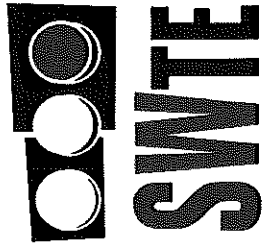


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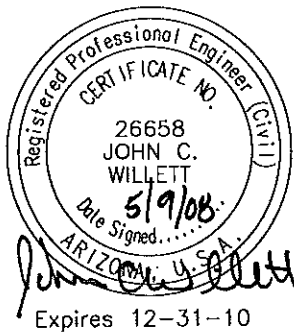


**SOUTHWEST TRAFFIC  
ENGINEERING, LLC**

## TRAFFIC IMPACT ANALYSIS

# COTTONFLOWER MARKETPLACE

REVISED FEBRUARY 12, 2008  
REVISED APRIL 1, 2008  
REVISED MAY 9, 2008



APPROVED - CITY OF GOODYEAR TRAFFIC ENGINEER

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Traffic Counts

Trip Generation Calculations

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Capacity Calculations

Auxiliary/Turn Lane Calculations

Comment Resolution Letters



## TRAFFIC IMPACT ANALYSIS COTTONFLOWER MARKETPLACE YUMA ROAD/COTTON LANE

### Executive Summary

The purpose of this traffic study is to evaluate the current and future transportation system within the project study area surrounding the site without and with the project. In addition, the study will analyze traffic operations at the existing intersections of:

- Yuma Road/173<sup>rd</sup> Avenue
- Yuma Road/Cotton Lane

### **Existing and Future Traffic Data Without Project**

Weekday AM and PM peak hour turning movement counts were recorded at the existing intersections of:

- Yuma Road/173<sup>rd</sup> Avenue
- Yuma Road/Cotton Lane

Additionally, 24-hour weekday bi-directional traffic counts were recorded on Yuma Road, just west of Cotton Lane.

According to the Maricopa County Department of Transportation (MCDOT), the long term plan for the study area is to improve Cotton Lane from the current two-way, four-lane rural roadway to a six lane divided freeway as an extension of the existing Loop 303 located approximately two miles north of the project at Interstate 10 (I-10). Frontage roads for the Loop 303 are planned as part of the long term improvements as well.

The Canyon Trails Towne Center development is located on the northeast corner of the Yuma Road/Cotton Lane intersection. The TIA for the project discussed long term improvements to Cotton Lane are unlikely to occur for 10 to 15 years. As part of the Canyon Trails Towne Center project construction, interim improvements to both Yuma Road and Cotton Lane immediately adjacent to the project will be constructed. The interim Cotton Lane would become a four lane divided roadway from I-10 to Yuma Road (the additional through lanes on Cotton Lane have since been installed).

Direct access to Cotton Lane from the site will be limited as traffic islands are planned for Access 3 and 4 to limit traffic to right-in, right-out only from Cotton Lane – Access 3 will have a northbound left turn into the site from Cotton Lane until the freeway is constructed. This is in preparation for the Loop 303 extension. Once the extension is constructed, the driveway accesses onto Cotton Lane will remain right-in/right-out access only onto the frontage roads. Additionally, the long term plan for Yuma Road is to improve the road to have a similar number of lanes as the long term Cotton Lane



roadway. Improvements to the north side of Yuma Road, between Cotton Lane and 173<sup>rd</sup> Avenue will be completed by the developer of the Village Square project site, which is located directly north of the Cottonflower Marketplace development. Improvements to the south side of Yuma Road, between Cotton Lane and 173<sup>rd</sup> Avenue will be completed by the developer of the Cottonflower Marketplace.

All of the movements at the intersections of Yuma Road/Cotton Lane and Yuma Road/173<sup>rd</sup> Avenue currently operate at an acceptable level of service (LOS) C or better during the weekday peak hours.

The Yuma Road/Cotton Lane intersection is predicted to operate with level of service of C or better on all approaches in 2008. In 2013, the intersection is predicted to operate at LOS C/D with a LOS F for the eastbound left turn movement. This delay is due partly to high levels of westbound through traffic in addition to large eastbound left-turning traffic. Turning traffic from Yuma Road must attempt to find a gap in the increasing westbound through traffic volumes on Yuma Road. It is anticipated that the developer of the Canyon Trails Towne Center development will install a traffic signal at Yuma Road/Cotton Lane and it will be operational in 2008.

The Yuma Road/173<sup>rd</sup> Avenue intersection is predicted to operate at an overall acceptable LOS C or better during the weekday AM and PM peak hours in 2008 and 2013 without the project and a traffic signal installed.

### **Future Traffic Data With Project**

The Yuma Road/173<sup>rd</sup> Avenue intersection results shown in Tables 7 and 8 indicate an overall adequate level of service C during the weekday AM and PM peak hours in 2008 and 2013 with the project and a traffic signal installed.

The Yuma Road/Cotton Lane intersection is predicted to operate at an overall acceptable LOS C during the weekday AM and PM peak hours in 2008 with the project. However, the intersection is predicted to operate at an overall LOS D during the weekday AM peak hour and LOS E during the PM peak hour in 2013 with the project and a traffic signal installed. This is due to the intersection's limited ability to provide enough traffic signal green time to accommodate high volumes of through and left-turning traffic with single left turn lanes on each approach.

The Yuma Road/Access1 intersection results indicate an overall adequate level of service B or better in 2008 and 2013 with the project and a traffic signal installed.

Results for Yuma Road/Access 2 in 2008 with the project indicate an overall acceptable LOS C during the weekday AM peak hour and an overall LOS D during the weekday PM peak hour. The delay experienced in the PM peak hour is caused by traffic exiting the project site attempting to merge with high eastbound through volumes on Yuma Road traveling on only one through lane approaching Cotton Lane. In the future as additional



eastbound travel lanes become available, the delay for exiting site traffic at Access 2 is expected to decrease. In 2013 with additional eastbound through lanes the intersection is predicted to operate with an acceptable LOS B in the AM and PM peak hours.

The Cotton Lane/Access 3 and Cotton Lane/Access 4 intersections are both predicted to operate with an acceptable LOS B or better in the AM and PM peak hours in 2008 and 2013 with the project.

### **Mitigation**

The Yuma Road/Cotton Lane intersection is predicted to operate with the eastbound left-turn movement experiencing an unacceptable LOS F in 2013 with the project. This is due to the intersection's limited capacity to accommodate high volumes of through and left-turning traffic with only single left turn lanes on each approach and a single eastbound through lane.

Mitigation for year 2013 includes the installation of an additional eastbound and westbound left-turn lane, and modifications to the eastbound approach to include one more through lane. This, combined with modifications to the traffic signal timing and equipment at the Yuma Road/Cotton Lane intersection, will allow the green time to be more adequately distributed to each approach, thereby optimizing the traffic signal operation and decreasing overall delay for the entire intersection. The predicted LOS with mitigation improves the eastbound left-turn movement LOS to D, and improves the overall intersection from LOS E to LOS C in the PM peak hour.

The Cottonflower Marketplace site plan indicates 75 feet of new right-of-way on the south side of Yuma Road, which is enough for two eastbound left turn lanes, two through lanes, and a right turn lane. However, installation of a second eastbound and westbound left-turn lane may require additional right-of-way on Yuma Road, east of Cotton Lane.

### **Recommendations**

The installation of roadway improvements to include a westbound left-turn lane and an eastbound right-turn lane at the Yuma Road/Access 1 intersection are recommended to ensure an acceptable LOS for the intersection.

The installation of a second eastbound left turn lane and a second westbound left turn lane are recommended at Yuma Road/Cotton Lane. Additionally, an exclusive eastbound right turn lane should be installed at the intersection.



## TRAFFIC IMPACT ANALYSIS COTTONFLOWER MARKETPLACE YUMA ROAD/COTTON LANE

### Project Description

Diversified Partners Development Company, LLC proposes to construct a mixed use development on the southwest corner of the intersection of Yuma Road/Cotton Lane in Goodyear, Arizona. A vicinity map of the project is shown in **Figure 1**. A site plan is provided in **Figure 2**. The project would consist of a several land uses including a health/fitness club, a pharmacy/drugstore with drive-through window, three new fast food restaurants with drive-through windows, and a shopping center with approximately three new retail shop locations within the site. Access to the site will be from four new intersections including two on Yuma Road and two on Cotton Lane.

The purpose of this traffic impact analysis is to:

- Evaluate the current and future transportation system within the area surrounding the site.
- Estimate the traffic generation associated with the project and assign that traffic to the roadway system.
- Analyze traffic operations at the existing intersections of:

Yuma Road/Cotton Lane  
Yuma Road/173<sup>rd</sup> Avenue

- Analyze the four new site access points.

The author of this report is a registered professional engineer (civil) in the State of Arizona having specific expertise and experience in the preparation of traffic impact analyses.

### Study Methodology

In order to analyze and evaluate the potential traffic impacts of the proposed development, the following tasks were undertaken:

- Field observation of the proposed site and surrounding area was conducted to evaluate the existing physical and operational characteristics of the adjacent roadway network.
- Site traffic volumes generated by the proposed site were calculated using the Institute of Transportation Engineers (ITE) *Trip Generation Manual, 7<sup>th</sup> Edition, 2003*.
- Trip distribution assignments were made and used to assign the site traffic to the site access points and the primary roadways within the project study limits.
- Capacity analyses were performed for the existing conditions and future conditions without and with the project based on an opening year of 2008 and 2013 (five years after opening).



**Figure 1 – Vicinity Map**

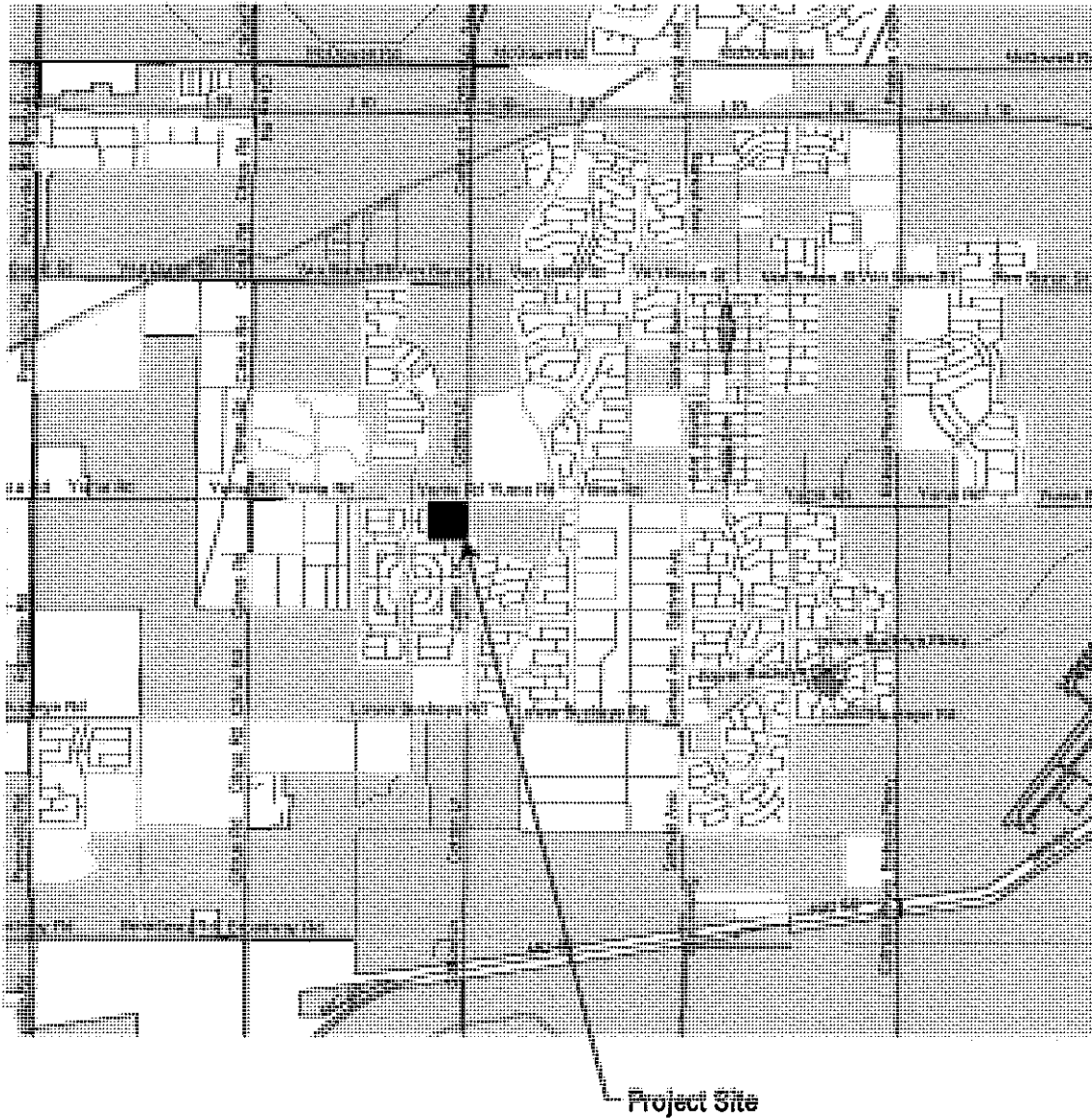
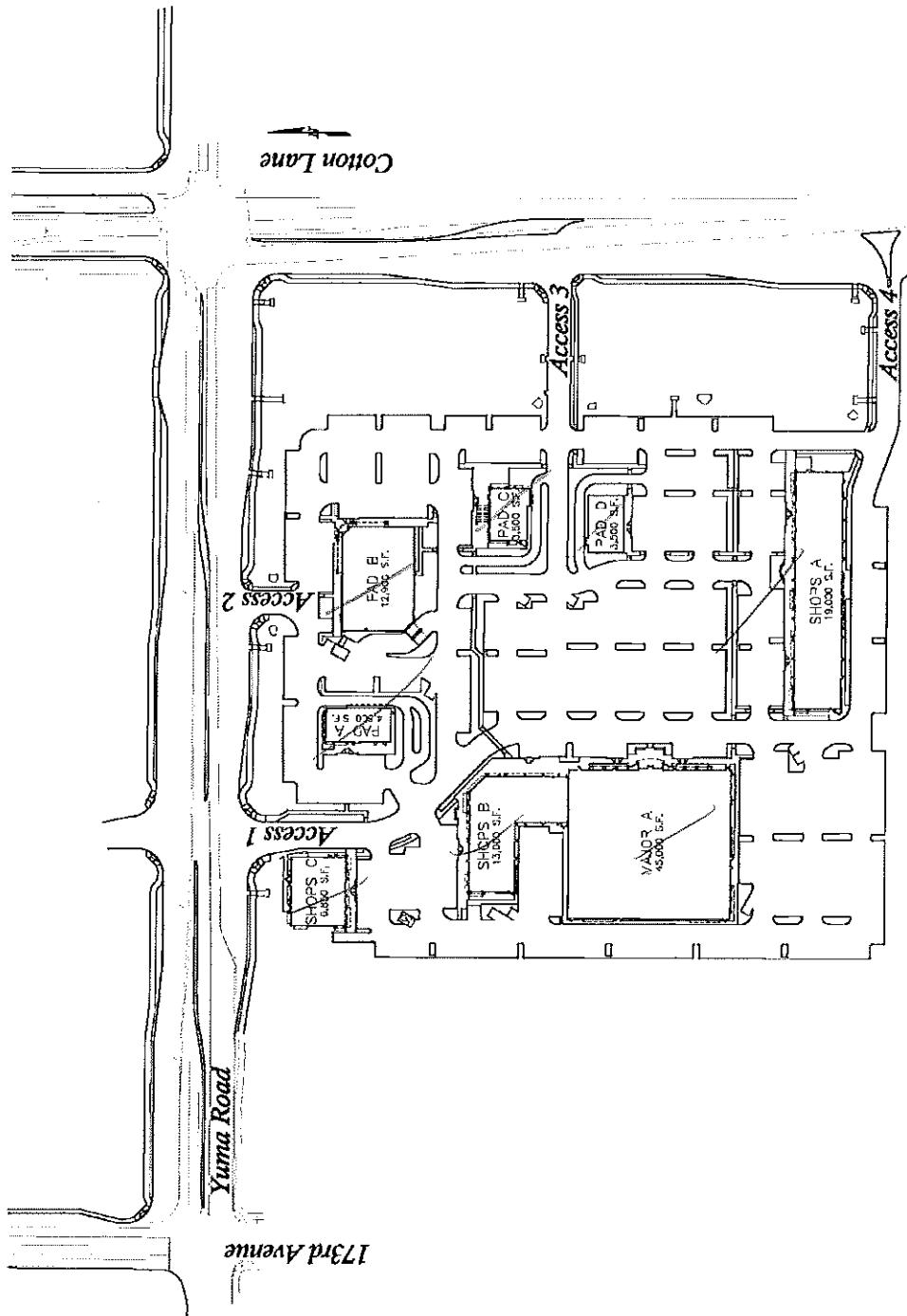






Figure 2 – Site Plan





- The intersections were analyzed using the methodology presented in the *2000 Highway Capacity Manual (HCM)*.
- Traffic analyses were revised to address revisions to the site plan as directed by the City of Goodyear.

### **Existing Conditions**

The project site is located in Goodyear, Arizona, on the southwest corner of the Yuma Road/Cotton Lane intersection.

The study location includes the existing un-signalized intersections of Yuma Road/Cotton Lane and Yuma Road/173<sup>rd</sup> Avenue.

Yuma Road is a two-way, two-lane undivided roadway with mostly dirt shoulders. Curb, gutter, and sidewalk facilities briefly exist on the south side of the pavement near 173<sup>rd</sup> Avenue. Yuma Road is posted at 50 miles per hour (MPH), follows an east/west section line alignment and provides access to mainly residential areas.

Cotton Lane is a two-way, four-lane divided roadway with dirt shoulders, no curb, gutter, or sidewalk facilities and is posted at 45 MPH. A dirt median separates traffic on Cotton Lane north of Yuma Road. South of Yuma Road a dirt median exists for approximately 750 feet then the northbound and southbound traffic on Cotton Lane is separated by a painted double-yellow centerline. Cotton Lane follows a north/south section line alignment and serves as one of the major north/south arterial routes in the area providing access to Interstate 10 (I-10) approximately two miles north of the site.

173<sup>rd</sup> Avenue south of Yuma Road is a two-way, two-lane divided roadway with curb gutter and sidewalk facilities. A landscaped median with curb and gutter separates northbound and southbound traffic. The posted speed limit is 25 MPH. 173<sup>rd</sup> Avenue serves as a collector route for adjacent residential areas needing access to Yuma Road.

173<sup>rd</sup> Avenue north of Yuma Road is a two-way, three-lane undivided roadway with curb and gutter. No sidewalk facilities exist and the posted speed limit is 35 MPH. 173<sup>rd</sup> Avenue serves as a collector route for a sparse number of new homes in the adjacent residential areas traveling to Yuma Road and the surrounding areas.

The un-signalized intersection of Yuma Road/Cotton Lane is controlled by STOP signs on all of the approaches. The westbound and eastbound approaches to the intersection offer a shared left turn/through/right turn lane. The northbound approach offers an exclusive left turn lane, a through lane, and a shared through/right turn lane. The southbound approach offers exclusive left-turn, through, and right-turn lanes. No curb, gutter, or sidewalk facilities are located at the intersection.

The un-signalized intersection of Yuma Road/173<sup>rd</sup> Avenue is controlled by a stop sign for northbound and southbound 173<sup>rd</sup> Avenue traffic while Yuma Road is free-flow. The



northbound approach to the intersection provides one shared left turn/through lane and one right turn lane. The southbound approach to the intersection provides separate right turn, through and left turn lanes. The eastbound approach to the intersection provides one shared left turn lane/through lane and one right turn lane while the westbound approach provides an exclusive left turn lane, one through lane and a right turn lane. Curb, gutter, and sidewalk facilities are located on the south side of Yuma Road near the intersection only. Cross-hatched pavement markings are provided in unused pavement areas on Yuma Road near the intersection. These pavement areas may be re-striped in the future to provide an additional eastbound left-turn lane or width for another eastbound through lane as development occurs and the south side of Yuma Road is widened.

The existing lane configurations and intersection controls are shown in **Figure 3**.

### **Existing Traffic Data**

In order to form a basis for analysis of the project impacts, weekday AM and PM peak hour turning movement counts were conducted at the intersections of:

- Yuma Road/Cotton Lane
- Yuma Road/173<sup>rd</sup> Avenue

The weekday turning movement counts at the study intersections were conducted from 7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM.

24-hour weekday bi-directional traffic counts were conducted on Yuma Road west of the Yuma Road/Cotton Lane intersection.

The traffic counts were conducted in late May 2007.

The existing weekday AM and PM peak hour traffic volumes are shown in **Figure 4**. The complete traffic volume summaries can be found in the Appendix.

### **Trip Generation**

Trip generation for the project was developed utilizing nationally agreed upon data contained in the Institute of Transportation Engineers (ITE) publication *Trip Generation, 7<sup>th</sup> Edition, 2003*. So as to provide analysis for the full build-out of the project, trip generation was estimated for the construction of a Health/Fitness Club with 45,000 square feet based on ITE Land Use Code (LUC) 492, a Shopping Center with 38,850 square feet based on LUC 820, a Drugstore With Drive-Through Window with 12,900 square feet based on LUC 881, and a three Fast Food Restaurants with Drive Thru Windows totaling 11,600 square feet based on LUC 934. The result is the expected weekday trip generation for the new Cottonflower Marketplace project as shown in **Table 1**. The complete trip generation calculations can be found in the Appendix.

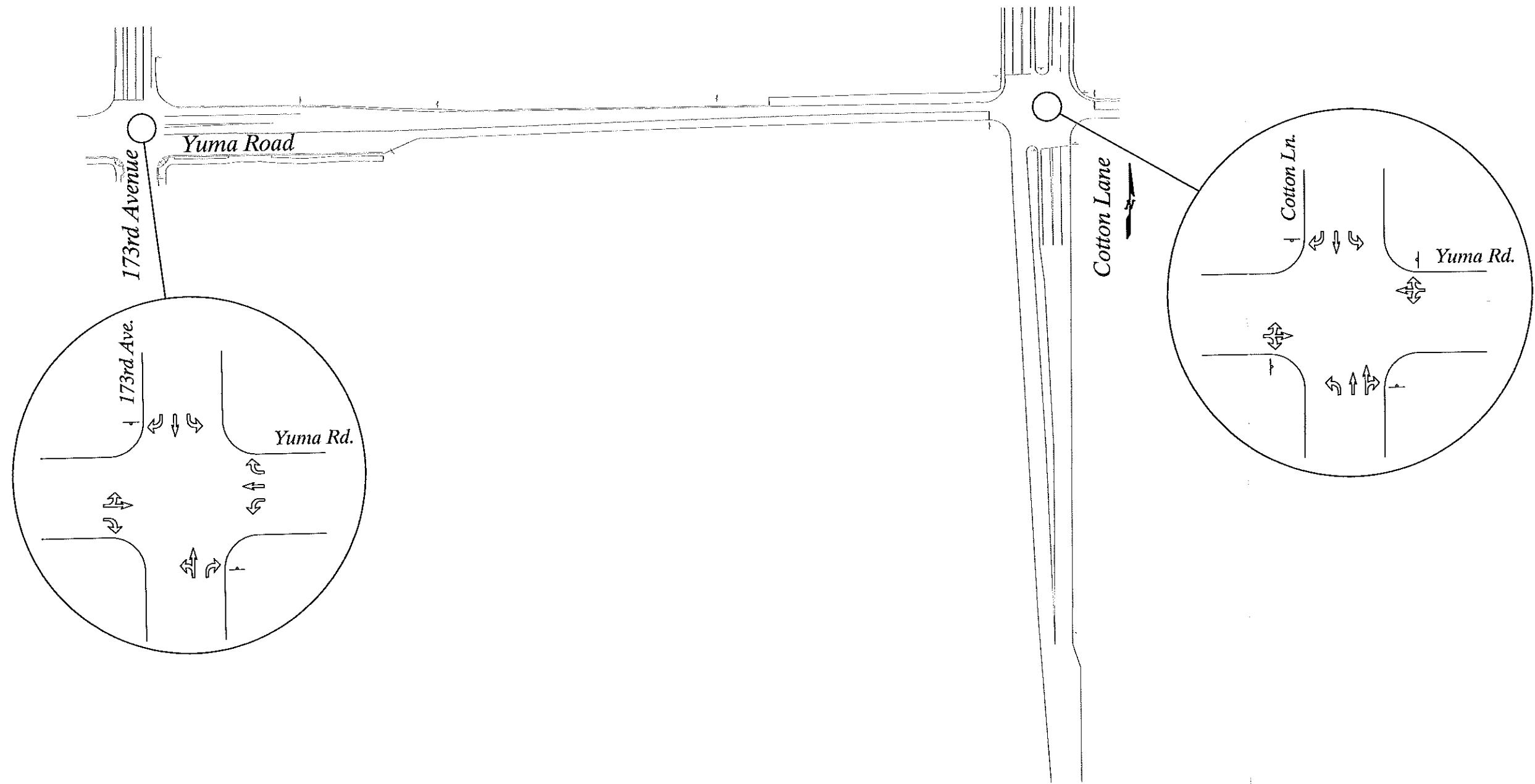
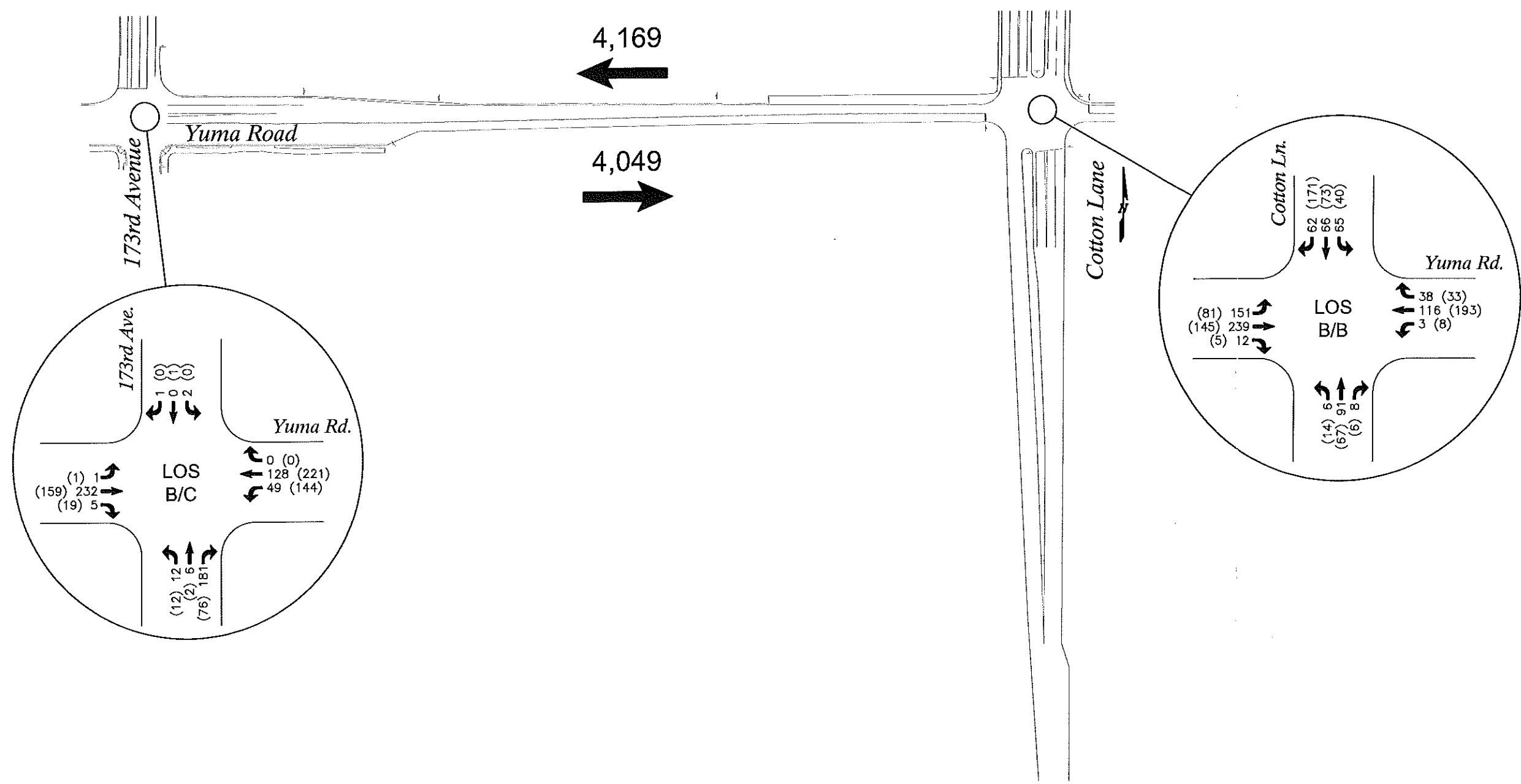


Figure 3  
Existing Lane Configurations and Controls



**Legend:**  
 → Traffic Movement  
 LOS Level of Service AM/PM  
 X,XXX Average Daily Traffic  
 XX AM Peak Hour  
 (XX) PM Peak Hour  
 Vehicle-Trips per Hour



Figure 4  
 Existing Weekday Peak Hour Traffic Volumes and LOS



**Table 1 – Weekday Project Site Generated Trips**

Time Period	Land Use Code (LUC)				Internal Capture Reduction (20%)	TOTAL
	492	820	881	934		Veh-Trips
	Veh-Trips	Veh-Trips	Veh-Trips	Veh-Trips	Weekday	Weekday
	Weekday	Weekday	Weekday	Weekday	Weekday	Weekday
Average Daily, Inbound (vtpd)	0	834	654	2,878	873	3,492
Average Daily, Outbound (vtpd)	0	834	654	2,878	873	3,492
<b>Total Daily</b>	<b>0</b>	<b>1,668</b>	<b>1,308</b>	<b>5,756</b>	<b>1,746</b>	<b>6,984</b>
AM Peak Hour, Inbound (vtph)	23	25	20	315	77	306
AM Peak Hour, Outbound (vtph)	32	16	15	302	73	292
<b>Total AM Peak</b>	<b>55</b>	<b>41</b>	<b>35</b>	<b>617</b>	<b>150</b>	<b>598</b>
PM Peak Hour, Inbound (vtph)	93	70	55	209	85	342
PM Peak Hour, Outbound (vtph)	90	76	57	193	83	333
<b>Total PM Peak</b>	<b>183</b>	<b>146</b>	<b>112</b>	<b>402</b>	<b>168</b>	<b>675</b>

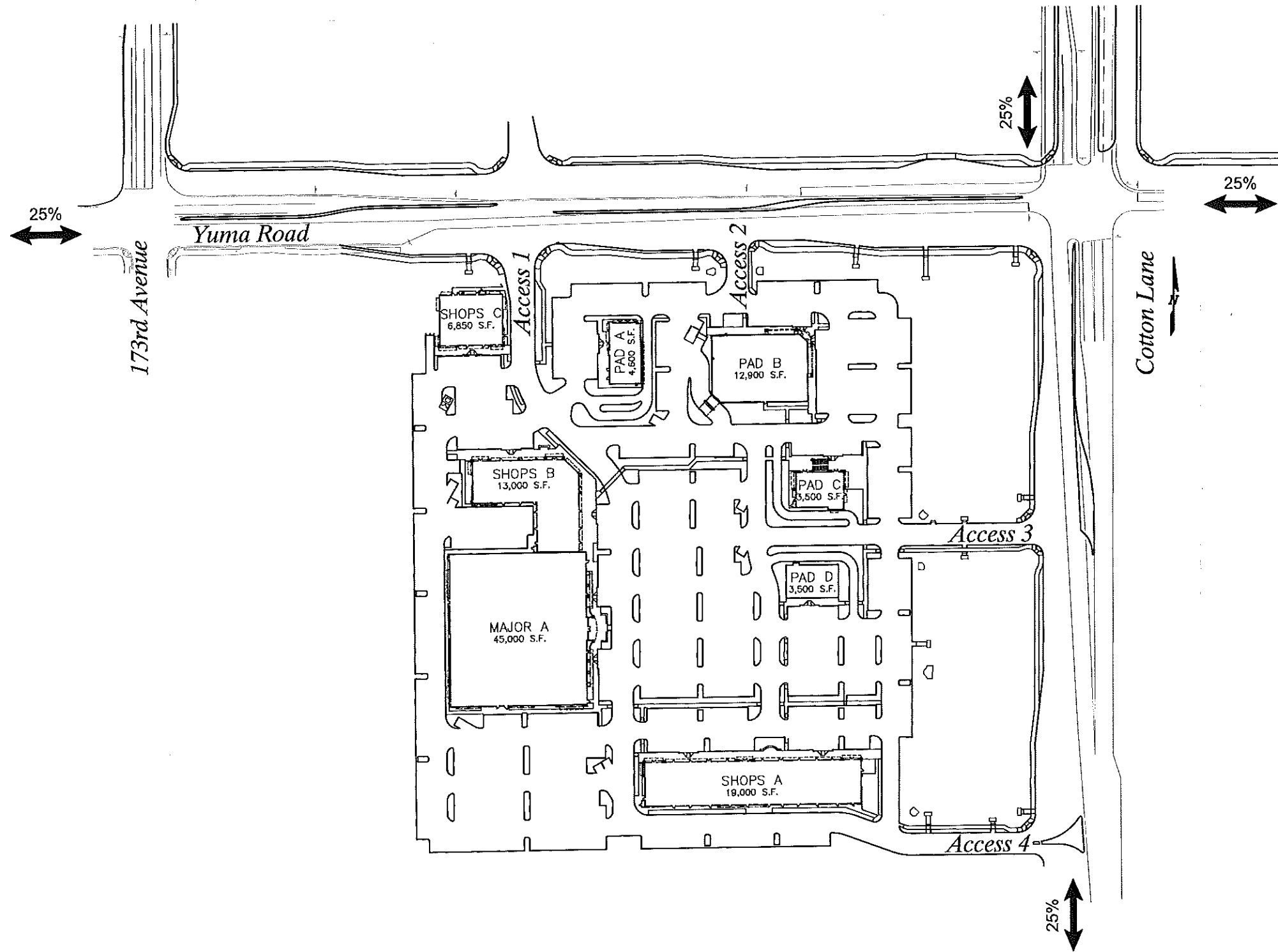
vtpd - vehicle trips per day, vtph - vehicle trips per hour

Some of the proposed land uses for the Cottonflower Marketplace – Fast Food Restaurant with Drive-Thru Window, and Drug Store with Drive-Thru Window – have trip generation characteristics that includes attracting vehicles that are already on the adjacent roadway. These are classified as pass-by trips as they would be on the adjacent roads – Cotton Lane and Yuma Road – whether the project is built or not. Therefore, these vehicle-trips are not new vehicle-trips to the area and could be removed from the projected new vehicle-trips the development is projected to generate. These are still turning volumes into and out of the site and still need to be analyzed as driveway volumes into and out of the development. In order to evaluate a possible worst case scenario impact the project has on the adjacent roadway network, the reduction for the pass-by trips was not applied.

Based upon the Land Use Codes analyzed, the ITE *Trip Generation* manual states that approximately 30% of the vehicle trips generated by the development could be traveling from one of the other land uses on the site, rather than from somewhere off-site. To remain conservative, an internal capture reduction rate of 20% was used to reduce the number of site generated vehicle-trips as shown in Table 1.

**Trip Distribution & Assignment**

Trip distribution for the project opening year of 2008 was based upon a review of current volumes, traffic patterns and land uses near the site. **Figure 5** shows the weekday trip distribution for the project as a percentage of net new primary trips. **Figure 6** shows the assignment of these trips in 2008 and 2013 to the existing project intersections within the study area.



**Legend:**  
 XX%  
 ↔ Percent of Site Trips



Figure 5  
 Weekday Peak Hour Trip Distribution

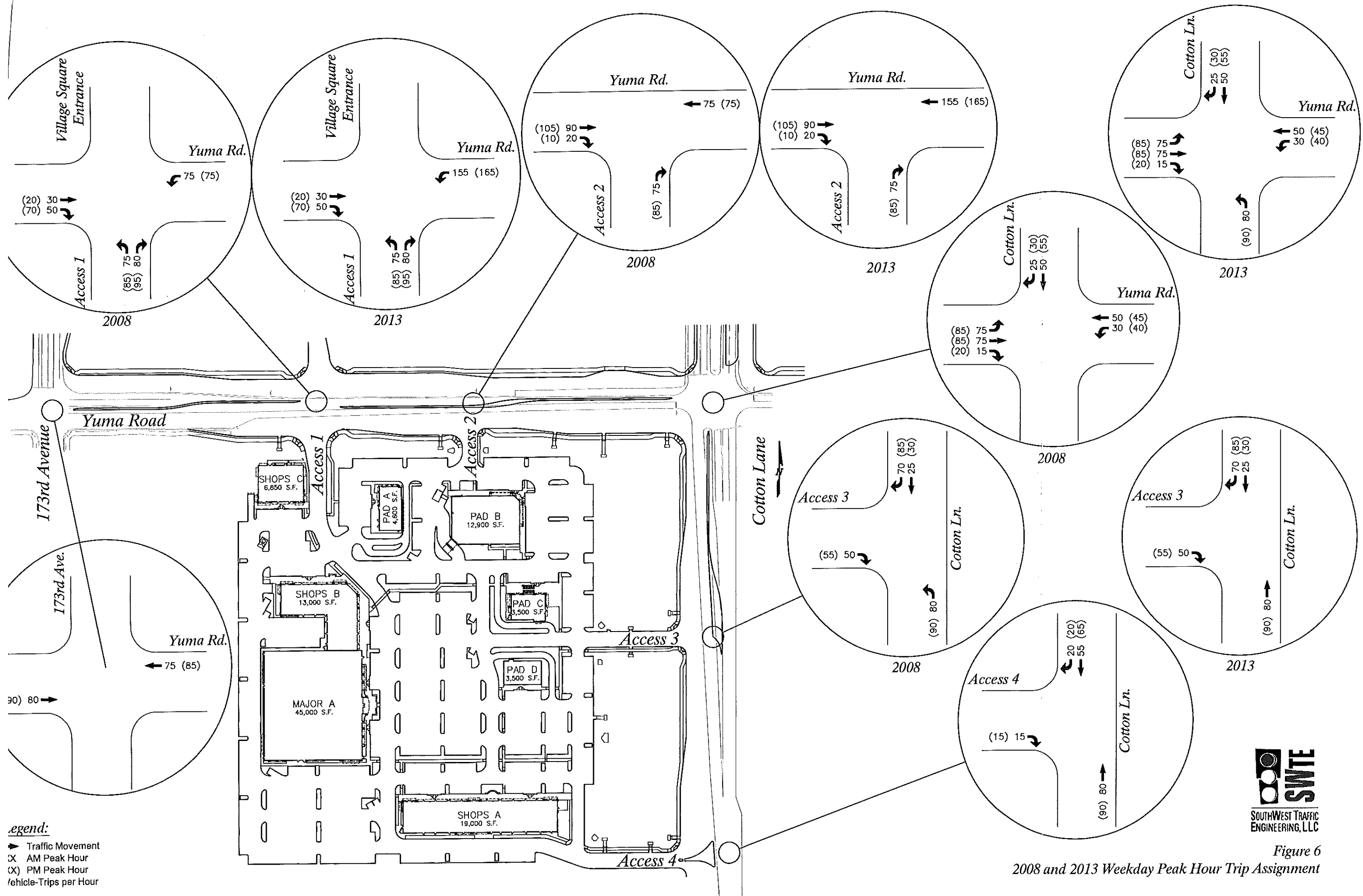


Figure 6  
 2008 and 2013 Weekday Peak Hour Trip Assignment





## **Access**

As mentioned previously, the new project will be constructed on an undeveloped property on the southwest corner of the intersection of Yuma Road/Cotton Lane. Access to the site will be from four new intersections.

Access 1 will be located approximately 810 feet west of the Yuma Road/Cotton Lane intersection on the south side of Yuma Road. The new northbound approach will offer exclusive left and right-turn lanes. The westbound approach will be modified to add an exclusive left-turn lane into the project site. The eastbound approach will be modified to add an exclusive right-turn lane.

Access 2 will be located approximately 300 feet east of the Access 1/Yuma Road intersection on the south side of Yuma Road. This 'T' intersection will be controlled by a STOP sign out of the project site. Traffic on Yuma Road will remain free flow. The new northbound approach will offer a single right turn lane creating right in/right out access only.

Access 3 will be located approximately 470 feet south of the Yuma Road/Cotton Lane intersection on the west side of Cotton Lane. This 'T' intersection will be controlled by a STOP sign out of the project site. Traffic on Cotton Lane will remain free flow. The new eastbound approach will offer a single right turn lane. The southbound approach will be modified to add an exclusive right-turn lane. The northbound approach will be modified to add an exclusive left turn lane until the frontage roads are constructed and then the access will become right-in/right-out only.

Access 4 will be located approximately 440 feet south of the Access 3/Cotton Lane intersection on the west side of Cotton Lane. This 'T' intersection will be controlled by a STOP sign out of the project site. Traffic on Cotton Lane will remain free flow. The new eastbound approach will offer a single right turn lane creating right in/right out access only. The southbound approach will be modified to add an exclusive right-turn lane.

Sight distances at the access points should be verified during the design process.

## **Existing Traffic Operations**

Analysis of current intersection operations was conducted for the weekday AM and PM peak hours using the nationally accepted methodology set forth in the *Highway Capacity Manual*, Transportation Research Board, 2000. The computer software HCS (Highway Capacity Software) was utilized to calculate the levels of service for individual movements, approaches, and for the intersections as a whole.

Level of service (LOS) is a qualitative measure of the traffic operations at an intersection or on a roadway segment. Level of service is ranked from LOS A, which signifies little or no congestion and is the highest rank, to LOS F, which signifies congestion and jam



conditions. LOS D is typically considered adequate operation at signalized and un-signalized intersections during the peak periods.

At un-signalized intersections, level of service is calculated for those movements which must either stop for or yield to oncoming traffic and is based on average control delay for the particular movement. Control delay is the portion of total delay attributed to traffic control measures such as stop signs and traffic signals. The criteria for level of service at un-signalized intersections are shown below in **Table 2**.

**Table 2 – Level of Service Criteria – Un-signalized Intersections**

Level-of-Service	Delay
A	≤ 10 seconds
B	> 10 and ≤ 15 seconds/vehicle
C	> 15 and ≤ 25 seconds/vehicle
D	> 25 and ≤ 35 seconds/vehicle
E	> 35 and ≤ 50 seconds/vehicle
F	> 50 seconds per vehicle

At signalized intersections, level of service is calculated for each movement and then is summed in a weighted fashion to yield the LOS for the approach and for the intersection as a whole. The criteria for level of service at signalized intersections are shown in **Table 3**.

**Table 3 - Level of Service Criteria – Signalized Intersections**

Level-of-Service	Average Total Delay
A	≤ 10.0 seconds
B	> 10.0 and ≤ 20.0 seconds/vehicle
C	> 20.0 and ≤ 35.0 seconds/vehicle
D	> 35.0 and ≤ 55.0 seconds/vehicle
E	> 55.0 and ≤ 80.0 seconds/vehicle
F	> 80.0 seconds per vehicle

In calculating the levels of service, assumed traffic signal phasing and timing data was used. Other assumptions included:

- Cycle length – 90 seconds
- Lane widths – 12 feet
- Right Turn on Red – 20%
- Approach grade – 0%

Existing levels of service were calculated for the adjacent project intersections in the study area. The results of this analysis are shown in **Table 4**. Complete capacity calculations are included in the Appendix.



**Table 4 – Existing Peak Hour Levels of Service**

Intersection	AM Peak		PM Peak	
	LOS	Delay	LOS	Delay
Yuma Road/173rd Avenue	<b>2-Way Stop</b>			
Eastbound Left/Through	A	7.5	A	7.7
Westbound Left	A	7.9	A	8.0
Northbound Left/Through	B	13.3	C	17.6
Northbound Right	B	11.2	A	9.6
Southbound Left	C	17.6	C	19.4
Southbound Through	B	13.1	C	17.2
Southbound Right	A	9.0	A	9.5
Yuma Road/Cotton Lane	<b>All-Way Stop</b>			
Eastbound Left/Through/Right	C	17.5	B	12.2
Westbound Left/Through/Right	B	10.5	B	11.9
Northbound Left	A	10.0	A	10.0
Northbound Through/Right	B	11.0	B	10.3
Southbound Left	B	10.9	A	10.0
Southbound Through/Right	B	10.8	B	12.6

Delay - seconds per vehicle-trip

As shown in Table 4, all of the movements at the intersections of Yuma Road/Cotton Lane and Yuma Road/173<sup>rd</sup> Avenue currently operate at an acceptable level of service C or better during the weekday peak hours.

**Future Traffic Operations Without Project**

In order to assess the impacts of the project on future traffic operations, traffic projections were made for the year 2008, which is the year the project is expected to open as well as the year 2013, five years after project opening.

According to the Maricopa County Department of Transportation (MCDOT), the long term plan for the study area is to improve Cotton Lane from the current two-way, four-lane rural roadway to a six lane divided freeway as an extension of the existing Loop 303 located about two miles north of the project at Interstate 10. Frontage roads for the Loop 303 are planned as part of the long term improvements as well. This information came from a review of an adjacent development’s traffic study titled the *Canyon Trails Towne Center Traffic Impact Analysis (TIA)*, by Kimley-Horne and Associates, dated October 2004, as provided to SWTE. The Canyon Trails Towne Center development’s proposed location is on the northeast corner of the Yuma Road/Cotton Lane intersection. The report mentions that long term improvements to Cotton Lane are unlikely to occur for 10 to 15 years, and a plan to construct interim improvements was developed. The interim Cotton Lane would become a four-lane divided roadway from I-10 to Yuma Road. Direct access to Cotton Lane from the site will be limited as traffic islands are planned for Access 3 and 4 to limit traffic to right-in, right-out only from Cotton Lane – Access 3 will have a northbound left turn into the site from Cotton Lane until the freeway is



constructed. This is in preparation for the Loop 303 extension. Once the extension is constructed, the driveway accesses onto Cotton Lane will remain right-in/right-out access only onto the frontage roads. Additionally, the long term plan for Yuma Road is to widen the pavement to have a similar number of lanes as the long term Cotton Lane roadway. Improvements to the north side of Yuma Road, between Cotton Lane and 173<sup>rd</sup> Avenue will be completed by the developer of the Village Square project site. Improvements to the south side of Yuma Road, between Cotton Lane and 173<sup>rd</sup> Avenue will be completed by the developer of the Cottonflower Marketplace site. Improvements to the north side of Yuma Road, east of Cotton Lane will be completed by the developer of the Canyon Trails Towne Center.

Future traffic volumes for 2008 and 2013 without the project at Yuma Road/Cotton Lane were derived directly from the adjacent Canyon Trails Towne Center development's traffic study data. The number and type of traffic lanes analyzed at the Yuma Road/Cotton Lane intersection was also taken from the *Canyon Trails Towne Center Traffic Impact Analysis* (TIA), by Kimley-Horne and Associates. The resulting traffic data was used to develop eastbound and westbound through movement traffic volumes at the Yuma Road/173<sup>rd</sup> Avenue intersection. However, for the northbound and southbound 173<sup>rd</sup> Avenue approaches to Yuma Road, the Canyon Trails Towne Center development's data was not used. Due to the lack of historic traffic count data in the area, a five percent growth rate was used instead to estimate traffic growth in the project area. The growth rate was applied to the existing traffic volumes recorded in late May 2007 to increase the data to 2008 and 2013. This five percent growth rate is the same growth rate used in the *Canyon Trails Towne Center Traffic Impact Analysis* and the *Village Square Traffic Impact Analysis* (TIA), by SouthWest Traffic Engineering, LLC, dated September 2007.

As with the current volumes, levels of service were calculated for the intersections in the study area for 2008 and 2013 without the project. A review of an adjacent development's traffic study titled the *Village Square Traffic Impact Analysis* indicated two new traffic signals will be installed on Yuma Road in 2008. The first at 173<sup>rd</sup> Avenue/Yuma Road (unrelated to the adjacent Village Square development) and the second at the Village Square's direct access to Yuma Road (installed as part of Village Square development). The Village Square development's proposed location is directly north of the Cottonflower Marketplace project, on the northwest corner of the Yuma Road/Cotton Lane intersection. This direct access point onto Yuma Road (where the second traffic signal is to be installed) for the Village Square lines up directly across from the proposed Access 1/Yuma Road intersection for the Cottonflower Marketplace development. 2008 and 2013 traffic volumes from the Village Square development were incorporated into the 2008 and 2013 without the project volumes.

After review of the *Canyon Trails Towne Center Traffic Impact Analysis* and the *Village Square Traffic Impact Analysis* it is assumed a traffic signal will be existing in the year 2008 at the following locations:

- 173<sup>rd</sup> Avenue/Yuma Road
- Access 1/Yuma Road
- Cotton Lane/Yuma Road



The lane configurations and intersection traffic controls analyzed for 2008 are shown in **Figure 7**. The lane configurations and intersection traffic controls analyzed for 2013 are shown in **Figure 8**. As directed by the City, the 2013 lane configurations indicate the addition of an exclusive northbound right turn lane at the Yuma Road/Cotton Lane intersection. All of the 2013 analyses included the new right turn lane. It is assumed that by 2013 the City has acquired the necessary right-of-way to construct the exclusive northbound right turn lane, separate from the Cottonflower Marketplace development.

The estimated 2008 and 2013 weekday peak hour traffic volumes without the project and the resulting intersection levels of service are shown in **Figure 9** and **Figure 10**. Detailed levels of service for 2008 without the project are shown in **Table 5**. Complete capacity calculations are included in the Appendix.

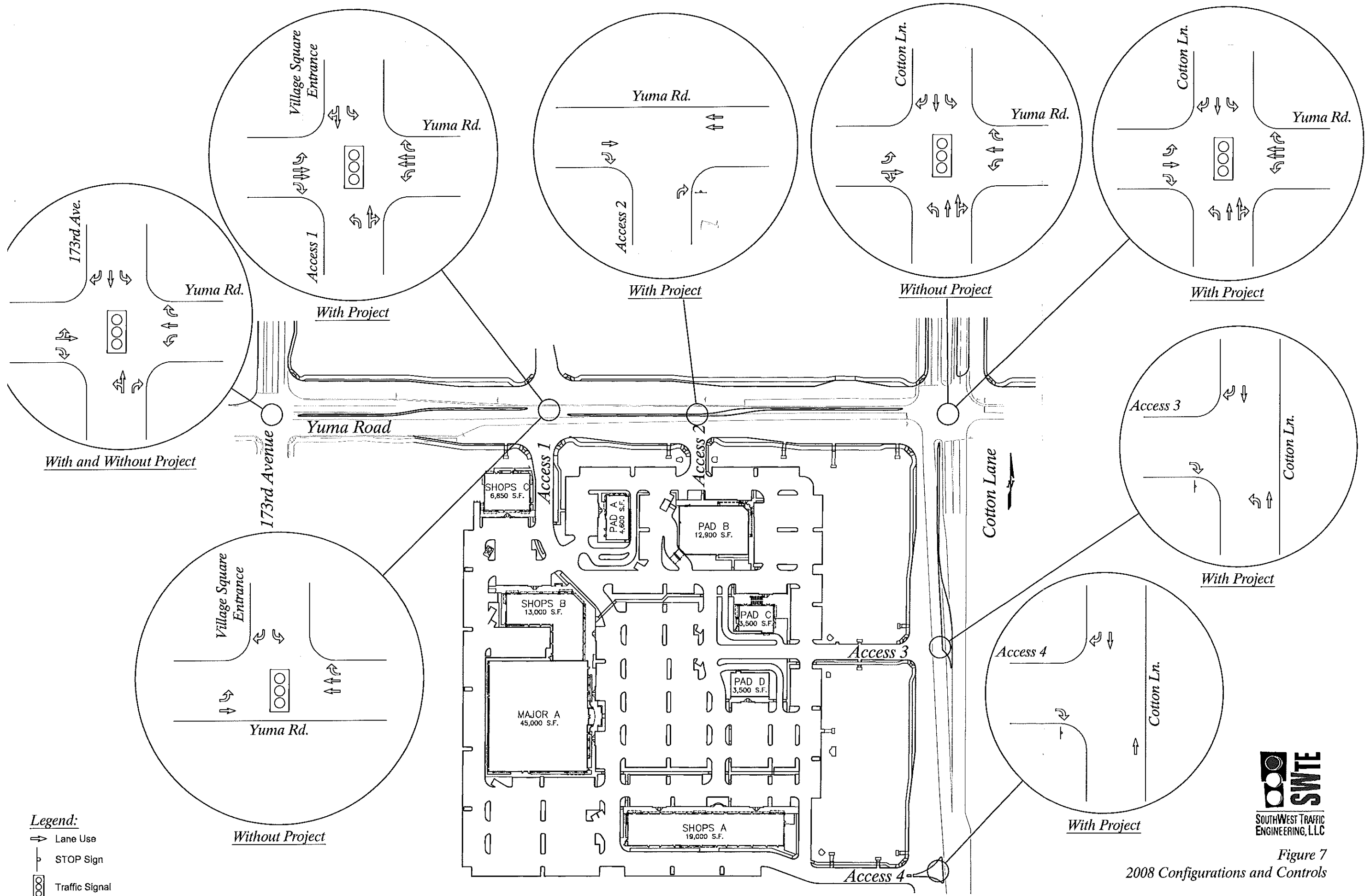
As shown in Table 5 on subsequent page 20, the Yuma Road/173<sup>rd</sup> Avenue and Yuma Road/Cotton Lane intersections are predicted to operate at overall acceptable LOS C during the weekday AM and PM peak hours in 2008 without the project. The Yuma Road/Village Square intersection is predicted to operate at overall acceptable LOS B.

Detailed levels of service for 2013 without the project are shown in **Table 6**. Complete capacity calculations are included in the Appendix.

Table 6 results on subsequent page 21 indicate that the Yuma Road/173<sup>rd</sup> Avenue intersection is predicted to operate at an overall acceptable LOS C during the weekday AM and PM peak hours in 2013 without the project.

The Yuma Road/Cotton Lane intersection results shown in Table 6 indicate level of service F for the eastbound left turn movement. This delay is due partly to high levels of westbound through traffic in addition to large eastbound left-turning traffic. Turning traffic from Yuma Road must attempt to find a gap in the increasing westbound through traffic volumes on Yuma Road. The overall LOS for the intersection is C for the AM peak hour and D for the PM peak hour.

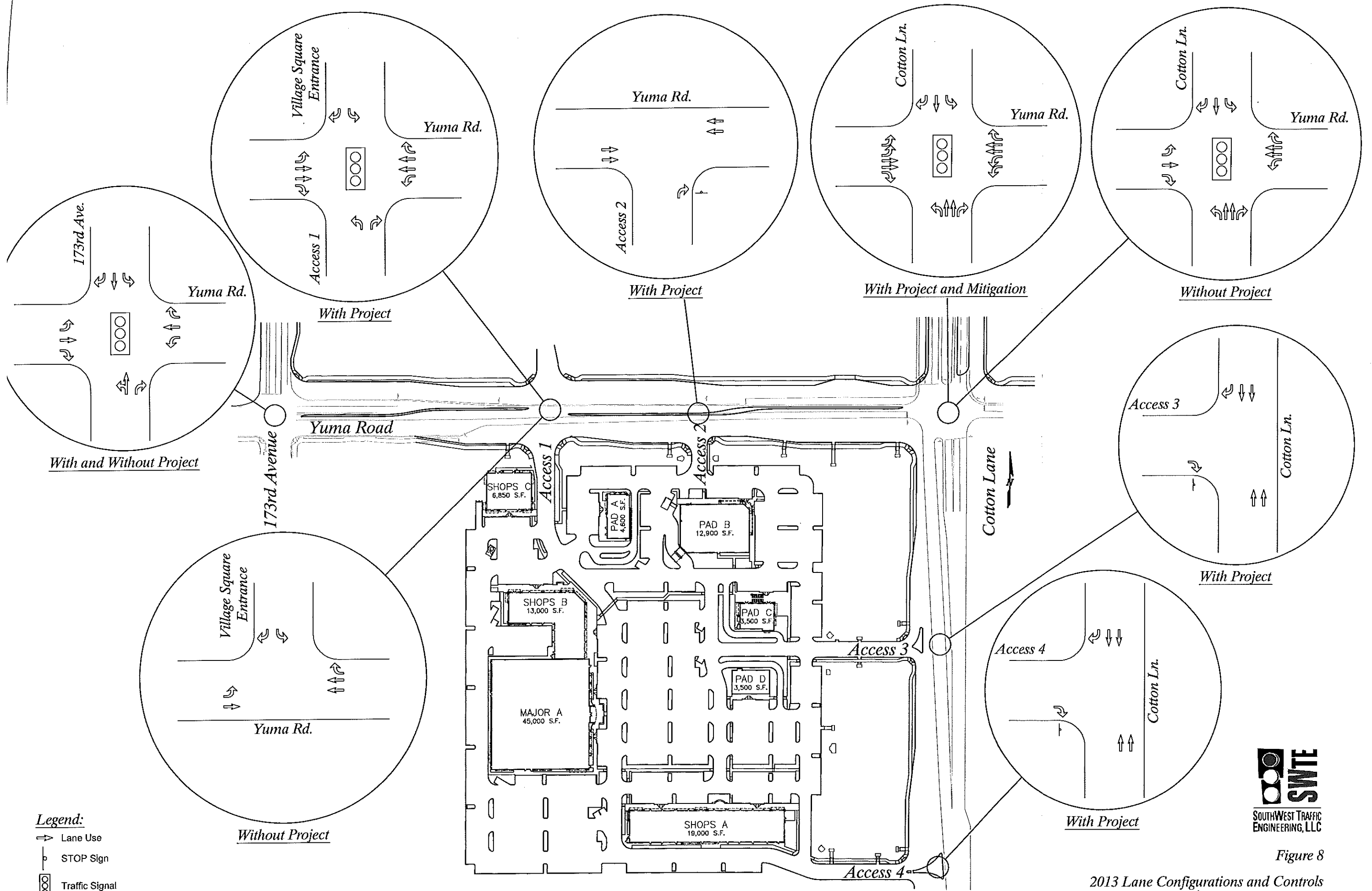
The Yuma Road/Village Square intersection is predicted to operate at overall acceptable LOS B in 2013 without the project.



- Legend:**
- Lane Use
  - ⊥ STOP Sign
  - ⊞ Traffic Signal



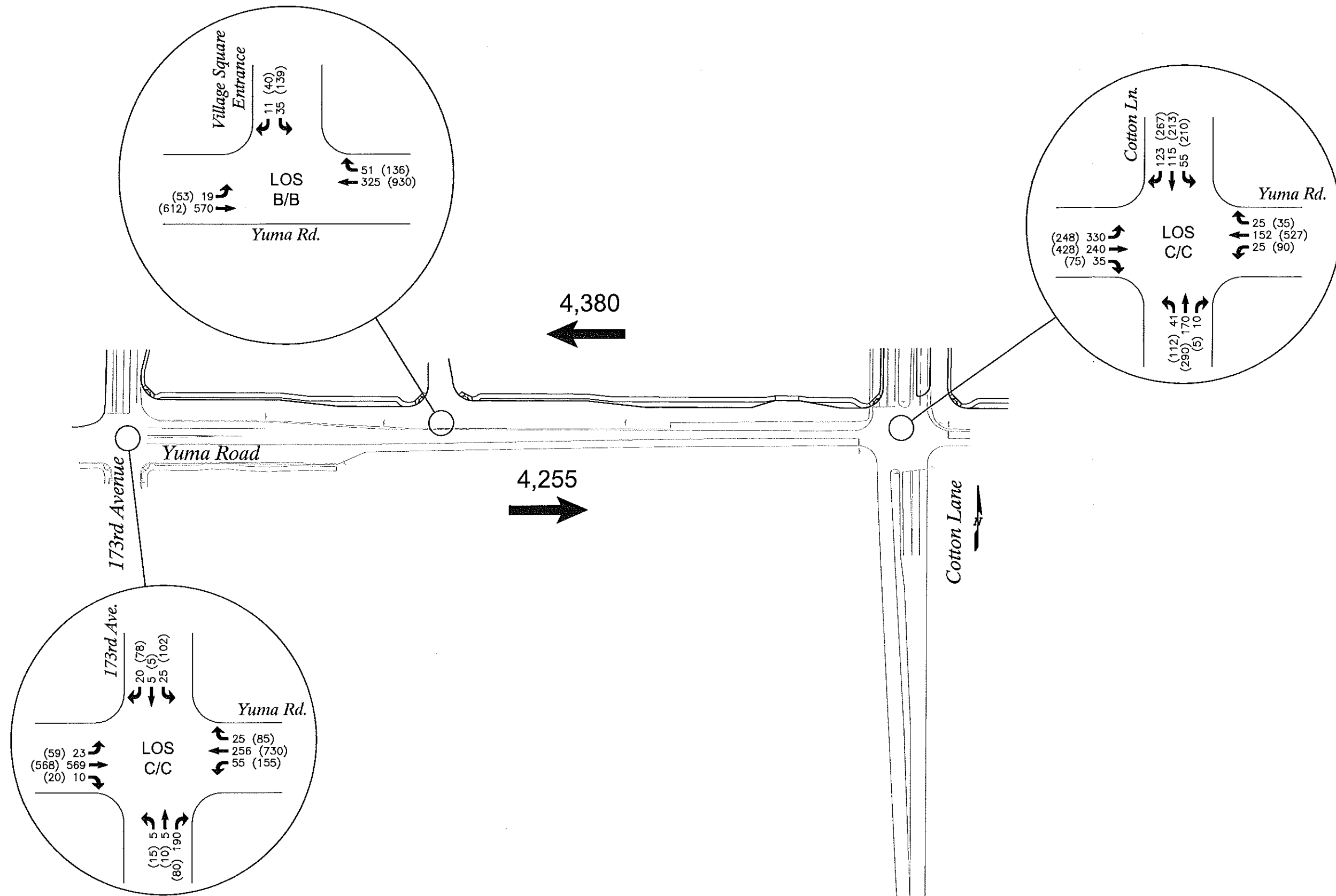
Figure 7  
2008 Configurations and Controls



- Legend:**
- Lane Use
  - STOP Sign
  - ⊞ Traffic Signal



Figure 8  
2013 Lane Configurations and Controls



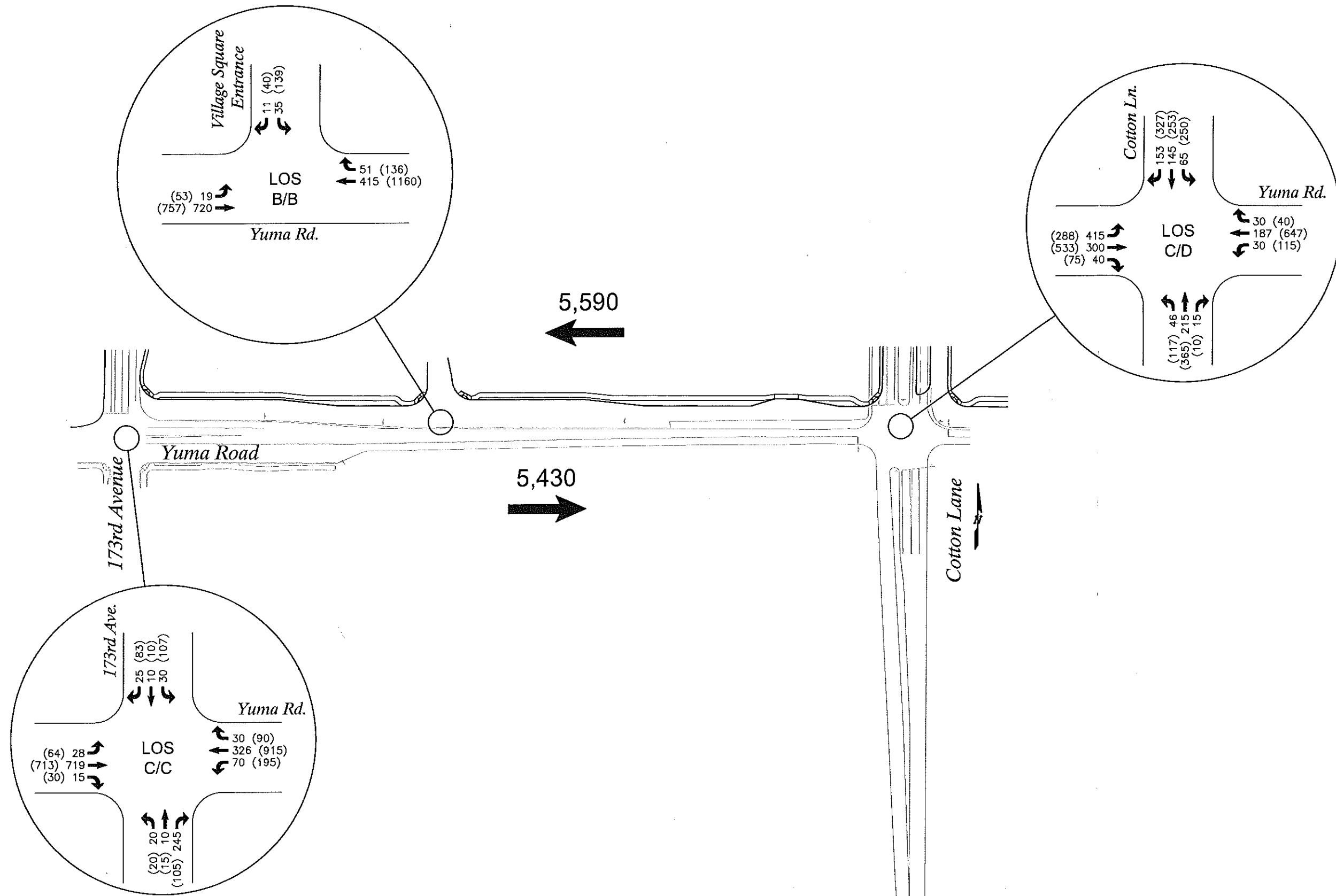
**Legend:**

- ➔ Traffic Movement
- LOS Level of Service AM/PM
- X,XXX Average Daily Traffic
- XX AM Peak Hour
- (XX) PM Peak Hour
- Vehicle-Trips per Hour



Figure 9  
2008 Weekday Peak Hour Traffic Volumes and LOS Without Project





**Legend:**

- ➔ Traffic Movement
- LOS Level of Service AM/PM
- X,XXX Average Daily Traffic
- XX AM Peak Hour
- (XX) PM Peak Hour
- Vehicle-Trips per Hour



Figure 10  
2013 Weekday Peak Hour Traffic Volumes and LOS Without Project



**Table 5 – 2008 Peak Hour Levels of Service Without Project**

Intersection	2008 Without Project			
	AM Peak		PM Peak	
	LOS	Delay	LOS	Delay
<b>Yuma Road/173rd Ave</b>	<b>Traffic Signal</b>			
Eastbound Left	B	10.1	B	17.5
Eastbound Through	C	31.0	C	22.4
Eastbound Right	B	15.7	B	13.0
Westbound Left	B	15.1	B	14.4
Westbound Through	B	18.7	D	39.4
Westbound Right	B	15.9	B	13.7
Northbound Left/Through	C	27.4	C	32.0
Northbound Right	C	34.2	C	33.9
Southbound Left	B	19.7	C	24.7
Southbound Through	B	19.4	C	22.8
Southbound Right	B	19.6	C	24.3
Overall Intersection	C	26.8	C	28.4
<b>Yuma Road/Cotton Lane</b>	<b>Traffic Signal</b>			
Eastbound Left	C	22.2	D	39.2
Eastbound Through	C	23.8	C	32.6
Eastbound Right	C	20.6	C	21.2
Westbound Left	B	13.7	B	17.3
Westbound Through	C	21.1	C	24.3
Westbound Right	C	20.4	C	20.6
Northbound Left	C	23.0	B	17.2
Northbound Through/Right	C	23.5	C	24.5
Southbound Left	B	15.8	C	23.3
Southbound Through	C	23.9	C	25.8
Southbound Right	C	24.5	C	29.7
Overall Intersection	C	22.4	C	27.1
<b>Yuma Road/Village Square Entrance</b>	<b>Traffic Signal</b>			
Eastbound Left	B	11.6	B	12.1
Eastbound Through	B	14.5	B	11.6
Westbound Through	B	15.5	B	16.4
Westbound Right	B	14.5	B	12.6
Southbound Left	B	17.2	C	22.1
Southbound Right	B	16.9	C	20.6
Overall Intersection	B	14.9	B	15.0

Delay - seconds per vehicle-trip



**Table 6 – 2013 Peak Hour Levels of Service Without Project**

Intersection	2013 Without Project			
	AM Peak		PM Peak	
	LOS	Delay	LOS	Delay
<b>Traffic Signal</b>				
Yuma Road/173rd Ave				
Eastbound Left	A	9.5	C	20.9
Eastbound Through	D	41.6	B	18.9
Eastbound Right	B	13.5	A	9.1
Westbound Left	B	19.6	C	27.7
Westbound Through	B	16.9	D	43.3
Westbound Right	B	13.6	A	9.5
Northbound Left/Through	C	28.7	D	37.1
Northbound Right	D	48.2	D	47.5
Southbound Left	C	21.1	C	30.5
Southbound Through	C	20.8	C	27.4
Southbound Right	C	21.1	C	29.3
Overall Intersection	C	33.8	C	31.2
<b>Traffic Signal</b>				
Yuma Road/Cotton Lane				
Eastbound Left	D	36.3	F	118.2
Eastbound Through	C	25.3	D	54.4
Eastbound Right	C	20.6	C	21.2
Westbound Left	B	14.2	C	22.9
Westbound Through	C	21.3	C	26.0
Westbound Right	C	20.5	C	20.6
Northbound Left	C	23.3	B	17.7
Northbound Through	C	23.8	C	25.1
Northbound Right	B	15.2	C	22.2
Southbound Left	B	16.0	D	33.9
Southbound Through	C	24.4	C	26.7
Southbound Right	C	25.2	D	35.9
Overall Intersection	C	26.4	D	40.8
<b>Traffic Signal</b>				
Yuma Road/Village Square Entrance				
Eastbound Left	B	11.8	B	15.0
Eastbound Through	C	19.3	B	15.0
Westbound Through	B	16.1	B	19.2
Westbound Right	B	14.5	B	12.6
Southbound Left	B	17.2	C	22.1
Southbound Right	B	16.9	C	20.6
Overall Intersection	B	17.8	B	17.5

Delay - seconds per vehicle-trip



## **Future Traffic Operations With Project**

In order to assess the impacts of the project on future traffic operations, levels of service were calculated for each project intersection for 2008 and 2013 with the project. Weekday peak hour traffic volumes for 2008 and 2013 without the project were combined with the estimated trips generated by the project to yield peak hour traffic volumes with the project as shown in **Figure 11** and **Figure 12**. Weekday intersection levels of service for 2008 and 2013 with the project were then calculated as shown in **Table 7** and **Table 8**. Complete capacity calculations are included in the Appendix.

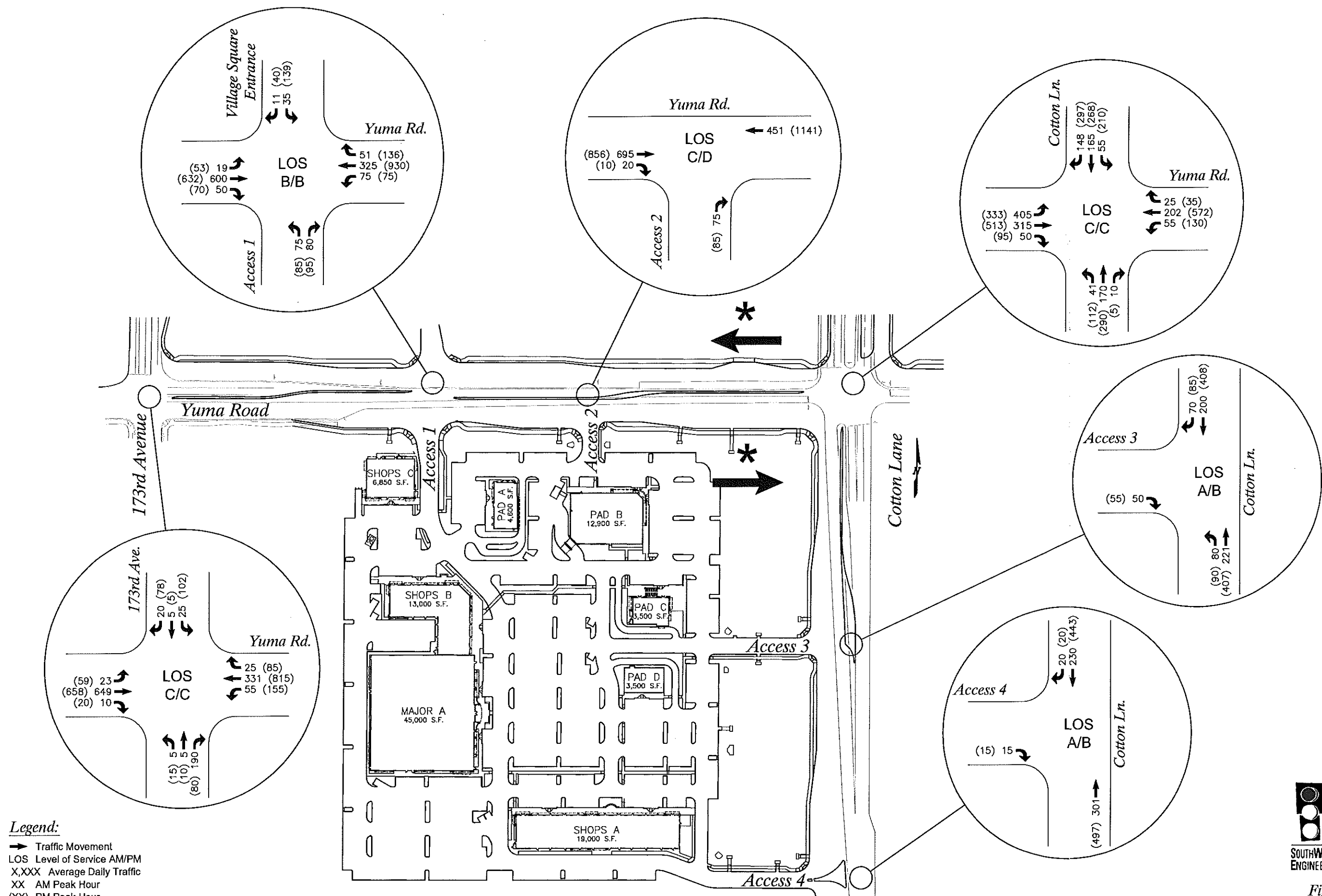
The Yuma Road/173<sup>rd</sup> Avenue intersection results shown in Table 7 indicate an overall adequate level of service C during the weekday AM and PM peak hours in 2008 with the project and a traffic signal installed.

As shown in Table 7 on the following pages, the Yuma Road/Cotton Lane intersection is predicted to operate at an overall acceptable LOS C during the weekday AM and PM peak hours in 2008 with the project and a traffic signal installed.

The Yuma Road/Access 1 intersection results shown in Table 7 indicate an overall adequate level of service B during the weekday AM and PM peak hours in 2008 with the project and a traffic signal installed.

Table 7 results for Yuma Road/Access 2 indicate an overall acceptable LOS C during the weekday AM peak hour and an overall LOS D during the weekday PM peak hour. The delay experienced in the PM peak hour is caused by traffic exiting the project site attempting to merge with high eastbound through volumes on Yuma Road traveling in only one through lane approaching Cotton Lane. In the future as additional eastbound travel lanes become available, the delay for exiting site traffic at Access 2 is expected to decrease.

As shown in Table 7, the remaining site access points are predicted to have approaches that operate at an acceptable LOS B or better during the weekday AM and PM peak hours in 2008 with the project.

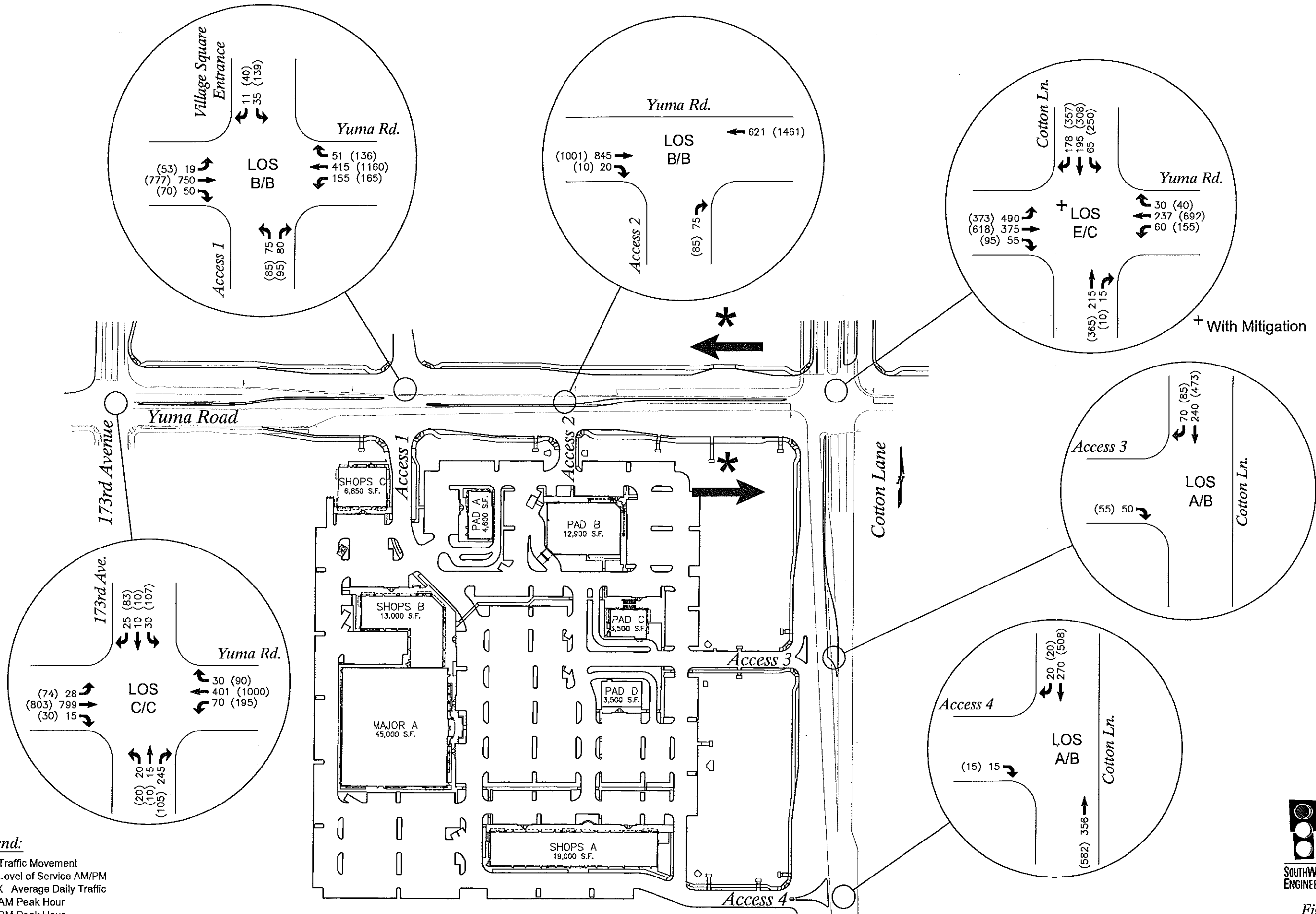


**Legend:**  
 → Traffic Movement  
 LOS Level of Service AM/PM  
 X,XXX Average Daily Traffic  
 XX AM Peak Hour  
 (XX) PM Peak Hour  
 Vehicle-Trips per Hour

\* Average Daily Traffic data is not available for LUC492-Heath / Fitness Club, therefore no ADT is shown for the With Project analysis.



Figure 11  
 2008 Weekday Peak Hour Traffic Volumes and LOS With Project



**Legend:**

- ➔ Traffic Movement
- LOS Level of Service AM/PM
- X,XXX Average Daily Traffic
- XX AM Peak Hour
- (XX) PM Peak Hour
- Vehicle-Trips per Hour

\* Average Daily Traffic data is not available for LUC492-Heath / Fitness Club, therefore no ADT is shown for the With Project analysis.



Figure 12  
2013 Weekday Peak Hour Traffic and LOS With Project



**Table 7 – 2008 Peak Hour Levels of Service With Project**

Intersection	2008 Without Project				2008 With Project			
	AM Peak		PM Peak		AM Peak		PM Peak	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
<b>Yuma Road/173rd Ave</b>	<b>Traffic Signal</b>				<b>Traffic Signal</b>			
Eastbound Left	B	10.1	B	17.5	B	10.0	B	17.5
Eastbound Through	C	31.0	C	22.4	C	32.6	B	17.9
Eastbound Right	B	15.7	B	13.0	B	14.0	A	9.5
Westbound Left	B	15.1	B	14.4	B	16.9	B	14.0
Westbound Through	B	18.7	D	39.4	B	17.7	C	28.4
Westbound Right	B	15.9	B	13.7	B	14.2	A	10.0
Northbound Left/Through	C	27.4	C	32.0	C	20.2	C	27.0
Northbound Right	C	34.2	C	33.9	C	23.6	C	28.4
Southbound Left	B	19.7	C	24.7	C	20.5	C	29.5
Southbound Through	B	19.4	C	22.8	C	20.1	C	26.5
Southbound Right	B	19.6	C	24.3	C	20.3	C	28.3
Overall Intersection	C	26.8	C	28.4	C	25.6	C	22.8
<b>Yuma Road/Cotton Lane</b>	<b>Traffic Signal</b>				<b>Traffic Signal</b>			
Eastbound Left	C	22.2	D	39.2	C	30.5	D	42.5
Eastbound Through	C	23.8	C	32.6	C	23.8	C	32.2
Eastbound Right	C	20.6	C	21.2	B	19.5	B	18.8
Westbound Left	B	13.7	B	17.3	B	13.5	C	34.7
Westbound Through	C	21.1	C	24.3	C	20.0	C	30.1
Westbound Right	C	20.4	C	20.6	B	19.1	C	24.2
Northbound Left	C	23.0	B	17.2	B	17.1	B	19.2
Northbound Through/Right	C	23.5	C	24.5	C	25.0	C	25.3
Southbound Left	B	15.8	C	23.3	B	17.0	C	26.9
Southbound Through	C	23.9	C	25.8	C	26.4	C	28.3
Southbound Right	C	24.5	C	29.7	C	26.7	B	14.6
Overall Intersection	C	22.4	C	27.1	C	24.7	C	28.7
<b>Yuma Road/Access 1(Village Square Entrance)</b>	<b>Traffic Signal</b>				<b>Traffic Signal</b>			
Eastbound Left	B	11.6	B	12.1	A	5.9	A	8.3
Eastbound Through	B	14.5	B	11.6	B	17.0	B	18.0
Eastbound Right	N/A				B	10.2	B	10.4
Westbound Left	N/A				B	10.2	B	10.9
Westbound Through	B	15.5	B	16.4	B	11.0	B	14.2
Westbound Right	B	14.5	B	12.6	B	10.2	B	10.9
Northbound Left	N/A				C	27.2	C	27.4
Northbound Right	N/A				C	27.5	C	27.9
Southbound Left	B	17.2	C	22.1	C	26.4	C	28.6
Southbound Right	B	16.9	C	20.6	C	25.9	C	26.6
Overall Intersection	B	14.9	B	15.0	B	16.0	B	16.9
<b>Yuma Road/Access 2</b>					<b>Stop Sign</b>			
Northbound Right	N/A				C	18.9	D	26.5
<b>Cotton Lane/Access 3</b>					<b>Stop Sign</b>			
Northbound Left	N/A				A	8.1	A	8.9
Eastbound Right	N/A				A	9.7	B	11.6
<b>Cotton Lane/Access 4</b>					<b>Stop Sign</b>			
Eastbound Right	N/A				A	9.7	B	11.4

Delay - seconds per vehicle-trip



**Table 8 – 2013 Peak Hour Levels of Service With Project**

Intersection	2013 Without Project				2013 With Project			
	AM Peak		PM Peak		AM Peak		PM Peak	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
<b>Yuma Road/173rd Ave</b>	<b>Traffic Signal</b>				<b>Traffic Signal</b>			
Eastbound Left	A	9.5	C	20.9	A	8.6	C	22.3
Eastbound Through	D	41.6	B	18.9	C	32.3	B	14.5
Eastbound Right	B	13.5	A	9.1	B	10.4	A	6.2
Westbound Left	B	19.6	C	27.7	C	22.5	C	20.4
Westbound Through	B	16.9	D	43.3	C	34.3	C	29.4
Westbound Right	B	13.6	A	9.5	C	21.9	A	6.5
Northbound Left/Through	C	28.7	D	37.1	C	25.6	C	34.0
Northbound Right	D	48.2	D	47.5	C	34.4	D	37.5
Southbound Left	C	21.1	C	30.5	C	25.7	D	41.1
Southbound Through	C	20.8	C	27.4	C	25.1	C	33.2
Southbound Right	C	21.1	C	29.3	C	25.5	D	36.1
Overall Intersection	C	33.8	C	31.2	C	31.5	C	23.8
<b>Yuma Road/Cotton Lane</b>	<b>Traffic Signal</b>				<b>Traffic Signal</b>			
Eastbound Left	D	36.3	F	118.2	F	90.5	F	>120
Eastbound Through	C	25.3	D	54.4	C	28.6	F	98.8
Eastbound Right	C	20.6	C	21.2	C	20.9	C	21.6
Westbound Left	B	14.2	C	22.9	B	15.6	D	36.2
Westbound Through	C	21.3	C	26.0	C	21.7	C	26.8
Westbound Right	C	20.5	C	20.6	C	20.5	C	20.6
Northbound Left	C	23.3	B	17.7	C	26.8	C	33.4
Northbound Through/Right	C	23.9	C	25.2	C	23.9	C	25.2
Southbound Left	B	16.0	D	35.0	B	16.0	D	35.0
Southbound Through	C	24.4	C	26.7	C	25.4	C	29.0
Southbound Right	C	25.2	D	35.9	C	25.8	D	41.7
Overall Intersection	C	26.5	D	40.9	D	40.3	E	70.7
<b>Yuma Road/Access 1(Village Square Entrance)</b>	<b>Traffic Signal</b>				<b>Traffic Signal</b>			
Eastbound Left	B	11.8	B	15.0	A	6.0	B	10.3
Eastbound Through	C	19.3	B	15.0	B	13.0	B	10.8
Eastbound Right	N/A				B	10.2	A	8.5
Westbound Left	N/A				A	8.6	A	9.1
Westbound Through	B	16.1	B	19.2	B	11.3	B	13.4
Westbound Right	B	14.5	B	12.6	B	10.2	A	9.0
Northbound Left	N/A				C	27.2	C	24.8
Northbound Right	N/A				C	27.5	C	25.3
Southbound Left	B	17.2	C	22.1	C	26.4	C	26.0
Southbound Right	B	16.9	C	20.6	C	25.9	C	24.1
Overall Intersection	B	17.8	B	17.5	B	13.6	B	13.5
<b>Yuma Road/Access 2</b>					<b>Stop Sign</b>			
Northbound Right	N/A				B	12.9	B	14.4
<b>Cotton Lane/Access 3</b>					<b>Stop Sign</b>			
Southbound Right	N/A				A	9.3	B	10.3
<b>Cotton Lane/Access 4</b>					<b>Stop Sign</b>			
Southbound Right	N/A				A	9.2	B	10.2

Delay - seconds per vehicle-trip





The Yuma Road/173<sup>rd</sup> Avenue intersection results shown in Table 8 indicate an overall adequate level of service C during the weekday AM and PM peak hours in 2013 with the project and a traffic signal installed.

As shown in Table 8, the Yuma Road/Cotton Lane intersection is predicted to operate at an overall unacceptable LOS D during the weekday AM peak hour and LOS E for the weekday PM peak hour in 2013 with the project and a traffic signal installed. This is due to the intersection's limited ability to provide enough traffic signal green time to accommodate high volumes of through and left-turning traffic with single left turn lanes on each approach. It should be noted that the intersection was already experiencing unacceptable delays for the eastbound left turn movement without the project.

The Yuma Road/Access 1 intersection results shown in Table 8 indicate an overall adequate level of service B during the weekday AM and PM peak hours in 2013 with the project and a traffic signal installed.

As shown in Table 8, the remaining site access points are predicted to have approaches that operate at an acceptable LOS B or better during the weekday AM and PM peak hours in 2013 with the project.

### Auxiliary/Turn Lane Analysis

A key element of this study is to determine if right and left turn lanes, on the major streets, are required at the project site intersections.

The City of Goodyear requires a right turn lane into a development when thirty or more right turns occur in a one hour period. As shown previously in Figure 6 – 2008 and 2013 Weekday Peak Hour Trip Assignment, more than thirty right turns are expected at Access 1 and Access 3. While more than thirty right turns are not expected at Access 2 and Access 4, the site plan for the Cottonflower Marketplace development indicates right turn lanes will be installed.

Additionally, the ITE provides guidelines for the consideration of turn lanes on roadways. The figures from the ITE *Traffic Engineering Handbook, 5th Edition* are provided in the Technical Appendix. The figures compare the through volumes on the major road against the turn lane volumes from the major road to determine if the specific turn lane is warranted.

These charts, which are included in the Appendix, were used to determine the consideration for left turn lanes at the project intersections. Turn lanes should be considered when the percentage of turning traffic is high in relation to the total approach volume. A turn lane removes the traffic slowing to complete their turn from the through traffic stream, improving capacity and reducing the potential for rear-end accidents. Based on the 2008 and 2013 PM peak hour traffic volumes with the project, **Table 9** was developed.



**Table 9 – Recommended Turn Treatments With Project**

Intersection	Direction	Turn Treatment Warranted 2008 With Project	Turn Treatment Warranted 2013 With Project	Turn Lane Criteria
Access 1/ Yuma Road	EB	Right Turn Lane	Right Turn Lane	Goodyear & ITE Guidelines
	WB	Left Turn Lane	Left Turn Lane	Goodyear & ITE Guidelines
Access 2/ Yuma Road	EB	NONE	NONE	Goodyear & ITE Guidelines
Access 3/ Cotton Lane	SB	Right Turn Lane	Right Turn Lane	Goodyear & ITE Guidelines
	NB	Left Turn Lane	N/A	Goodyear & ITE Guidelines
Access 4/ Cotton Lane	SB	Right Turn Lane*	Right Turn Lane*	Goodyear & ITE Guidelines
	NB	N/A	N/A	Goodyear & ITE Guidelines

\* Directed by the City of Goodyear

As shown in **Table 9**, left and right turning auxiliary lanes should be considered at several of the project intersections during the AM and PM peak hours. However, before an auxiliary lane should be installed several items should be considered – available right-of-way to construct the turn lane, impacts to existing utility features that may require relocation, spacing between adjacent driveway to allow adequate construction of the turn lane, etc.

Another key element of this study is to determine storage lengths for the turn lanes associated with the project. The queue storage requirements for the access points were calculated using the following methods as recommended in *A Policy of Geometric Design of Highways and Streets* (AASHTO, 2004).

For un-signalized driveways along arterials, storage for vehicles likely to arrive in an average two-minute period within the peak hour should be provided.

$$\begin{aligned} \text{Vehicles per 2 min. period} &= (\text{vehicles/hour}) \div (30 \text{ periods/hour}) \\ \text{Storage length} &= \text{vehicles per 2 min. period} \times 25 \text{ feet} \end{aligned}$$

For signalized intersections, storage for vehicles should be based on one and a half to two times the number of vehicles that would queue up per cycle.

$$\begin{aligned} \text{Vehicles per cycle} &= 2 * (\text{vehicles/hour}) \div (\text{cycles/hour}) \\ \text{Storage length} &= (\text{vehicles per cycle}) \times 25 \text{ feet} \end{aligned}$$

Based on the 2013 AM and PM peak hour traffic volumes with the project, the storage lengths were calculated for the warranted turn lanes at the intersections serving the project site. Additionally, storage lengths for exiting site traffic were calculated for the four access points. Lastly, storage lengths were calculated for the necessary turn lanes at the Yuma Road/Cotton Lane intersection. The computed values were rounded up to the



nearest 25 feet. **Table 10** shows the recommended storage lengths. Complete storage length calculations can be found in the Appendix.

**Table 10 – Recommended Storage Lengths With Project**

Intersection	2013 With Project							
	Left Turn Storage				Right Turn Storage			
	NB	SB	EB	WB	NB	SB	EB	WB
Access 1/Yuma Rd								
Turning Volume (vph)	85		165		95		70	
$S_{\text{calculated}} =$	106		206		79		58	
$S_{\text{rounded}} =$	125		225		100		100	
Access 2/Yuma Rd								
Turning Volume (vph)					85		20	
$S_{\text{calculated}} =$			N/A		71		17	
$S_{\text{rounded}} =$					75		100	
Access 3/Cotton Ln								
Turning Volume (vph)					85		55	
$S_{\text{calculated}} =$			N/A		71		46	
$S_{\text{rounded}} =$					100		100	
Access 4/Cotton Ln								
Turning Volume (vph)					20		15	
$S_{\text{calculated}} =$			N/A		17		13	
$S_{\text{rounded}} =$					100		100	
Yuma Rd/Cotton Ln								
Turning Volume (vph)			490	155			95	
$S_{\text{calculated}} =$			613	194			119	
$S_{\text{rounded}} =$			625	200			125	

S - storage in feet, vph -

A minimum of 100 feet should be provided for the specified auxiliary/turn lanes. Due to restrictions with right of way (ROW), utilities, and adjacent property, the complete storage area for these turn lanes may not be able to be constructed completely.

The eastbound left turn lane storage lengths for the Yuma Road/Cotton Lane intersection shown in Table 10 represent the total left turn storage at this intersection. Therefore,  $625/2 =$  two separate 325 foot (rounded up) left turn lanes should be provided in 2013.

**Traffic Mitigation**

The Yuma Road/Cotton Lane intersection is predicted to operate with the eastbound left-turn and through movements experiencing an unacceptable LOS F. This is due to the intersection’s limited capacity to accommodate high volumes of through and left-turning traffic with only single left turn lanes on each approach and a single eastbound through lane.



It is possible to propose mitigation measures, or improvements for the Yuma Road/Cotton Lane intersection. Possible mitigation strategies are shown in **Table 11**.

**Table 11 – Recommended Mitigation Measures 2013**

Intersection	Improvement	2013 Without Mitigation		2013 With Mitigation	
		PM Peak		PM Peak	
		LOS	Delay	LOS	Delay
Yuma Road/Cotton Lane					
Eastbound Left	Install eastbound and westbound dual-left turn lanes & provide protected left turn arrows on eastbound & westbound approaches.  Provide southbound right turn overlap turn arrows. Install an additional eastbound through lane and exclusive right turn lane.	F	>120	D	43.5
Eastbound Through		F	98.8	C	32.8
Eastbound Right		C	21.6	C	26.3
Westbound Left		D	36.2	C	34.1
Westbound Through		C	26.8	C	36.4
Westbound Right		C	20.6	C	25.0
Northbound Left		C	33.4	C	28.5
Northbound Through		C	25.1	C	27.6
Northbound Right		C	22.2	C	24.4
Southbound Left		C	33.9	C	33.3
Southbound Through		C	29.0	C	33.6
Southbound Right		D	41.7	B	17.1
Overall Intersection		E	70.6	C	32.1

Delay - seconds per vehicle-trip

The installation of an additional eastbound and westbound left-turn lane, and modifications to the eastbound approach to include one more through lane combined with modifications to the traffic signal timing and equipment at the Yuma Road/Cotton Lane intersection, will allow the green time to be more adequately distributed to each approach, thereby optimizing the traffic signal operation and decreasing overall delay for the entire intersection.

**Conclusion**

When fully completed, the proposed project will generate approximately an additional 7,000 vehicle trips per day (vtpd) on weekdays to the adjacent street system from the new retail development. Fifty percent (3,500 vehicle trips) will be into the project and fifty percent will be out of the project.

The additional traffic generated by the project will not significantly affect the operation of the intersection of Yuma Road/173<sup>rd</sup> Avenue in 2008 or 2013.

The additional traffic generated by the project will not significantly affect the operation of the intersection of Yuma Road/Cotton Lane in 2008. Traffic volumes from the project along with the growing number of non-site traffic volumes in the area could affect the Yuma Road/Cotton Lane intersection in the year 2013. The addition of a second left-turn lane for the eastbound and westbound approaches along with traffic signal modifications should improve the operation of the intersection to an acceptable LOS.



The Yuma Road/Access 1 intersection is predicted to operate at an adequate LOS B or better during the weekday peak hours in 2008 and 2013 with the project.

Results for Yuma Road/Access 2 in 2008 with the project indicate an overall acceptable LOS C during the weekday AM peak hour and an overall LOS D during the weekday PM peak hour. The delay experienced in the PM peak hour is caused by traffic exiting the project site attempting to merge with high eastbound through volumes on Yuma Road traveling on only one through lane approaching Cotton Lane. In the future as additional eastbound travel lanes become available, the delay for exiting site traffic at Access 2 is expected to decrease. In 2013 with additional eastbound through lanes the intersection is predicted to operate with an acceptable LOS B in the AM and PM peak hours.

The Cotton Lane/Access 3 and Cotton Lane/Access 4 intersections are both predicted to operate with an acceptable LOS B or better in the AM and PM peak hours in 2008 and 2013 with the project.



**TRAFFIC IMPACT ANALYSIS  
COTTONFLOWER MARKETPLACE  
YUMA ROAD/COTTON LANE**

**APPENDIX (ON CD)**

**Traffic Counts**

**Trip Generation Calculations**

**Trip Distribution Calculations**

**Capacity Calculations**

**Auxiliary/Turn Lane Calculations**

**Comment Resolution Letters**