KUNZMAN ASSOCIATES, INC.

TENTATIVE TRACT MAP NO. 36561

FOCUSED TRAFFIC ANALYSIS

June 27, 2016

June 27, 2016

Mr. Brook Morris, President
PRISM REALTY CORPORATION
3189 Airway Avenue, Suite B
Costa Mesa, CA 92626-4612

Dear Mr. Morris:

INTRODUCTION

The firm of Kunzman Associates, Inc. is pleased to provide this focused traffic analysis for the Tentative Tract Map No. 36561 project. The purpose of this analysis is to determine if the project access will be adequate for the proposed project.

This report summarizes our methodology, analysis, and findings. Although this is a technical report, every effort has been made to write the report clearly and concisely. To assist the reader with those terms unique to transportation engineering, a glossary of terms is provided within Appendix A.

PROJECT DESCRIPTION

The project site is located at 54721 Monroe Street in the City of La Quinta. The proposed project consists of a total of 36 single-family detached residential dwelling units. The project site is currently developed with one single-family residence, which will be displaced with the proposed project. Figure 1 shows the project location map and the proposed site plan is illustrated on Figure 2. Project access will be provided at Monroe Street with northbound left-turns in prohibited and an acceleration lane for left-turns out to merge with northbound vehicles on Monroe Street.

TRIP GENERATION

The trips generated by the project are determined by multiplying an appropriate trip generation rate by the quantity of land use. Trip generation rates are predicated on the assumption that energy costs, the availability of roadway capacity, the availability of vehicles to drive, and life styles remain similar to what are known today. A major change in these variables may affect trip generation rates.

Trip generation rates were determined for daily traffic, morning peak hour inbound and outbound traffic, and evening peak hour inbound and outbound traffic for the project land use. By multiplying the trip generation rates by the land use quantity, the traffic volumes are determined. The trip generation rates are from the Institute of Transportation Engineers, Trip Generation Manual, 9th Edition, 2012.

Table 1 shows the trip generation rates, project peak hour trips, and project daily trips used for this analysis. As shown in Table 1, the project site is projected to generate approximately 343 daily vehicle trips, 27 of which will occur during the morning peak hour and 36 of which will occur during the evening peak hour. Specifically, 16 trips are forecast to turn left when exiting the project site during the morning peak hour and 10 trips are forecast to turn left when exiting the project site during the evening peak hour.

INTERSECTION DELAY AND LEVEL OF SERVICE ANALYSIS

Existing traffic counts conducted adjacent to the proposed project site were obtained by Kunzman Associates, Inc. in October 2015. Traffic count worksheets are provided in Appendix B. In accordance with City of La Quinta Engineering Bulletin #06-13, the existing traffic counts conducted during October (see Appendix B), have a 10% seasonal variation factor.

The proposed project access will be STOP-sign controlled at the project site egress and Monroe Street will continue to be uncontrolled. As shown on the project site plan (see Figure 2), this analysis assumes the proposed project will have full access at Monroe Street, including a northbound left-turn lane.

The technique used to assess the performance of unsignalized intersections in the City of La Quinta is the Intersection Delay Method (see Appendix C) based on the Highway Capacity Manual - Transportation Research Board Special Report 209. To calculate delay, the volume of traffic using the intersection is compared with the capacity of the intersection.

The City of La Quinta has established Level of Service E as the minimum Level of Service for a side street on a two-way stop-controlled intersection. A potentially significant impact at an unsignalized intersection is defined to occur when the addition of project trips causes or worsens Level of Service F on a side street for two-way stop control.

Existing Plus Project

The forecast Existing Plus Project morning and evening peak hour intersection turning movement volumes are shown on Figure 3. Project trips were assigned to the project access at Monroe Street based on the directional trip distribution also shown on Figure 3. The forecast project trip distribution is based on a review of existing traffic data, surrounding land uses, and the local and regional roadway facilities in the project vicinity.

The Existing Plus Project delay and Levels of Service for the study intersection are shown in Table 2. As shown in Table 2, the proposed project access at Monroe Street is forecast to operate within acceptable Levels of Service during the peak hours. Additionally, the proposed project is forecast to result in no significant traffic impacts at the intersection of the proposed project access and Monroe Street for Existing Plus Project conditions. Existing Plus Project delay and Level of Service worksheets are provided in Appendix C.

General Plan Buildout (Year 2035) With Project

Figure 4 shows the forecast General Plan Buildout (Year 2035) With Project traffic volumes. General Plan Buildout (Year 2035) With Project traffic volumes were derived from the average daily traffic volumes forecast in the City of La Quinta General Plan for General Plan Buildout (Year 2035) conditions.

General Plan Buildout (Year 2035) With Project traffic conditions assume Monroe Street will be constructed at its ultimate right-of-way with two lanes in each direction. Figure 5 shows a conceptual median acceleration lane for proposed left-turn out project access. As shown on Figure 5, a proposed median acceleration lane on the north leg of the Monroe Street/Project Access intersection would allow for a two-stage turning movement for left-turning vehicles exiting the project site. General Plan Buildout (Year 2035) With Project conditions were analyzed using the Highway Capacity Software 2010 to account for breaks in traffic flow created by the planned traffic signal approximately 750 feet north of the proposed project access at the future intersection of Monroe Street/Firenze Street. This is a conservative analysis since the Highway Capacity Software analyzes the project access intersection as a two-way left-turn lane along Monroe Street and does not account for the additional capacity provided by the proposed acceleration lane (i.e., in reality, the project access intersection is expected to operate better than indicated by this Level of Service analysis).

The General Plan Buildout (Year 2035) With Project delay and Levels of Service for the study intersection are shown in Table 3. As shown in Table 3, the proposed project access at Monroe Street is forecast to operate within acceptable Levels of Service during the peak hours. Additionally, the proposed project is forecast to result in no significant traffic impacts at the intersection of the proposed project access and Monroe Street for General Plan Buildout (Year 2035) With Project conditions. General Plan Buildout (Year 2035) With Project delay and Level of Service worksheets are provided in Appendix C.

MEDIAN ACCELERATION LANE

The purpose of a median acceleration lane is to allow merging vehicles from the minor road (e.g., left-turning vehicles exiting the project site) to accelerate within the median along the major road before merging into the through lane. Since the project access at Monroe Street is forecast to operate acceptably as a two-way left-turn lane based on the Level of Service analysis discussed in the previous section, the proposed median acceleration lane is more than adequate because it provides additional capacity and protection.

It is important to note that the City of La Quinta does not have a standard plan for median acceleration lanes. The available guidance for parallel-type acceleration lanes included in A Policy on Geometric Design of Highways and Streets (American Association of State Highway and Transportation Officials, 2011) is in reference to freeway acceleration lanes, which typically differ significantly from the proposed median acceleration lane both in traffic volumes and speed. Freeway acceleration lanes require vehicles to continually accelerate before being forced to find a gap in the mainline traffic and merge. Typically, merging vehicles cannot pause on a freeway acceleration lane without impacting other vehicles and causing substantial queues.

As evidenced by the previously discussed Level of Service analysis, the number of left-turning vehicles forecast to exit the project site is sufficiently low (16 vehicles during the morning peak hour and 10 vehicles during the evening peak hour) that a two-way left-turn lane is forecast to operate acceptably. Therefore, unlike a freeway acceleration lane, a vehicle could pause within the proposed median acceleration lane, if necessary, until a suitable gap is available in the adjacent through lane without causing substantial delays to other vehicles.

The length of the proposed median acceleration lane is constrained by the distance between the proposed project access and a future northbound left-turn lane for the future Tentative Tract Map No. 34642 ("TTM 34642") project to the north. Based on the traffic impact study for TTM 34642 (Griffin Ranch SP 2004-074 Amendment No. 1 and Tentative Tract Map No. 34642 Traffic Impact Study, Endo Engineering, November 2006), approximately 15 vehicles per hour, or roughly one vehicle every four minutes, are forecast to use the future northbound left-turn lane for TTM 34642 access during the afternoon peak hour. The storage length should be designed to accommodate 1.5 to 2 times the number of vehicles per cycle, but not be less than 2 vehicles. Therefore, a common left-turn lane design of 100 feet of storage length plus 90 feet of taper length would provide more than sufficient vehicle storage. To provide some extra distance for deceleration, a 130-foot storage length is recommended with a 60-foot taper length.

Assuming a minimum 300-foot merging taper[1], the proposed median acceleration lane has been designed to maximize the full-width acceleration lane. Approximately 70 feet within the 300-foot merge taper can accommodate the width of a passenger car; therefore, nearly 330 feet of acceleration distance is provided. As previously stated, since the project access at Monroe Street is forecast to operate acceptably as a two-way left-turn lane, the proposed median acceleration lane is more than adequate because it provides additional capacity and protection.

EMERGENCY VEHICLE ACCESS

As shown on the project site plan (see Figure 2), the project will have right-in/right-out with left-turn out only access at Monroe Street and a gated emergency vehicle only access through the adjacent community at the western project boundary. Adequate emergency vehicle access appears to be provided since there will be two ways of reaching the project site in case of emergency.

All hospitals and emergency care facilities appear to be located to the north of the project site; therefore, left-turn out access at the project site egress is critical for minimizing travel time from the project site to an emergency care facility. Prohibiting left-turns out would likely increase travel time by more than two minutes because emergency vehicles and residents would be forced to turn right when exiting the project site and travel in a more circuitous path, potentially at a time when every minute counts.

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[1] Conservatively based on minimum taper length for freeway acceleration lanes recommended by A Policy on Geometric Design of Highways and Streets (American Association of State Highway and Transportation Officials, 2011, p. 10-108).

CONCLUSIONS & RECOMMENDATIONS

The proposed project is forecast to result in no significant traffic impacts at the intersection of the proposed project access and Monroe Street for the evaluated scenarios.

The project is proposed to have right-in/right-out with left-turn out only access at Monroe Street and a gated emergency vehicle only access through the adjacent community at the western project boundary.

The planned traffic signal approximately 750 feet north of the proposed project access at the future intersection of Monroe Street/Firenze Street will create breaks in traffic flow along Monroe Street, which will provide helpful gaps in southbound flow for vehicles exiting the project.

Figure 5 shows a conceptual median acceleration lane for proposed left-turn out project access. The proposed median acceleration lane has been designed to maximize the full-width acceleration lane. Approximately 70 feet within the 300-foot merge taper can accommodate the width of a passenger car; therefore, nearly 330 feet of acceleration distance is provided. Since the project access at Monroe Street is forecast to operate acceptably as a two-way left-turn lane, the proposed median acceleration lane is more than adequate because it provides additional capacity and protection.

Adequate emergency vehicle access appears to be provided since there will be two ways of reaching the project site in case of emergency. All hospitals and urgent care facilities appear to be located to the north of the project site; therefore, left-turn out access at the project site egress is critical for minimizing travel time from the project site to an emergency care facility.

Construct Monroe Street from the north project boundary to the south project boundary at its ultimate half-section width including landscaping and parkway improvements in conjunction with development, as necessary.

The proposed project driveway should be constructed in conformance with City of La Quinta standards and/or as approved by the Department of Public Works, including provisions for sight distance.

As is the case for any roadway design, the City of La Quinta should periodically review traffic operations in the vicinity of the project once the project is constructed to assure that the traffic operations are satisfactory.

It has been a pleasure to service your needs on this project. Should you have any questions or if we can be of further assistance, please do not hesitate to call at (714) 973-8383.

Sincerely,

KUNZMAN ASSOCIATES, INC.

Giancarlo Ganddini, P.E.
Manager of Traffic Engineering

REGISTERED PROFESSIONAL ENGINEER
GIANCARLO J. GANDDINI
TR 2663
TRAFFIC
STATE OF CALIFORNIA

KUNZMAN ASSOCIATES, INC.

Carl Ballard, LEED GA
Principal

Jn5839

Table 1

Project Trip Generation

Land Use	Quantity	Units[1]	Peak Hour						Daily
			Morning			Evening			
			Inbound	Outbound	Total	Inbound	Outbound	Total	
Trip Generation Rates[2]									
Single-Family Detached Residential	-	DU	0.19	0.56	0.75	0.63	0.37	1.00	9.52
Trips Generated									
Single-Family Detached Residential	36	DU	7	20	27	23	13	36	343

[1] DU = Dwelling Units

[2] Source: Institute of Transportation Engineers, Trip Generation Manual, 9th Edition, 2012, Land Use Category 210.

Table 2

Existing Plus Project Intersection Delay and Level of Service

Intersection	Jurisdiction	Traffic Control[2]	Intersection Approach Lanes[1]												Delay-LOS[3]	
			Northbound			Southbound			Eastbound			Westbound			Morning Peak Hour	Evening Peak Hour
			L	T	R	L	T	R	L	T	R	L	T	R		
Monroe Street (NS) at: Project Access (EW)	La Quinta	**<u>CSS</u>**	0	1	0	0	0.5	0.5	0.5	0	0.5	0	0	0	11.5-B	11.8-B

[1] When a right turn lane is designated, the lane can either be striped or unstriped. To function as a right turn lane there must be sufficient width for right turning vehicles to travel outside the through lanes.
L = Left; T = Through; R = Right; **1** = Improvement

[2] CSS = Cross Street Stop

[3] Delay and Level of Service (LOS) have been calculated using the following analysis software: Vistro, Version 3.00-06.

Table 3

General Plan Buildout (Year 2035) With Project Intersection Delay and Level of Service

Intersection	Jurisdiction	Traffic Control[2]	Intersection Approach Lanes[1]												Delay-LOS[3]	
			Northbound			Southbound			Eastbound			Westbound			Morning Peak Hour	Evening Peak Hour
			L	T	R	L	T	R	L	T	R	L	T	R		
Monroe Street (NS) at: Project Access (EW)	La Quinta	**CSS**	0	**2**	0	0	**2**	**1**	**0.5**	0	**0.5**	0	0	0	26.0-D	27.8-D

[1] When a right turn lane is designated, the lane can either be striped or unstriped. To function as a right turn lane there must be sufficient width for right turning vehicles to travel outside the through lanes.
L = Left; T = Through; R = Right; **1** = Improvement

[2] CSS = Cross Street Stop

[3] Delay and Level of Service (LOS) have been calculated using the following analysis software: HCS 2010.

Figure 1
Project Location Map

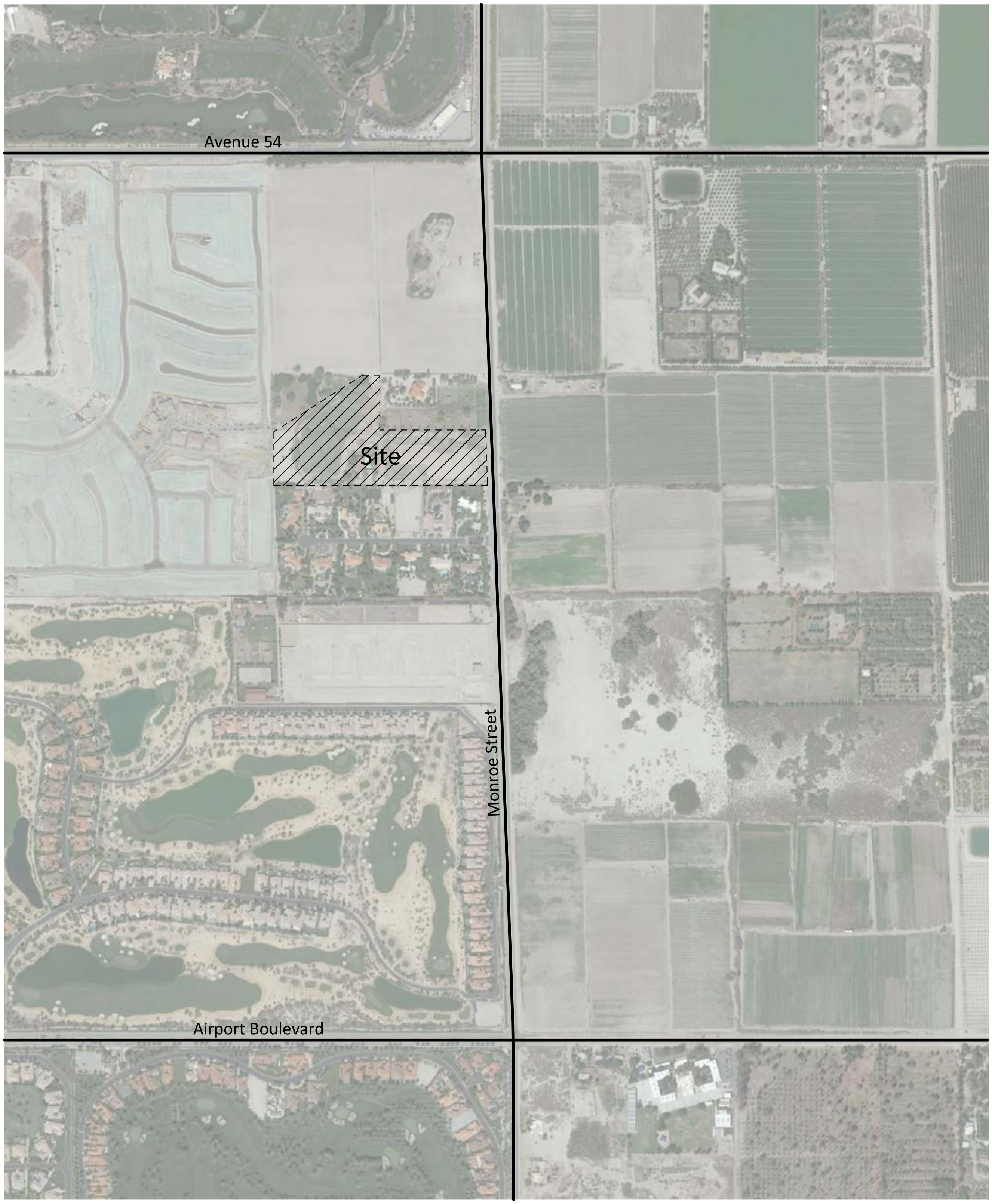

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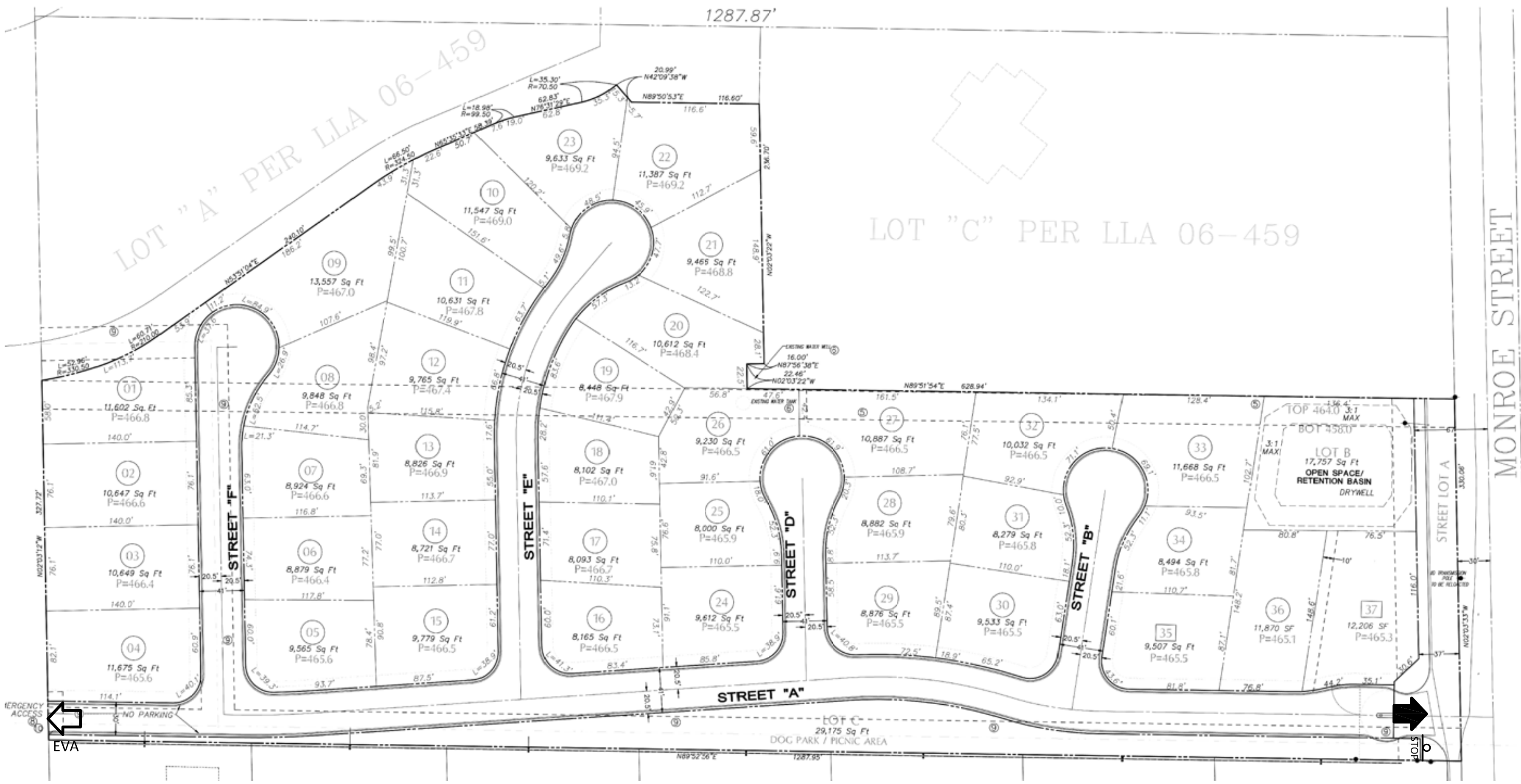
Figure 2
Site Plan



Legend

- EVA = Emergency Vehicle Access Only
- STOP = Stop Sign
- = Right-In/Right-Out with Left-Turn Out Access Driveway

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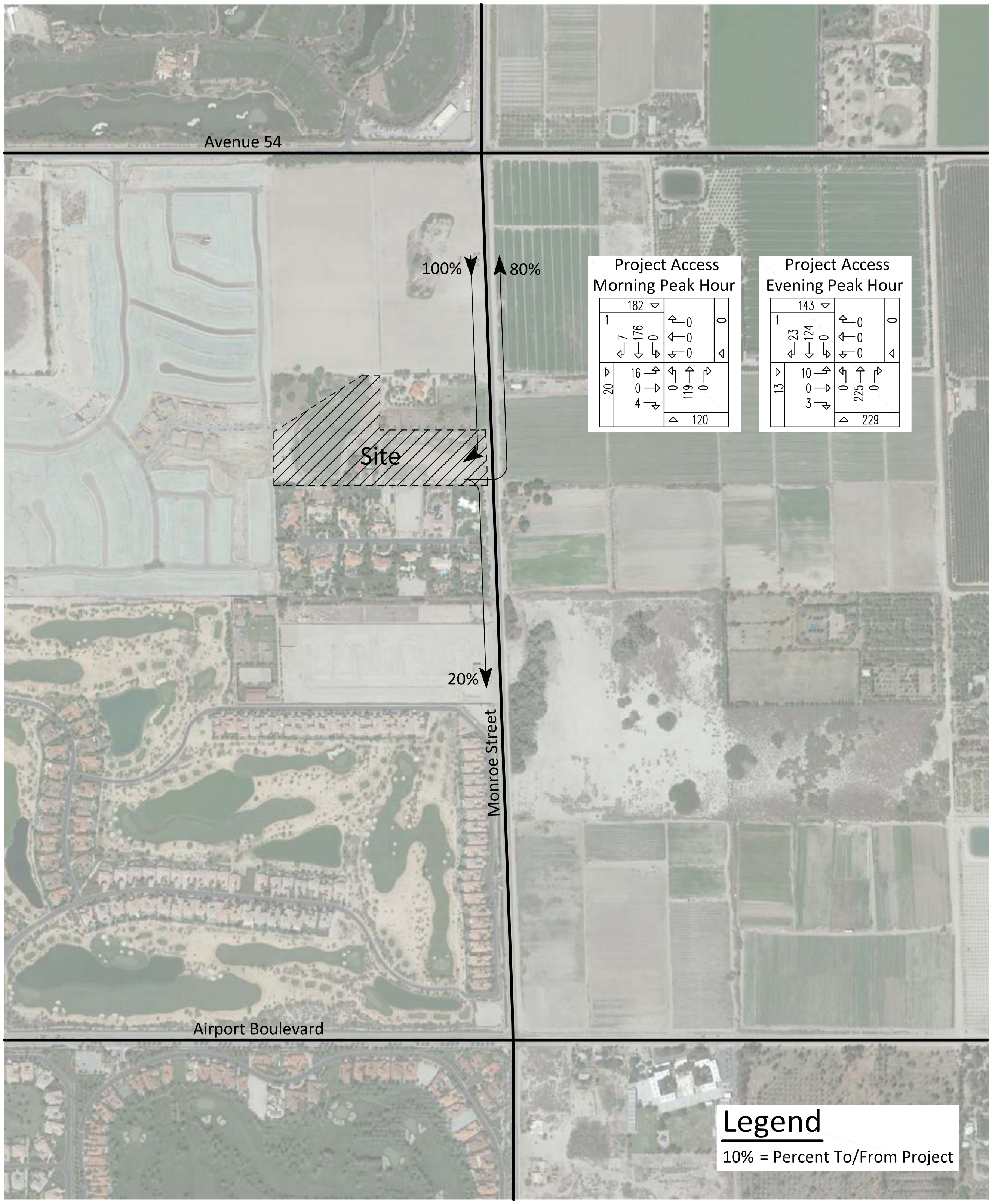
Figure 3
Existing Plus Project Peak Hour Intersection Turning Movement Volumes



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Kunzman Associates, Inc. Intersection reference numbers are in upper left corner of turning movement boxes.

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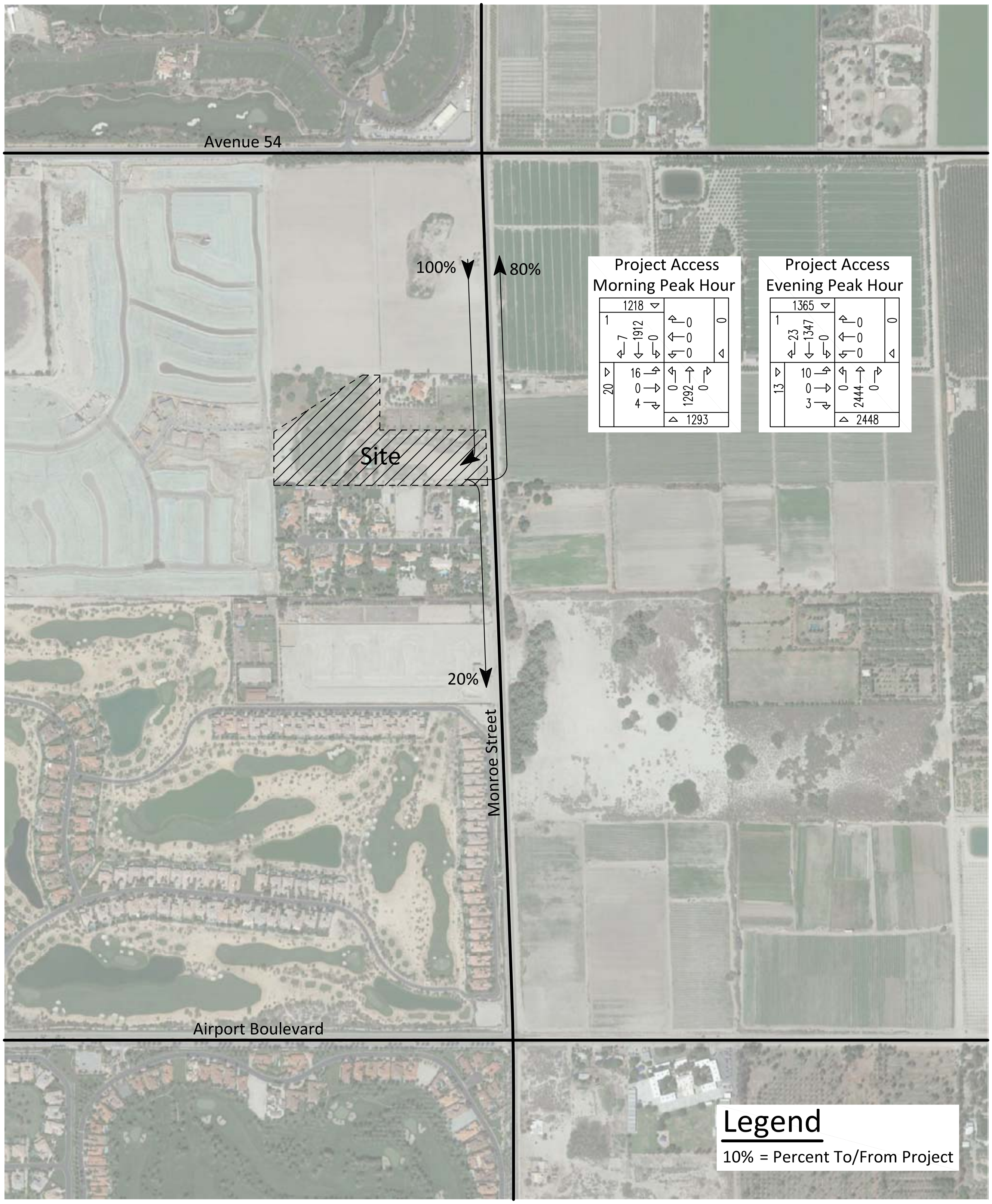
Figure 4
General Plan Buildout (Year 2035) With Project
Peak Hour Intersection Turning Movement Volumes



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KUNZMAN ASSOCIATES, INC. Intersection reference numbers are in upper left corner of turning movement boxes.

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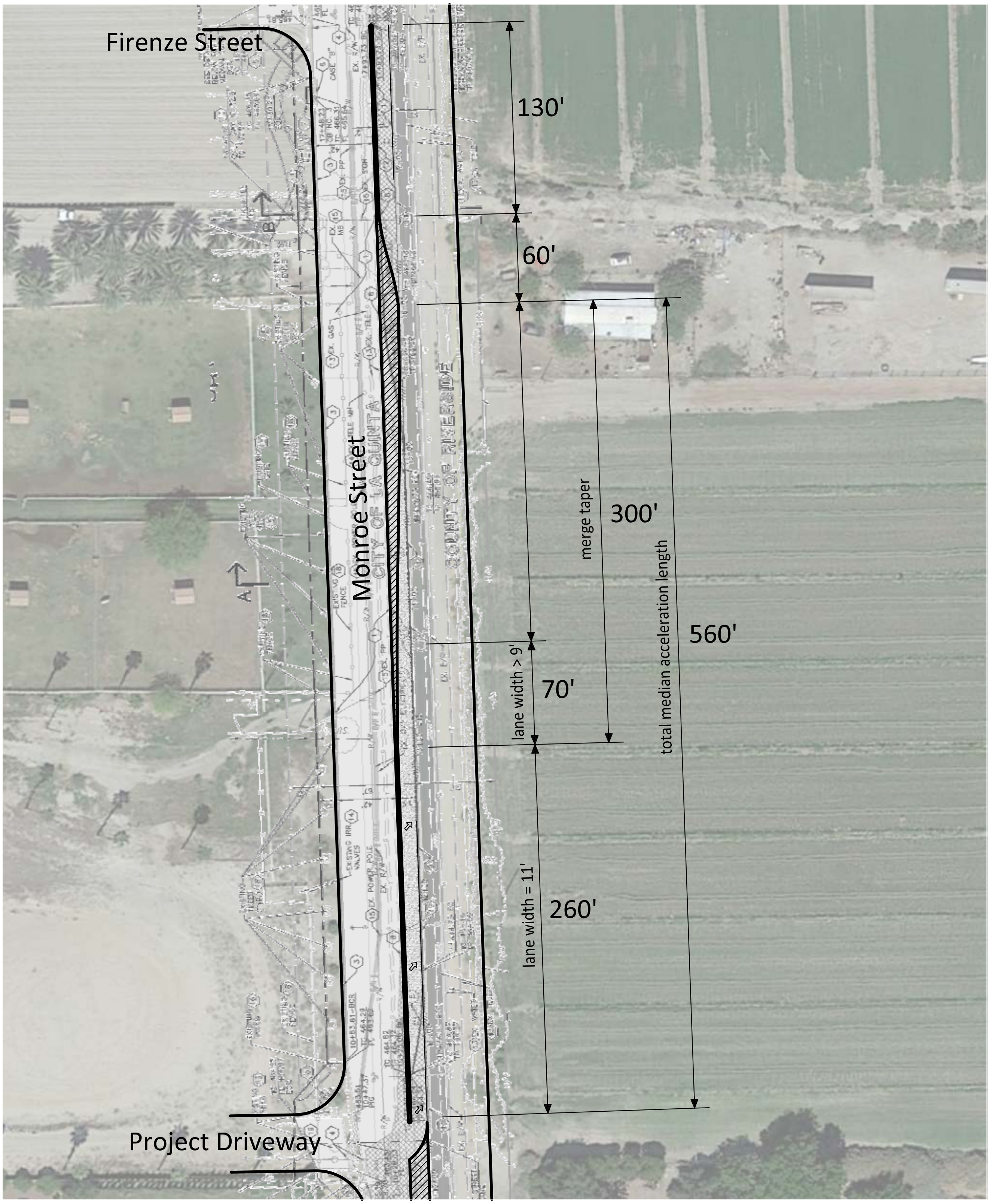
Figure 5
Conceptual Median Acceleration Lane



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APPENDIX A

Glossary of Transportation Terms

GLOSSARY OF TRANSPORTATION TERMS

COMMON ABBREVIATIONS

AC:	Acres
ADT:	Average Daily Traffic
Caltrans:	California Department of Transportation
DU:	Dwelling Unit
ICU:	Intersection Capacity Utilization
LOS:	Level of Service
TSF:	Thousand Square Feet
V/C:	Volume/Capacity
VMT:	Vehicle Miles Traveled

TERMS

AVERAGE DAILY TRAFFIC: The total volume during a year divided by the number of days in a year. Usually only weekdays are included.

BANDWIDTH: The number of seconds of green time available for through traffic in a signal progression.

BOTTLENECK: A constriction along a travelway that limits the amount of traffic that can proceed downstream from its location.

CAPACITY: The maximum number of vehicles that can be reasonably expected to pass over a given section of a lane or a roadway in a given time period.

CHANNELIZATION: The separation or regulation of conflicting traffic movements into definite paths of travel by the use of pavement markings, raised islands, or other suitable means to facilitate the safe and orderly movements of both vehicles and pedestrians.

CLEARANCE INTERVAL: Nearly same as yellow time. If there is an all red interval after the end of a yellow, then that is also added into the clearance interval.

CORDON: An imaginary line around an area across which vehicles, persons, or other items are counted (in and out).

CYCLE LENGTH: The time period in seconds required for one complete signal cycle.

CUL-DE-SAC STREET: A local street open at one end only, and with special provisions for turning around.

DAILY CAPACITY: The daily volume of traffic that will result in a volume during the peak hour equal to the capacity of the roadway.

DELAY: The time consumed while traffic is impeded in its movement by some element over which it has no control, usually expressed in seconds per vehicle.

DEMAND RESPONSIVE SIGNAL: Same as traffic-actuated signal.

DENSITY: The number of vehicles occupying in a unit length of the through traffic lanes of a roadway at any given instant. Usually expressed in vehicles per mile.

DETECTOR: A device that responds to a physical stimulus and transmits a resulting impulse to the signal controller.

DESIGN SPEED: A speed selected for purposes of design. Features of a highway, such as curvature, superelevation, and sight distance (upon which the safe operation of vehicles is dependent) are correlated to design speed.

DIRECTIONAL SPLIT: The percent of traffic in the peak direction at any point in time.

DIVERSION: The rerouting of peak hour traffic to avoid congestion.

FORCED FLOW: Opposite of free flow.

FREE FLOW: Volumes are well below capacity. Vehicles can maneuver freely and travel is unimpeded by other traffic.

GAP: Time or distance between successive vehicles in a traffic stream, rear bumper to front bumper.

HEADWAY: Time or distance spacing between successive vehicles in a traffic stream, front bumper to front bumper.

INTERCONNECTED SIGNAL SYSTEM: A number of intersections that are connected to achieve signal progression.

LEVEL OF SERVICE: A qualitative measure of a number of factors, which include speed and travel time, traffic interruptions, freedom to maneuver, safety, driving comfort and convenience, and operating costs.

LOOP DETECTOR: A vehicle detector consisting of a loop of wire embedded in the roadway, energized by alternating current and producing an output circuit closure when passed over by a vehicle.

MINIMUM ACCEPTABLE GAP: Smallest time headway between successive vehicles in a traffic stream into which another vehicle is willing and able to cross or merge.

MULTI-MODAL: More than one mode; such as automobile, bus transit, rail rapid transit, and bicycle transportation modes.

OFFSET: The time interval in seconds between the beginning of green at one intersection and the beginning of green at an adjacent intersection.

PLATOON: A closely grouped component of traffic that is composed of several vehicles moving, or standing ready to move, with clear spaces ahead and behind.

ORIGIN-DESTINATION SURVEY: A survey to determine the point of origin and the point of destination for a given vehicle trip.

PASSENGER CAR EQUIVALENTS: One car is one Passenger Car Equivalent. A truck is equal to 2 or 3 Passenger Car Equivalents in that a truck requires longer to start, goes slower, and accelerates slower. Loaded trucks have a higher Passenger Car Equivalent than empty trucks.

PEAK HOUR: The 60 consecutive minutes with the highest number of vehicles.

PRETIMED SIGNAL: A type of traffic signal that directs traffic to stop and go on a predetermined time schedule without regard to traffic conditions. Also, fixed time signal.

PROGRESSION: A term used to describe the progressive movement of traffic through several signalized intersections.

SCREEN-LINE: An imaginary line or physical feature across which all trips are counted, normally to verify the validity of mathematical traffic models.

SIGNAL CYCLE: The time period in seconds required for one complete sequence of signal indications.

SIGNAL PHASE: The part of the signal cycle allocated to one or more traffic movements.

STARTING DELAY: The delay experienced in initiating the movement of queued traffic from a stop to an average running speed through a signalized intersection.

TRAFFIC-ACTUATED SIGNAL: A type of traffic signal that directs traffic to stop and go in accordance with the demands of traffic, as registered by the actuation of detectors.

TRIP: The movement of a person or vehicle from one location (origin) to another (destination). For example, from home to store to home is two trips, not one.

TRIP-END: One end of a trip at either the origin or destination; i.e. each trip has two trip-ends. A trip-end occurs when a person, object, or message is transferred to or from a vehicle.

TRIP GENERATION RATE: The quantity of trips produced and/or attracted by a specific land use stated in terms of units such as per dwelling, per acre, and per 1,000 square feet of floor space.

TRUCK: A vehicle having dual tires on one or more axles, or having more than two axles.

UNBALANCED FLOW: Heavier traffic flow in one direction than the other. On a daily basis, most facilities have balanced flow. During the peak hours, flow is seldom balanced in an urban area.

VEHICLE MILES OF TRAVEL: A measure of the amount of usage of a section of highway, obtained by multiplying the average daily traffic by length of facility in miles.

APPENDIX B

Traffic Count Worksheets

Counts Unlimited, Inc
PO Box 1178
Corona, CA 92878
Phone: 951-268-6268
email: counts@countsunlimited.com

City of La Quinta
Monroe Street
S/ Avenue 54
24 Hour Directional Volume Count

LQAMOS54
Site Code: 075-15565

Start	15-Oct-15	Northbound		Hour Totals		Southbound		Hour Totals		Combined Totals	
Time	Thu	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		0	30			1	24				
12:15		2	20			1	22				
12:30		0	33			0	26				
12:45		0	20	2	103	0	20	2	92	4	195
01:00		1	27			1	21				
01:15		1	24			1	33				
01:30		1	28			0	26				
01:45		0	34	3	113	0	22	2	102	5	215
02:00		1	34			0	23				
02:15		1	34			0	26				
02:30		0	56			0	34				
02:45		0	**55**	2	179	1	**37**	1	120	3	299
03:00		0	**69**			1	**23**				
03:15		1	**33**			0	**24**				
03:30		0	**68**			2	**40**				
03:45		0	42	1	212	1	30	4	117	5	329
04:00		3	29			3	25				
04:15		1	34			2	26				
04:30		1	30			6	19				
04:45		0	24	5	117	9	16	20	86	25	203
05:00		2	33			5	18				
05:15		4	40			12	20				
05:30		10	18			35	14				
05:45		16	27	32	118	29	16	81	68	113	186
06:00		14	16			35	7				
06:15		17	15			49	10				
06:30		39	11			45	10				
06:45		28	12	98	54	42	11	171	38	269	92
07:00		21	9			**31**	10				
07:15		23	5			**39**	7				
07:30		28	3			**55**	8				
07:45		**47**	3	119	20	**51**	17	176	42	295	62
08:00		**25**	12			19	12				
08:15		**24**	2			29	7				
08:30		**30**	2			22	5				
08:45		25	4	104	20	28	5	98	29	202	49
09:00		17	5			22	13				
09:15		18	3			20	6				
09:30		26	3			18	7				
09:45		21	2	82	13	27	4	87	30	169	43
10:00		22	6			27	3				
10:15		24	1			20	1				
10:30		19	0			21	3				
10:45		22	1	87	8	35	3	103	10	190	18
11:00		35	0			26	4				
11:15		21	1			17	1				
11:30		33	1			25	1				
11:45		16	1	105	3	13	1	81	7	186	10
Total		640	960	640	960	826	741	826	741	1466	1701
Combined Total		1600		1600		1567		1567		3167	
AM Peak	-	07:45	-	-	-	07:00	-	-	-	-	-
Vol.	-	126	-	-	-	176	-	-	-	-	-
P.H.F.		0.670				0.800					
PM Peak	-	-	02:45	-	-	-	02:45	-	-	-	-
Vol.	-	-	225	-	-	-	124	-	-	-	-
P.H.F.			0.815				0.775				
Percentage		40.0%	60.0%			52.7%	47.3%				
ADT/AADT		ADT 3,167		AADT 3,167							

APPENDIX C

Explanation and Calculation of Intersection Delay

EXPLANATION AND CALCULATION OF INTERSECTION LEVEL OF SERVICE USING DELAY METHODOLOGY

The levels of service at the unsignalized and signalized intersections are calculated using the delay methodology in the Highway Capacity Manual. This methodology views an intersection as consisting of several lane groups. A lane group is a set of lanes serving a movement. If there are two northbound left turn lanes, then the lane group serving the northbound left turn movement has two lanes. Similarly, there may be three lanes in the lane group serving the northbound through movement, one lane in the lane group serving the northbound right turn movement, and so forth. It is also possible for one lane to serve two lane groups. A shared lane might result in there being 1.5 lanes in the northbound left turn lane group and 2.5 lanes in the northbound through lane group.

For each lane group, there is a capacity. That capacity is calculated by multiplying the number of lanes in the lane group times a theoretical maximum lane capacity per lane time's 12 adjustment factors.

Each of the 12 adjustment factors has a value of approximately 1.00. A value less than 1.00 is generally assigned when a less than desirable condition occurs.

The 12 adjustment factors are as follows:

1. Peak hour factor (to account for peaking within the peak hour)
2. Lane utilization factor (to account for not all lanes loading equally)
3. Lane width
4. Percent of heavy trucks
5. Approach grade
6. Parking
7. Bus stops at intersections
8. Area type (CBD or other)
9. Right turns
10. Left turns

11. Pedestrian activity

12. Signal progression

The maximum theoretical lane capacity and the 12 adjustment factors for it are all unknowns for which approximate estimates have been recommended in the Highway Capacity Manual. For the most part, the recommended values are not based on statistical analysis but rather on educated estimates. However, it is possible to use the delay method and get reasonable results as will be discussed below.

Once the lane group volume is known and the lane group capacity is known, a volume to capacity ratio can be calculated for the lane group.

With a volume to capacity ratio calculated, average delay per vehicle in a lane group can be estimated. The average delay per vehicle in a lane group is calculated using a complex formula provided by the Highway Capacity Manual, which can be simplified and described as follows:

Delay per vehicle in a lane group is a function of the following:

1. Cycle length

2. Amount of red time faced by a lane group

3. Amount of yellow time for that lane group

4. The volume to capacity ratio of the lane group

The average delay per vehicle for each lane group is calculated, and eventually an overall average delay for all vehicles entering the intersection is calculated. This average delay per vehicle is then used to judge Level of Service. The Level of Services are defined in the table that follows this discussion.

Experience has shown that when a maximum lane capacity of 1,900 vehicles per hour is used (as recommended in the Highway Capacity Manual), little or no yellow time penalty is used, and none of the 12 penalty factors are applied, calculated delay is realistic. The delay calculation for instance assumes that yellow time is totally unused. Yet experience shows that most of the yellow time is used.

An idiosyncrasy of the delay methodology is that it is possible to add traffic to an intersection and reduce the average total delay per vehicle. If the average total delay is 30 seconds per vehicle for all vehicles traveling through an intersection, and traffic is added to a movement that has an average total delay of 15 seconds per vehicle, then the overall average total delay is reduced.

The delay calculation for a lane group is based on a concept that the delay is a function of the amount of unused capacity available. As the volume approaches capacity and there is no more unused capacity available, then the delay rapidly increases. Delay is not proportional to volume, but rather increases rapidly as the unused capacity approaches zero.

Because delay is not linearly related to volumes, the delay does not reflect how close an intersection is to overloading. If an intersection is operating at Level of Service C and has an average total delay of 18 seconds per vehicle, you know very little as to what percent the traffic can increase before Level of Service E is reached.

LEVEL OF SERVICE DESCRIPTION[1]

Level Of Service	Description	Average Total Delay Per Vehicle (Seconds)	
		Signalized	Unsignalized
A	Level of Service A occurs when progression is extremely favorable and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.	0 to 10.00	0 to 10.00
B	Level of Service B generally occurs with good progression and/or short cycle lengths. More vehicles stop than for Level of Service A, causing higher levels of average total delay.	10.01 to 20.00	10.01 to 15.00
C	Level of Service C generally results when there is fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear in this level. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.	20.01 to 35.00	15.01 to 25.00
D	Level of Service D generally results in noticeable congestion. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high volume to capacity ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.	35.01 to 55.00	25.01 to 35.00
E	Level of Service E is considered to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high volume to capacity ratios. Individual cycle failures are frequent occurrences.	55.01 to 80.00	35.01 to 50.00
F	Level of Service F is considered to be unacceptable to most drivers. This condition often occurs with oversaturation, i.e., when arrival flow rates exceed the capacity of the intersection. It may also occur at high volume to capacity ratios below 1.00 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.	80.01 and up	50.01 and up

[1] Source: Highway Capacity Manual Special Report 209, Transportation Research Board, National Research Council, Washington, D.C., 2000.

Existing Plus Project

Intersection Level Of Service Report
Intersection 1: Monroe Street (NS) at Project Access (EW)

Control Type:	Two-way stop	Delay (sec / veh):	11.5
Analysis Method:	HCM 2010	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.036

Intersection Setup

Name	Monroe Street		Monroe Street		Project Access	
Approach	Northbound		Southbound		Eastbound	
Lane Configuration						
Turning Movement	Left	Thru	Thru	Right	Left	Right
Lane Width [ft]	12.00	12.00	12.00	12.00	12.00	12.00
No. of Lanes in Pocket	0	0	0	0	0	0
Pocket Length [ft]	100.00	100.00	100.00	100.00	100.00	100.00
Speed [mph]	30.00		30.00		30.00	
Grade [%]	0.00		0.00		0.00	
Crosswalk	No		No		No	

volumes

Name	Monroe Street		Monroe Street		Project Access	
Base Volume Input [veh/h]	0	119	176	0	0	0
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	0.00	0.00	0.00	0.00	0.00	0.00
Growth Rate	1.10	1.10	1.10	1.10	1.10	1.10
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	7	16	4
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	131	194	7	16	4
Peak Hour Factor	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	44	65	2	5	1
Total Analysis Volume [veh/h]	0	175	259	9	21	5
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Free	Free	Stop
Flared Lane			No
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance			No
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.00	0.00	0.00	0.04	0.01
d_M, Delay for Movement [s/veh]	0.00	0.00	0.00	0.00	11.48	9.88
Movement LOS		A	A	A	B	A
95th-Percentile Queue Length [veh]	0.00	0.00	0.00	0.00	0.13	0.13
95th-Percentile Queue Length [ft]	0.00	0.00	0.00	0.00	3.34	3.34
d_A, Approach Delay [s/veh]	0.00		0.00		11.17	
Approach LOS	A		A		B	
d_I, Intersection Delay [s/veh]	0.62					
Intersection LOS	B					

Intersection Level Of Service Report

Intersection 1: Monroe Street (NS) at Project Access (EW)

Control Type:	Two-way stop	Delay (sec / veh):	11.8
Analysis Method:	HCM 2010	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.022

Intersection Setup

Name	Monroe Street		Monroe Street		Project Access	
Approach	Northbound		Southbound		Eastbound	
Lane Configuration						
Turning Movement	Left	Thru	Thru	Right	Left	Right
Lane Width [ft]	12.00	12.00	12.00	12.00	12.00	12.00
No. of Lanes in Pocket	0	0	0	0	0	0
Pocket Length [ft]	100.00	100.00	100.00	100.00	100.00	100.00
Speed [mph]	30.00		30.00		30.00	
Grade [%]	0.00		0.00		0.00	
Crosswalk	No		No		No	

volumes

Name	Monroe Street		Monroe Street		Project Access	
Base Volume Input [veh/h]	0	225	124	0	0	0
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	0.00	0.00	0.00	0.00	0.00	0.00
Growth Rate	1.10	1.10	1.10	1.10	1.10	1.10
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	23	10	3
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	248	136	23	10	3
Peak Hour Factor	0.8100	0.8100	0.8100	0.8100	0.8100	0.8100
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	77	42	7	3	1
Total Analysis Volume [veh/h]	0	306	168	28	12	4
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Free	Free	Stop
Flared Lane			No
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance			No
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results

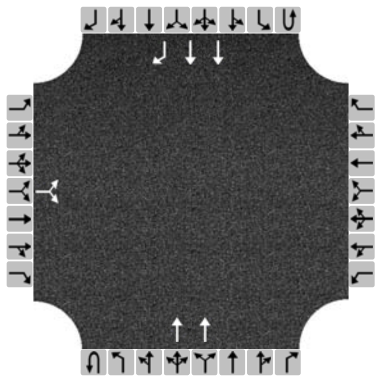
V/C, Movement V/C Ratio	0.00	0.00	0.00	0.00	0.02	0.00
d_M, Delay for Movement [s/veh]	0.00	0.00	0.00	0.00	11.80	9.32
Movement LOS		A	A	A	B	A
95th-Percentile Queue Length [veh]	0.00	0.00	0.00	0.00	0.08	0.08
95th-Percentile Queue Length [ft]	0.00	0.00	0.00	0.00	2.06	2.06
d_A, Approach Delay [s/veh]	0.00		0.00		11.18	
Approach LOS	A		A		B	
d_I, Intersection Delay [s/veh]	0.35					
Intersection LOS	B					

General Plan Buildout (Year 2035) With Project

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	Kunzman Associates, Inc.	Intersection	
Agency/Co.		Jurisdiction	La Quinta
Date Performed	6/7/2016	East/West Street	Project Access
Analysis Year	2035	North/South Street	Monroe Street
Time Analyzed	AM Peak Hour	Peak Hour Factor	1.00
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	TTM 36561		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	2	0	0	0	2	1
Configuration			LR								T				T	R
Volume (veh/h)		16		4							1292				1912	7
Percent Heavy Vehicles		0		0												
Proportion Time Blocked		0.800		0.800												
Right Turn Channelized	No				No				No				No			
Median Type	Left Only															
Median Storage	2															

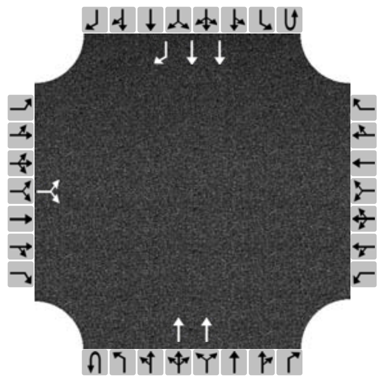
Delay, Queue Length, and Level of Service

Flow Rate (veh/h)			20													
Capacity			191													
v/c Ratio			0.10													
95% Queue Length			0.3													
Control Delay (s/veh)			26.0													
Level of Service (LOS)			D													
Approach Delay (s/veh)	26.0															
Approach LOS	D															

HCS 2010 Two-Way Stop Control Summary Report

General Information		Site Information	
Analyst	Kunzman Associates, Inc.	Intersection	
Agency/Co.		Jurisdiction	La Quinta
Date Performed	6/7//2016	East/West Street	Project Access
Analysis Year	2035	North/South Street	Monroe Street
Time Analyzed	PM Peak Hour	Peak Hour Factor	1.00
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	TTM 36561		

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	0	0	0	2	0	0	0	2	1
Configuration			LR								T				T	R
Volume (veh/h)		10		3							2444				1347	23
Percent Heavy Vehicles		0		0												
Proportion Time Blocked		0.800		0.800							0.000				0.000	0.000
Right Turn Channelized	No				No				No				No			
Median Type	Left Only															
Median Storage	2															

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)			13													
Capacity			171													
v/c Ratio			0.08													
95% Queue Length			0.2													
Control Delay (s/veh)			27.8													
Level of Service (LOS)			D													
Approach Delay (s/veh)	27.8															
Approach LOS	D															

Kunzman Associates, Inc.

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