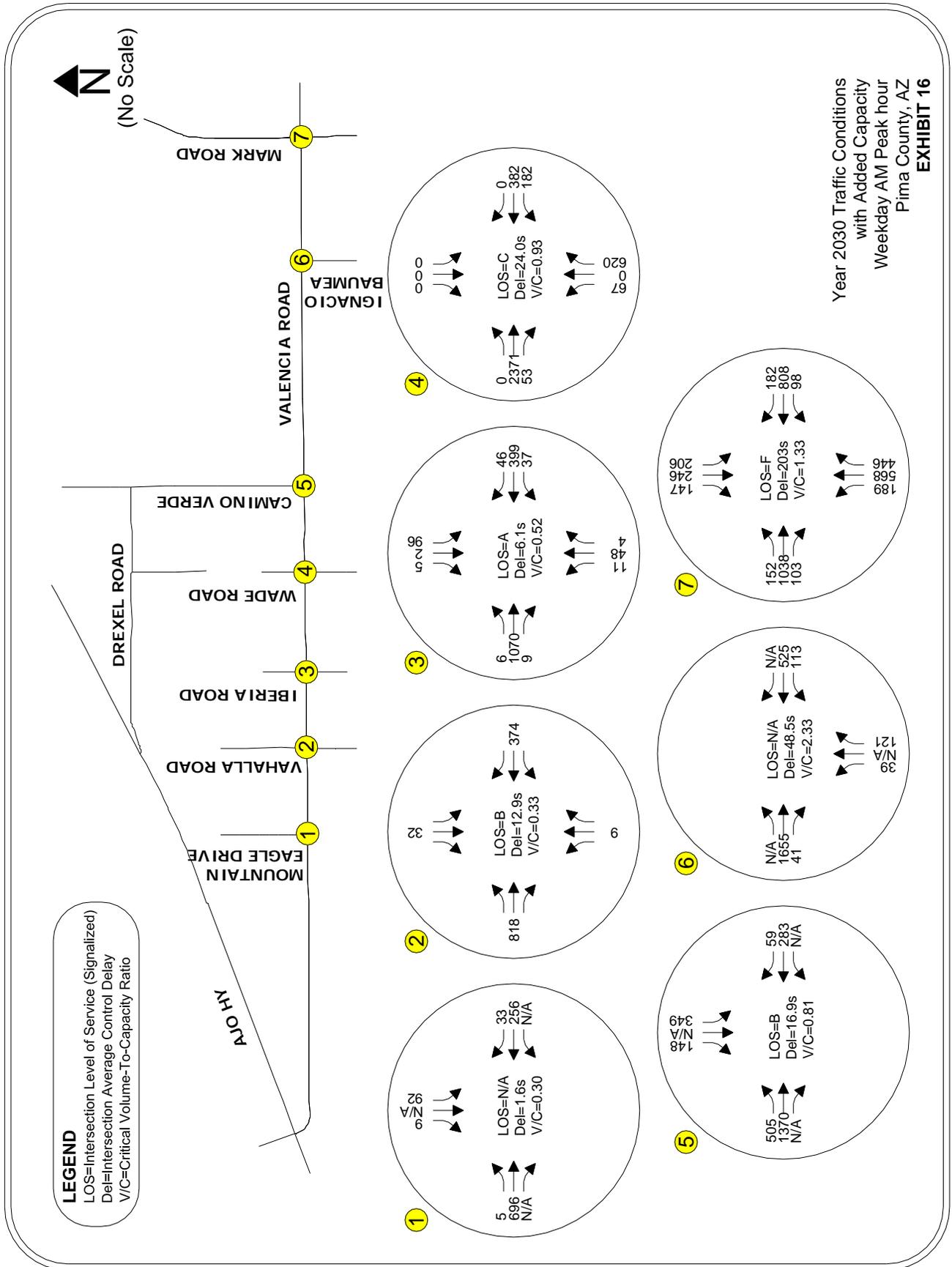
Capacity on a roadway segment depends greatly on intersection traffic control along the segment as well as street environment such as roadside activity, lane uses, driveway density, parking, speed limit, type of median, etc. Florida Department of Transportation (FDOT) has established that a 2-lane arterial can generally accommodate 15,600 vehicles per day (vpd) at LOS E and a 4-lane arterial can accommodate 32,900 vpd. The existing daily traffic volumes along Valencia Road range from 2,100 to 17,200 vpd, and the 2030 daily traffic volumes are estimated to be in the range of 6,000 to 36,000 vpd. Considering FDOT's LOS criteria and number of through lanes required at the major signalized intersections along Valencia Road, a 4-lane cross section will be required to accommodate the 2030 traffic.

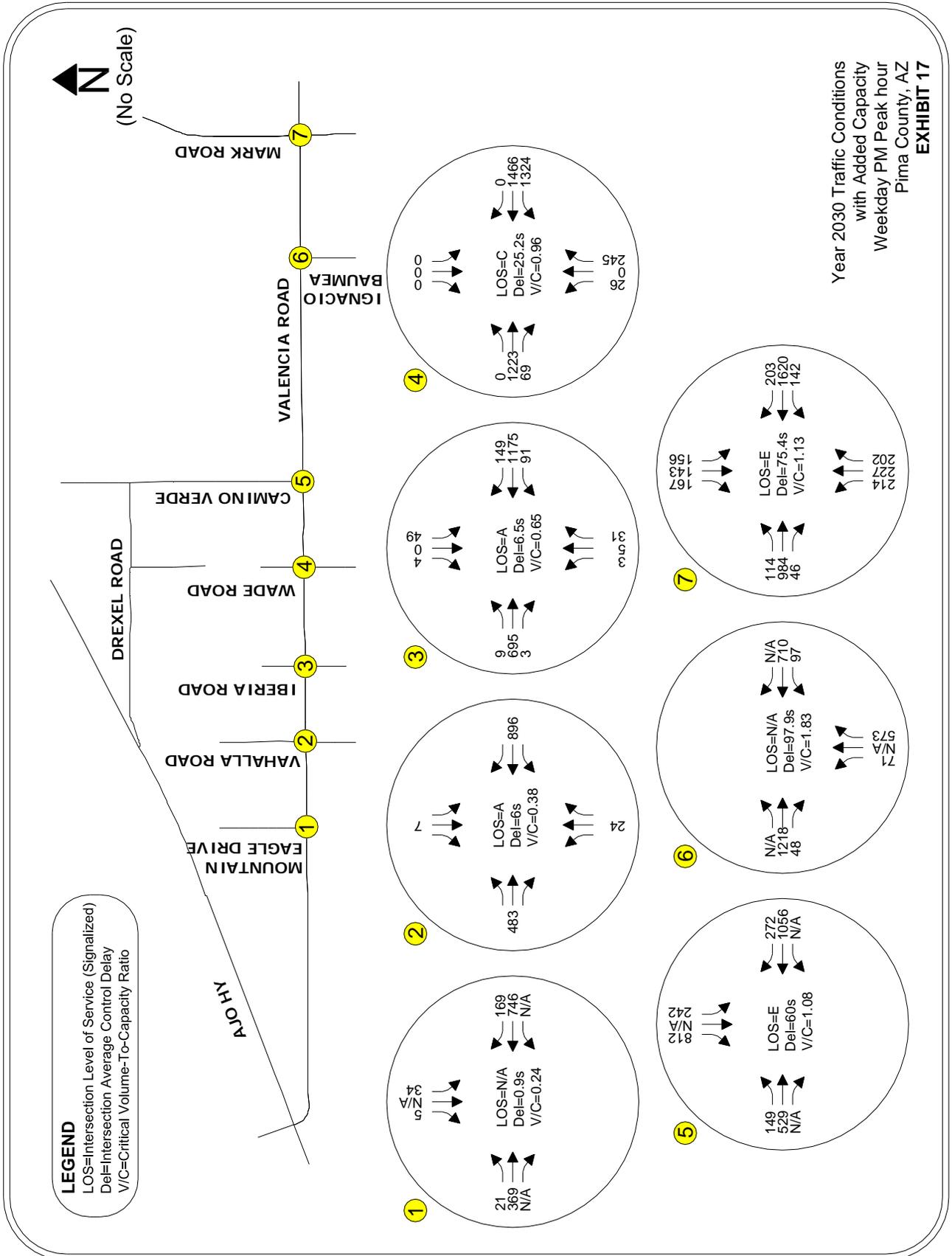
For the major intersections, Synchro (version 7) was used to assess future capacity requirements. Exhibits 13 and 14 show the intersection levels of service (LOS) in 2030 if no capacity improvements were implemented. The results indicate that all of the signalized intersections will operate at unacceptable level of service and cause excessive delays and queuing. Required intersection lane configurations to adequately accommodate the 2030 peak hour traffic are illustrated in Exhibit 15. Specific needs/improvements for each intersection are discussed below. Exhibits 16 and 17 summarize the capacity analysis results with the improvements in place. Turn-lane storage length requirements are discussed separately in Section 5.4.











#### *4.4.1 Intersection of Valencia Road and Vahalla Road*

With the existing lane configurations and 2030 turning volume, the intersection of Valencia Road and Vahalla will operate with an intersection delay of 0.6 seconds. With the intersection widening to two through lanes, the intersection delay will be 12.9 seconds with a LOS A during the a.m. peak hour and a LOS B during the p.m. peak hour.

#### *4.4.2 Intersection of Valencia Road and Iberia Avenue*

With the existing lane configurations and 2030 turning volume, the intersection of Valencia Road and Iberia Avenue will operate with an intersection delay of 7.8 seconds. With the intersection widening to two through lanes, the intersection delay will be 6.5 seconds with a LOS A during the a.m. and p.m. peak hours.

#### *4.4.3 Intersection of Valencia Road and Wade Road*

With the existing lane configurations and 2030 turning volume, the intersection of Valencia Road and Wade Road will operate with an intersection delay of 433.9 seconds, or 7.2 minutes. With the intersection widening to two through lanes with dedicated left and right turn lanes in the east and west directions, the intersection delay will be 25.2 seconds with a LOS C during the a.m. and p.m. peak hours. Volumes necessitate dual westbound left-turn lanes. Pima County guidelines require an exclusive eastbound right-turn lane with the future volume. The north leg of Wade Road is currently an unmaintained, dirt road; however, with the intersection widening to two through lanes on Valencia, the north leg of Wade Road should be realigned to meet the signalized intersection for continued vehicle access.

#### *4.4.4 Intersection of Valencia Road and Camino Verde*

With the existing lane configurations and 2030 volume, the intersection of Valencia Road and Camino Verde will operate with an intersection delay of 132.5 seconds with a LOS E during the a.m. peak hour and a LOS F during the p.m. peak hour. With the intersection widening to two through lanes with dedicated left and right turn lanes in the east and west directions, the intersection delay will be 60 seconds with a LOS B during the a.m. peak hour and a LOS E during the p.m. peak hour. Pima County guidelines require an exclusive westbound right-turn lane with the future volume.

## 5. Proposed Improvements

Based on the results of the various capacity and safety analyses, a set of corridor improvements is developed and recommended. The recommendations include appropriate design parameters, number of through lanes for the corridor, lane configuration and traffic control at the major intersections, access control, storage length of turn bays, and multi modal requirements. The following sections describe the proposed improvements in detail.

### 5.1 Design Parameters

Valencia Road from Mountain Eagle Drive to Mark Road will be designed according to the requirements and parameters identified in the latest Pima County Roadway Design Manual and the AASHTO "Green Book".

The following design criteria are recommended for this project.

**Design Speed:** The design speed selected for the Valencia Road widening should be consistent with other arterials in the area to provide for driver expectation and safety. The design speed will also need to be flexible to address right-of-way, environmental, and cost constraints. Considering that the widening of Valencia Road is intended to function as a major arterial, and to provide for consistency with other arterials in the area, a 50 mph design speed is recommended.

**Stopping Sight Distance:** The stopping sight distance should be a minimum of 425 feet for a design speed of 50 mph, based on the design criteria provided in Exhibit 7-1 of the AASHTO Green Book, 2004.

**Clear Zone:** According to the AASHTO Roadside Design Guide (2002), the clear zone for a 45 or 50 mph design speed should be 20 feet, depending on whether the roadway section is in a cut or a fill slope section with a 6:1 or flatter side slope. The clear zone extends from the edge of the nearest through lane to the toe or the top of the slope. Based on these criteria, a minimum 20-foot clear zone is recommended for the Valencia Road widening.

**Median:** The AASHTO Green Book Design Guidelines for urban arterials indicates that an 18-foot median (6-foot median at intersections with left-turn lanes) is the desired minimum. For the Valencia Road widening, a 20-foot median is recommended. This width is consistent with the cross-section standards listed in Table 2-2 of the Pima County Roadway Design Manual.

**Design Vehicle:** WB-50 semi-trailer combination for major intersections.

### 5.2 Roadway Segments

A four-lane divided roadway is proposed for Valencia Road from Mountain Eagle Drive to Mark Road. Through and turn lanes should be 11' wide. Pima County Roadway Design Manual standard travel lane width is 11'. Minimum six-foot multiuse lanes should be provided along this entire section for use by bicycles and disabled vehicles. Dedicated right turn lanes are recommended at major intersections along the entire corridor.

### 5.3 Intersections

The proposed lane configurations are shown in Exhibit 15. Eastbound traffic on Valencia Road will require a dedicated left-turn lane, two through lanes and a dedicated right-turn lane at

signalized intersections. Westbound will also require a dedicated left-turn lane, two through lanes and a dedicated right-turn lane at signalized intersections.

## 5.4 Turn Bay Storage

### 5.4.1 Signalized Intersections

Recommended storage lengths for the signalized intersections are provided in Exhibit 18. Storage lengths were based on the 95<sup>th</sup> percentile queue lengths calculated in the Synchro analysis and guidance on turn bay lengths provided by PCDOT/TDOT Pavement Marking Design Manual. The turn storage worksheets are included in Appendix H.

**Exhibit 18 Minimum Required Storage Lengths**

Intersection	Turn Bay	2030 Design Volume (vph)	Estimated Queue, ft	Required Minimum Storage, ft	Recommended Storage, ft
Iberia Avenue	WB LT	149	124	150	150
	NB RT	31	26	150	150
	SB LT	96	124	150	150
	WB RT	149	124	150	150
Wade Road	EB RT	75	63	150	150
	Dual WB LT	1324	1064	150	400
	NB RT	620	517	150	400
	NB LT	67	95	150	150
Camino Verde	EB LT	554	499	150	400
	WB RT	272	311	150	300
	SB LT	349	339	150	350
	SB RT	218	267	150	250

### 5.4.2 Unsignalized Intersections

Future traffic volumes at the minor unsignalized intersections were not projected since minor streets are not in the PAG regional model. Based on the existing turning volumes, the minimum storage length required by Pima County will be sufficient at these minor unsignalized intersections. It is also recommended that PCDOT standards should be used when providing turning lane storage at the median openings.

## 5.5 Median Openings

The Valencia Road corridor will function as a principal urban arterial, therefore the roadway design must provide for a high level of traffic safety and operations, and a raised median is recommended. While a raised median does not maintain the current level of access, the safety benefits of a raised median outweigh those associated with no median or with a two-way left-turn lane (TWLTL).

In order to provide access as necessary, frequent median openings should be provided. Existing access to adjacent properties were inventoried and are summarized in Exhibit 3. Determination of appropriate median openings was based on several factors, including level of access provided by each opening and the resulting median opening spacing.

The Pima County Design Guidelines recommend that median openings be spaced no closer than 660 feet to other median openings and require that they not be placed within the functional

limit of a major intersection. The preferred median opening spacing is ¼ mile. The practical limits of median opening spacing are typically dictated by the required turn-bay lengths. Based on the Pima County Guidelines, the minimum turn-bay length for a posted speed of 45 mph is 250 feet. This includes a 100 foot taper and 150 feet of storage.

The proposed median openings are shown in Exhibit 19. A description of each median opening, along with the access that will be provided is given in Exhibit 20.

**Exhibit 20 Summary of Median Openings Locations**

<b>I.D.</b>	<b>Location/Side Street</b>	<b>Allowed Movement</b>	<b>Comments</b>
1	Mountain Eagle Drive	EB LT	Serves Residential Area
		SB LT	
2	Eagle's Talon Parkway	EB LT	Serves Residential Area
		SB LT	
		WB LT	Serves Substation
3	Vahalla Road	All	Serves Residential Subdivision
4	Iberia Avenue	All	Serves Residential Subdivision
5	Victor Drive	WB LT	Serves Residential Area
		NB LT	
6	Wade Road	WB LT	Signalized Intersection
		NB LT	
		EB LT	Serves Residential Area
7	South Arrow	EB LT	Serves Residential Area
8	Camino Verde	EB LT	Signalized Intersection
		SB LT	
9	Mardick Avenue	EB LT	Serves Residential Area
		SB LT	
10	Viviana Road	EB LT	Serves Residential Area
		SB LT	

MATCHLINE B



MATCHLINE C

MATCHLINE A



MATCHLINE B

BEGIN PROJECT



MATCHLINE A

MATCHLINE E



STAR RIDGE PLACE

STAR DIAMOND PLACE

VALENCIA ROAD

WADE ROAD



MATCHLINE F

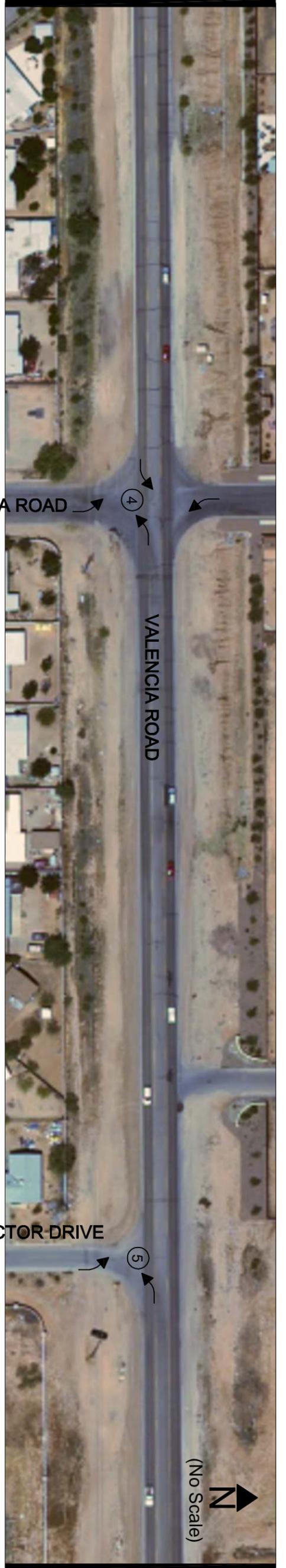
MATCHLINE D



VALENCIA ROAD

MATCHLINE E

MATCHLINE C



IBERIA ROAD



VALENCIA ROAD

VICTOR DRIVE



(No Scale)

MATCHLINE D

MATCHLINE H



MATCHLINE I

MATCHLINE G



MATCHLINE H

MATCHLINE F



MATCHLINE G

MATCHLINE K



MATCHLINE L

MATCHLINE J



MATCHLINE K

MATCHLINE I



MATCHLINE J

CAMINO RANCHO

CASINO DEL SOL

VIVIANA ROAD

8

VALENCIA ROAD

VALENCIA ROAD

VALENCIA ROAD

(No Scale)  
N

MATCHLINE N



VALENCIA ROAD

VALENCIA ROAD

MARK ROAD

MATCHLINE M



IGNACIO BAUMEA

VALENCIA ROAD

CASINO DEL SOL

MATCHLINE N

MATCHLINE L



VALENCIA ROAD



MATCHLINE M

Proposed Median Openings

Valencia Road

Pima County, AZ

EXHIBIT 19e

## **5.6 Alternative Transportation Modes**

Implementation of 6-foot paved multiuse lanes within the roadway cross section will provide a separate lane for use by bicycles. A continuous paved sidewalk along Valencia Road should be constructed for pedestrian use. ADA compliant ramps shall be provided at all intersections or driveways. Crosswalks shall be maintained at all signalized intersections.

## **5.7 Lighting and ITS**

Intersection lighting currently exists at all signalized intersections.

Intersection lighting will be provided with this project at the proposed signalized intersections of Valencia Road and Vahalla Road, Iberia Avenue and Wade Road.

Per Pima County policy, ITS conduit with inner ducts will need to be installed along one side of Valencia Road



Phasing

Ø 1	Ø 2	Ø 3	Ø 4

Proposed Lane Configuration and Phasing  
 Valencia Road at Vahalla Road  
 Pima County, AZ  
**EXHIBIT 21**



Phasing

Ø 1	Ø 2	Ø 3	Ø 4

Proposed Lane Configuration and Phasing  
 Valencia Road at Iberia Avenue  
 Pima County, AZ  
**EXHIBIT 22**



Phasing

Ø 1	Ø 2	Ø 3	Ø 4

Proposed Lane Configuration and Phasing  
 Valencia Road at Wade Road  
 Pima County, AZ  
**EXHIBIT 23**

N  
(No Scale)



Phasing

Ø 1	Ø 2	Ø 3

Proposed Lane Configuration and Phasing  
 La Cholla Blvd. and Lambert Ln.  
 Pima County, AZ  
**EXHIBIT 24**

## 6. Conclusions

An extensive amount of data was collected for this traffic engineering study. Capacity, queuing, and crash analyses were conducted to evaluate the corridor's current and future operations. The study's conclusions are summarized below.

The following conclusions were reached for the traffic and safety analyses conducted.

- Traffic flow on Valencia Road, is directional during the a.m. and p.m. peak periods. Different timing strategies should be implemented for different peak periods.
- To accommodate the projected 2030 traffic demands, a 4-lane roadway is needed for the entire section of Valencia Road, from Mountain Eagle Drive to Mark Road.
- Based on 2030 traffic projections, the turn lane storage lengths provided in Exhibit 18 are recommended for signalized intersections.
- A review of crash data covering the last three years showed crash rates at signalized intersections are higher than average for signalized intersections within Pima County. The addition of through lanes and proposed raised median to control access should improve the overall safety on Valencia Road.

The following improvements are proposed for the Valencia Road corridor:

- Widen Valencia Road from Mountain Eagle Drive to Mark Road to four through lanes.
- Signalize the intersections of Vahalla Road, Iberia Avenue and Wade Road.
- At all signalized intersections provide exclusive left-turn and right-turns with the recommended turn bay storage lengths.
- Realign the north leg of Wade Road to meet the signal and maintain vehicle access.
- Provide median openings at recommended locations.
- Provide a continuous paved sidewalk along Valencia Road.
- Install ITS conduit with inner ducts along one side of Valencia Road.
- The posted speed limit should remain 45 miles per hour along Valencia Road.

## 7. References

1. Pima County. Roadway Design Manual, Third Edition. 2010.
2. Transportation Research Board. Highway Capacity Manual. 2000.
3. AASHTO. Roadside Design Guide. 2002.
4. AASHTO. A Policy on Geometric Design of Highways and Streets. 2004.
5. Regional Transportation Authority. Approved RTA Project List. May 2006.
6. Pima County Southwest Infrastructure Plan. November 2007.
7. PCDOT Web Site. <http://www.dot.co.pima.az.us/trafeng/>.

## **List of Appendices**

- Appendix A** Traffic Counts
- Appendix B** Capacity Worksheets (2011)
- Appendix C** Crash Records
- Appendix D** Signal Warrant Worksheets
- Appendix E** 2030 Turning Volumes Worksheet
- Appendix F** Capacity Worksheets (Existing Capacity with 2030 Volume)
- Appendix G** Capacity Worksheets (2030)
- Appendix H** Storage Length Estimation