Traffic Impact Study for Altamira Family Apartments

Prepared for the City of Sonoma

Submitted by
W-Trans

June 7, 2017

TRAFFIC ENGINEERING
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Executive Summary

The project as proposed includes a 48-unit apartment complex to be located on a currently vacant parcel on the northwest corner of Broadway (SR 12)/Clay Street in the City of Sonoma. Access would be provided via a single driveway on Broadway. The project is expected to generate an average of 319 new daily trips, including 24 trips during the a.m. peak hour and 30 trips during the p.m. peak hour.

The intersection of Broadway/Clay Street is currently operating acceptably overall at LOS A during both the a.m. and p.m. peak hours. It is expected to operate acceptably under Future conditions, and also with project-added traffic.

Facilities for alternative modes in the vicinity of the project site are adequate for pedestrians, bicyclists, and transit users. Bicycle parking for 14 bicycles should be provided on-site.

Sight distance on Broadway at the project driveway would be adequate with the addition of 20 feet of red curb on either side of the project driveway. While a left-turn lane at the project driveway is not warranted under Existing or Future volumes, other factors, such as the excessive width of the road and ease of access to other properties in the vicinity, led to a recommendation to restripe Broadway with a two-way left-turn lane along the project frontage, filling in a missing link by connecting to the existing striping north and south of this segment.

Introduction

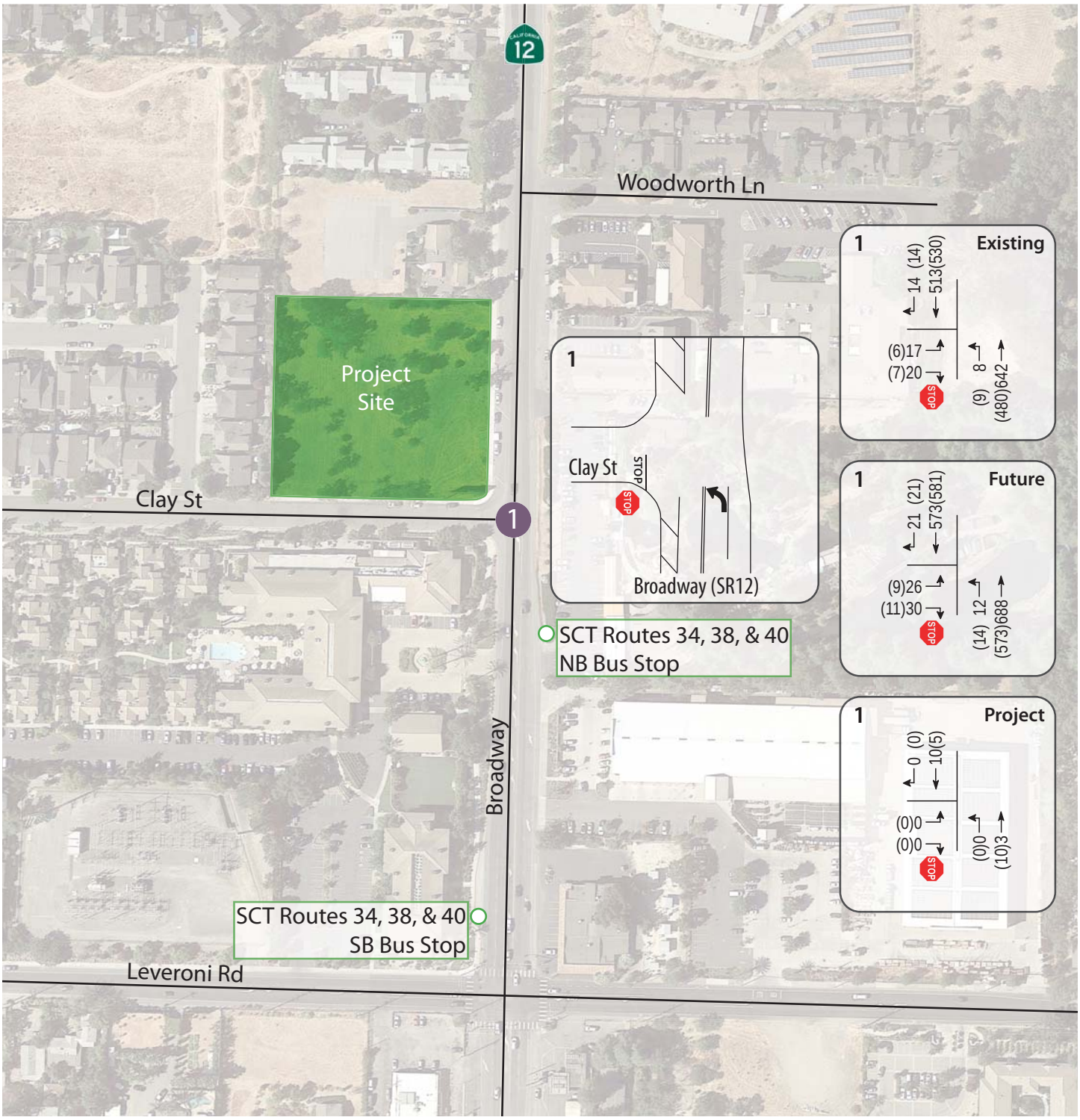
This report presents an analysis of the potential traffic impacts that would be associated with development of a proposed 48-unit apartment project to be located at 20269 Broadway in the City of Sonoma. The traffic study was completed in accordance with criteria established by the City of Sonoma, and is consistent with standard traffic engineering techniques.

Prelude

The purpose of a traffic impact study is to provide City staff and policy makers with data that they can use to make an informed decision regarding the potential traffic impacts of a proposed project, and any associated improvements that would be required in order to mitigate these impacts to a level of insignificance as defined by the City's General Plan or other policies. Vehicular traffic impacts are typically evaluated by determining the number of new trips that the proposed use would be expected to generate, distributing these trips to the surrounding street system based on existing travel patterns or anticipated travel patterns specific to the proposed project, then analyzing the impact the new traffic would be expected to have on critical intersections or roadway segments. Impacts relative to access for pedestrians, bicyclists, and to transit are also addressed.

Project Profile

The Sonoma Family Housing project includes 48 apartment units to be located on a currently vacant site at 20269 Broadway, as shown in Figure 1.



LEGEND

- Study Intersection
- SCT Bus Stop
- xx AM Peak Hour Volume
- (xx) PM Peak Hour Volume

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Traffic Impact Study for the Altamira Family Apartments Project

Figure 1 – Study Area, Lane Configuration, and Traffic Volumes

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Transportation Setting

Operational Analysis

Study Area and Periods

The study area consists of the sections of Broadway and Clay Street fronting the project site and the project access point as well as the intersection of Broadway/Clay Street.

Operating conditions during the a.m. and p.m. peak periods were evaluated to capture the highest potential impacts for the proposed project as well as the highest volumes on the local transportation network. The morning peak hour occurs between 7:00 and 9:00 a.m. and reflects conditions during the home to work or school commute, while the p.m. peak hour occurs between 4:00 and 6:00 p.m. and typically reflects the highest level of congestion during the homeward bound commute.

Study Intersections

Broadway/Clay Street is a three-legged intersection, with the terminating Clay Street approach stop-controlled.

Study Roadways

Broadway, also known as State Highway 12, is classified as an arterial in the City of Sonoma. There is one lane in each direction with a two-way left-turn lane south of Clay Street to just north of the Napa Road-Leveroni Road/Broadway intersection. Road width varies, but is approximately 60 feet in the vicinity of Clay Street. Travel lanes are 14 to 20 feet wide in the northbound direction and approximately 12 feet wide in the southbound direction with wide striped shoulders.

Clay Street is classified as a local street, 36 feet wide, primarily serving the residential community to the west of Broadway. The street serves approximately 35 vehicles during the a.m. peak hour and 48 vehicles during the p.m. peak hour. There are no parking restrictions on either side of Clay Street fronting the proposed project site. There is no striping distinguishing the directional flow of traffic.

The locations of the study intersection and the existing lane configurations and controls are shown in Figure 1.

Collision History

The collision history for the study intersection was reviewed to determine any trends or patterns that may indicate a safety issue based on data available from the California Highway Patrol as published in their Statewide Integrated Traffic Records System (SWITRS) report for July 1, 2011 through June 30, 2016. With only one crash reported during the five-year study period, the collision rate was 0.05 collisions per million vehicles entering (c/mve), which is below the statewide average of 0.18 c/mve for a side-street stop-controlled tee intersection. The collision rate calculation is provided in Appendix A.

Alternative Modes

Pedestrian Facilities

Pedestrian facilities include sidewalks, crosswalks, pedestrian signal phases, curb ramps, curb extensions, and various streetscape amenities such as lighting, benches, etc. In general, a network of sidewalks, crosswalks, pedestrian signals, and curb ramps provide access for pedestrians in the vicinity of the proposed project site; however, sidewalk gaps, obstacles, and barriers can be found along some of the roadways connecting to the project site. Existing gaps and obstacles along the connecting roadways impact convenient and continuous access for pedestrians and present safety concerns in those locations where appropriate pedestrian infrastructure would address potential conflict points.

- **Broadway** – While there are gaps in pedestrian facilities on the east side of Broadway, sidewalks, curb ramps, and crosswalks are complete on the west side of Broadway from West Napa Street to Leveroni Road.
- **Clay Street** – Continuous sidewalks are provided on both sides of Clay Street in the vicinity of the project site.

Bicycle Facilities

The *Highway Design Manual*, Caltrans, 2012, classifies bikeways into three categories:

- **Class I Multi-Use Path** – a completely separated right-of-way for the exclusive use of bicycles and pedestrians with cross flows of motorized traffic minimized.
- **Class II Bike Lane** – a striped and signed lane for one-way bike travel on a street or highway.
- **Class III Bike Route** – signing only for shared use with motor vehicles within the same travel lane on a street or highway.

There is a Class I bike path west of the project location, and Class II bike lanes and Class III sharrows are proposed adjacent to the project site on Broadway and Newcomb Street, respectively. Bicyclists ride in the roadway and/or on sidewalks along all other streets within the project study area. Table 1 summarizes the existing and planned bicycle facilities in the project vicinity, as contained in the *Sonoma Bicycle and Pedestrian Master Plan*.

Table 1 – Bicycle Facility Summary

Status Facility	Class	Length (miles)	Begin Point	End Point
Existing				
Madera Park Trail	I	0.64	W MacArthur St	Leveroni Rd
Planned				
Broadway	II	1.12	Napa St	Leveroni Rd-Napa Rd
Newcomb St	III	0.33	Madera Park Trail	Broadway

Source: *Sonoma Bicycle and Pedestrian Master Plan*, SCTA, 2014

Transit Facilities

Sonoma County Transit (SCT) provides fixed route bus service in Sonoma County and regionally. There are northbound and southbound stops on Broadway between Clay Street and Leveroni Road. The northbound stop is 250 feet from the project site and the southbound stop is 600 feet south of the project site, as shown in Figure 1. SCT Route 34 provides weekday service between Sonoma and Santa Rosa. The route operates once in the

morning in the eastbound direction, and once in the afternoon in the westbound direction. Sonoma and San Rafael are connected by SCT Route 38. This route operates one time southbound for the morning commute and one time northbound for the evening commute Monday through Friday. Route 40 provides service between Sonoma and Petaluma during weekdays. There are two departures in each direction during the morning peak period and three departures in each direction during the peak afternoon and evening periods.

Two or three bicycles can be carried on SCT buses. Bike rack space is on a first come, first served basis. Additional bicycles are allowed on SCT buses at the discretion of the driver.

Dial-a-ride, also known as paratransit, or door-to-door service, is available for those who are unable to independently use the transit system due to a physical or mental disability. SCT Paratransit is designed to serve the needs of individuals with disabilities within Sonoma County.

Capacity Analysis

Intersection Level of Service Methodologies

Level of Service (LOS) is used to rank traffic operation on various types of facilities based on traffic volumes and roadway capacity using a series of letter designations ranging from A to F. Generally, Level of Service A represents free flow conditions and Level of Service F represents forced flow or breakdown conditions. A unit of measure that indicates a level of delay generally accompanies the LOS designation.

The study intersection was analyzed using the unsignalized methodology published in the *Highway Capacity Manual* (HCM), Transportation Research Board, 2010. This source contains methodologies for various types of intersection control, all of which are related to a measurement of delay in average number of seconds per vehicle. The "Two-Way Stop-Controlled" intersection capacity methodology determines a level of service for each minor turning movement by estimating the level of average delay in seconds per vehicle. Results are presented for individual movements together with the weighted overall average delay for the intersection.

The ranges of delay associated with the various levels of service are indicated in Table 2.

Table 2 – Two-Way Stop-Controlled Intersection Level of Service Criteria	
LOS A	Delay of 0 to 10 seconds. Gaps in traffic are readily available for drivers exiting the minor street.
LOS B	Delay of 10 to 15 seconds. Gaps in traffic are somewhat less readily available than with LOS A, but no queuing occurs on the minor street.
LOS C	Delay of 15 to 25 seconds. Acceptable gaps in traffic are less frequent, and drivers may approach while another vehicle is already waiting to exit the side street.
LOS D	Delay of 25 to 35 seconds. There are fewer acceptable gaps in traffic, and drivers may enter a queue of one or two vehicles on the side street.
LOS E	Delay of 35 to 50 seconds. Few acceptable gaps in traffic are available, and longer queues may form on the side street.
LOS F	Delay of more than 50 seconds. Drivers may wait for long periods before there is an acceptable gap in traffic for exiting the side streets, creating long queues.

Reference: *Highway Capacity Manual*, Transportation Research Board, 2010

Traffic Operation Standards

City of Sonoma

In the *2016 Circulation Element* of the *City of Sonoma General Plan*, the following policy has been adopted:

> ***Policy 1.5**: Establish a motor vehicle Level of Service (LOS) standard of LOS D at intersections. The following shall be taken into consideration in applying this standard:*
>
> - *Efforts to meet the vehicle LOS standard shall not result in diminished safety for other modes including walking, bicycling, or transit (see Policy 1.6).*
> - *The standard shall be applied to the overall intersection operation and not that of any individual approach or movement.*
> - *Consideration shall be given to the operation of the intersection over time, rather than relying exclusively on peak period conditions.*

The five intersections surrounding the historic Sonoma Plaza shall be exempt from vehicle LOS standards in order to maintain the historic integrity of the Plaza and prioritize non-auto modes.

Caltrans

While the intersection lies within City of Sonoma limits, it is a part of a State Route. Caltrans indicates that they endeavor to maintain operation at the transition from LOS C to LOS D. Based on previous discussions with Caltrans staff, it is understood that the standard is to be applied to the overall average intersection delay, and *not* that associated with any single movement or approach. Under this approach, if one movement experiences very high delay and also has moderate to high traffic volumes, the overall delay and level of service should reflect the critical nature of the condition. However, if one movement is expected to experience high delay, but has very low traffic volumes, the overall intersection operation will likely still meet Caltrans standards.

Existing Conditions

The Existing Conditions scenario provides an evaluation of current operation based on existing traffic volumes during the a.m. and p.m. peak periods. This condition does not include project-generated traffic volumes. Volume data was collected April 14, 2017 while local schools were in session.

Intersection Levels of Service

Under existing conditions, the intersection operates acceptably at LOS A overall during both peak periods. The existing traffic volumes are shown in Figure 1. A summary of the intersection level of service calculations is contained in Table 3, and copies of the Level of Service calculations are provided in Appendix B.

Table 3 – Existing Peak Hour Intersection Levels of Service

Study Intersection ***Approach***	**AM Peak**		**PM Peak**	
	Delay	**LOS**	**Delay**	**LOS**
1. Broadway/Clay St	0.7	A	0.3	A
Eastbound (Clay St) Approach	*21.4*	*C*	*16.0*	*C*

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*

Future Conditions

Segment volumes for the horizon year of 2040 were obtained from the County's gravity demand model and the differences between the 2010 and 2040 volumes were applied to the existing turning movement counts to arrive at Future volumes. A growth factor of 1.5 was derived from the increase indicated by the model and applied to the side street volumes.

Under the anticipated Future volumes, the study intersections are expected to operate acceptably at LOS A overall during both study periods. Future volumes are shown in Figure 1 and operating conditions are summarized in Table 4.

Table 4 – Future Peak Hour Intersection Levels of Service				
Study Intersection *Approach*	**AM Peak**		**PM Peak**	
	Delay	**LOS**	**Delay**	**LOS**
1. Broadway/Clay St	0.9	A	0.4	A
Eastbound (Clay St) Approach	*21.6*	*C*	*17.7*	*C*

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*

Project Description

The project consists of 48 apartment units on a site that is currently vacant located at 20269 Broadway in the City of Sonoma. Access would be taken directly from Broadway. The proposed project site plan is shown in Figure 2.

Trip Generation

The anticipated trip generation for the proposed project was estimated using standard rates published by the Institute of Transportation Engineers (ITE) in *Trip Generation Manual*, 9th Edition, 2012 for the "Apartment" land use (ITE LU #220). As shown in Table 5, the proposed project is expected to generate an average of 319 trips per day, including 24 trips during the a.m. peak hour and 30 during the p.m. peak hour.

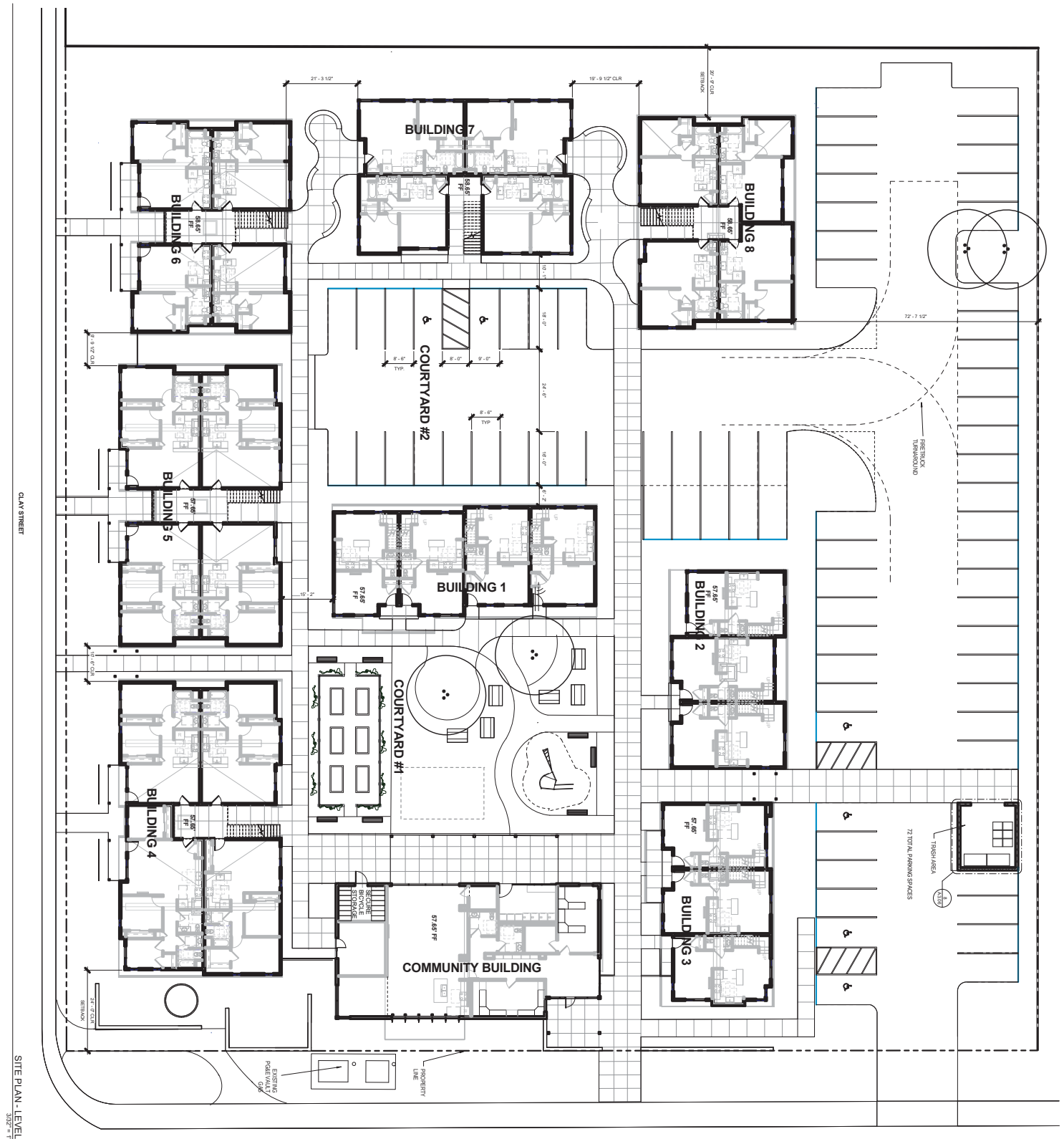
Table 5 – Trip Generation Summary											
Land Use	**Units**	**Daily**		**AM Peak Hour**				**PM Peak Hour**			
		Rate	**Trips**	**Rate**	**Trips**	**In**	**Out**	**Rate**	**Trips**	**In**	**Out**
Apartment	48 du	6.65	319	0.51	24	5	19	0.62	30	19	11

Note: du = dwelling unit

Trip Distribution

Based on the volumes at the study intersection as well as anticipated destinations for site residents, it was assumed that project trips would be distributed as shown in Table 6.

Table 6 – Trip Distribution Assumptions				
Route	**Percent**	**Daily Trips**	**AM Trips**	**PM Trips**
Broadway (to/from the north)	50%	160	12	15
Broadway (to/from the south)	50%	159	12	15
TOTAL	**100%**	**319**	**24**	**30**



SITE PLAN - LEVEL 1
3/32" = 1'-0" 1

PROJECT NORTH
TRUE NORTH

PYATOK
ARCHITECTURE + URBAN DESIGN
1611 TELEGRAPH AVE, SUITE 200
OAKLAND, CA 94612
510.465.7010 | 510.465.8575
www.pyatok.com

Satellite Affordable Housing Associates
1535 Kotobuki Avenue
Berkeley, CA 94703

ALTAMIRA FAMILY APARTMENTS

20269 Broadway, Sonoma, CA

STAMP:

2016 PHASE
DRAWN BY: BDC
CHECKED BY: CA
DATE: TB
SCALE: 5.19.17
TITLE: 3/32" = 1'-0"
SITE PLAN

SHEET
A1.01

- PRELIMINARY - Not for Construction -

Source: Pyatok Architects, 05/2017

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Traffic Impact Study for the Altamira Family Apartments Project

Figure 2 – Site Plan

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Intersection Operation

Existing plus Project Conditions

Upon the addition of project-related traffic to the Existing volumes, the study intersections are expected to continue to operate at LOS A overall, with minimal increases in delay expected on the stop-controlled side-street approach. These results are summarized in Table 7. Project traffic volumes are shown in Figure 1.

Table 7 – Existing and Existing plus Project Peak Hour Intersection Levels of Service

Study Intersection *Approach*	Existing Conditions				Existing plus Project			
	AM Peak		PM Peak		AM Peak		PM Peak	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1. Broadway/Clay St	0.7	A	0.3	A	0.7	A	0.3	A
Eastbound (Clay St) Approach	*21.4*	*C*	*16.0*	*C*	*21.8*	*C*	*16.2*	*C*

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*

Finding – The study intersection is expected to continue operating acceptably at the same levels of service upon the addition of project-generated traffic.

Future plus Project Conditions

Upon the addition of project-generated traffic to the anticipated Future volume, the study intersection is expected to continue operating acceptably. The Future plus Project operating conditions are summarized in Table 8.

Table 8 – Future and Future plus Project Peak Hour Intersection Levels of Service

Study Intersection *Approach*	Future Conditions				Future plus Project			
	AM Peak		PM Peak		AM Peak		PM Peak	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1. Broadway/Clay St	0.9	A	0.4	A	1.0	A	0.4	A
Eastbound (Clay St) Approach	*21.6*	*C*	*17.7*	*C*	*21.9*	*C*	*17.9*	*C*

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*

Finding – The study intersection will continue operating acceptably with project traffic added, at the same Levels of Service as without it and imperceptible increases in average delay for stop-controlled traffic.

Alternative Modes

Pedestrian Facilities

Given the proximity of commercial and residential land uses to the project site, it is reasonable to assume that some project patrons and employees will want to walk, bicycle, and/or use transit to reach the project site. There is existing sidewalk along both the project frontages of Broadway and Clay Street. There is also continuous sidewalk available along the west side of Broadway and a signalized intersection at Broadway/Newcomb Street with a marked crossing across Broadway that middle and high school students could use to walk between the project site and Adele Harrison Middle School and Sonoma Valley High School.

Project Site – Sidewalks exist along both the Broadway and Clay Street project frontages, and there is also continuous sidewalk and a marked crossing between the project site and the nearby middle and high school. A review of the site plan indicates pedestrian walkways are proposed within the project site as well.

Finding – Pedestrian facilities serving the project site are adequate.

Bicycle Facilities

Existing bicycle facilities, including shared use of minor streets, provide adequate access for bicyclists. Class II bike lanes are proposed on Broadway, including along the project frontage.

Bicycle Storage

Short-term bicycle parking is provided at the site by 14 secured bike parking spaces.

Finding – Bicycle facilities serving the project site are adequate.

Transit

Existing transit routes are adequate to accommodate project-generated transit trips. Existing stops are within acceptable walking distance of the site.

Finding – Transit facilities serving the project site are adequate.

Access and Circulation

Site Access

The project site will be accessed via a driveway on Broadway on the northern edge of the property, across from an existing driveway to Broadway Plaza.

Sight Distance

Sight distance along Broadway at the project driveway was evaluated based on sight distance criteria contained in the *Highway Design Manual* published by Caltrans. The recommended sight distances for minor street approaches that are a driveway are based on stopping sight distance, with approach travel speeds as the basis for determining the recommended sight distance. Additionally, the stopping sight distance needed for a following driver to stop if there is a vehicle waiting to turn into a side street or driveway is evaluated based on stopping sight distance criterion and the approach speed on the major street.

Sight distance at the proposed driveway location was field measured. Based on a design speed of 35 mph, the minimum stopping sight distance needed is 250 feet. Broadway is a straight, flat road and stopping sight distance for a posted speed limit of 35 mph is adequate so long as there are no vehicles parked along the curb. The sight distance, shown in the exhibit provided in Appendix C would be adequate at the project driveway with the addition of red curb on either side of the driveway.

Finding - Sight distance is adequate, but could be impacted by parked vehicles.

Recommendation - Parking restrictions in the form of red curbs should be installed for 20 feet on either side of the project driveway. Additionally, low-lying landscaping should be installed along the project frontage on Broadway near the driveway.

Access Analysis

Left-Turn Lane Warrants

The need for a left-turn lane on Broadway at the proposed driveway was evaluated based on criteria contained in the *Intersection Channelization Design Guide*, National Cooperative Highway Research Program (NCHRP) Report No. 279, Transportation Research Board, 1985, as well as a more recent update of the methodology developed by the Washington State Department of Transportation. The NCHRP report references a methodology developed by M. D. Harmelink that includes equations that can be applied to expected or actual traffic volumes in order to determine the need for a left-turn pocket based on safety issues. It is understood that this methodology is similar to what Caltrans uses for this type of analysis.

The left-turn warrant study was based on Existing and Future peak hour volumes as well as safety criteria. Under plus Project conditions, a left-turn lane is not warranted on Broadway at the project driveway during either of the peak periods evaluated, or under projected Future volumes. The turn lane warrant worksheets are included in Appendix C.

Left-Turn Lane Design

While a left-turn lane is not warranted on Broadway at the project driveway based on volumes, due to the inconsistency of the lane geometrics on Broadway along the project frontage compared to the rest of Broadway between Napa Street and Leveroni Road-Napa Road, as well as the excessive width that can contribute to speeding and other undesirable driving behaviors, it is recommended that the project restripe Broadway with a

two-way left-turn lane for the 770 feet between the existing two-way left-turn lane striping north and south of the missing segment. This modification would substantially improve access conditions for the project site and for other origins and destinations in the vicinity. As shown in the exhibit in Appendix C, it appears that the new striping will fit within the existing pavement width while retaining parking where it currently exists.

Potential Conflicts

Loading activity on Clay Street for the Sonoma Lodge was collected on video cameras for one week and then reviewed. Based on video footage obtained, it appears there is minimal potential for conflict with delivery trucks for the Sonoma Lodge. During the a.m. peak period trucks were observed parallel parking along the south side of Clay Street, with ample space for eastbound passenger vehicles to continue to Broadway.

Conclusions and Recommendations

Conclusions

- The project as proposed is expected to generate 326 new daily trips, including 25 during the a.m. peak hour and 30 during the p.m. peak hour.
- The study intersection experienced a lower collision rate than the statewide average for similar facilities.
- The intersection currently operates acceptably at LOS A and is expected to continue operating at LOS A under Existing plus Project, Future, and Future plus Project conditions.
- Sight distance at the project driveway is adequate.
- A left-turn lane is not warranted on Broadway at the project driveway based on volumes, but should be provided to improve access and safety.
- Pedestrian, bike and transit facilities are adequate.
- Trucks loading and unloading on the south side of Clay Street are not expected to interfere with access for vehicles traveling on Clay Street.

Recommendations

- Any vegetation at the project driveway should be planted and maintained so it is low-lying. Additionally, red curb should be painted on either side of the driveway for 20 feet.
- A two-way left-turn lane on Broadway designed to Caltrans specifications should be installed to connect to existing turn lane striping to the north and south.

Study Participants and References

Study Participants

Principal in Charge	Dalene J. Whitlock, PE, PTOE
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Graphics	Hannah Yung
Editing/Formatting	Corinne Rasmussen, Hannah Yung
Report Review	Dalene J. Whitlock, PE, PTOE

References

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Appendix A

Collision Rate Calculations

Intersection Collision Rate Calculations

TIS for Altamira Family Apartments

Intersection # 1: Broadway & Clay St
Date of Count: Tuesday, March 28, 2017

Number of Collisions: 1
Number of Injuries: 0
Number of Fatalities: 0
ADT: 10500
Start Date: July 1, 2011
End Date: June 30, 2016
Number of Years: 5

Intersection Type: Tee
Control Type: Stop & Yield Controls
Area: Urban

$$\text{collision rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x 365 Days per Year x Number of Years}}$$

$$\text{collision rate} = \frac{1 \times 1{,}000{,}000}{10{,}500 \times 365 \times 5}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.05 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.18 c/mve**	**0.7%**	**36.4%**

ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2013 Collision Data on California State Highways, Caltrans

Appendix B

Intersection Level of Service Calculations

Intersection	
Int Delay, s/veh	0.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	20	8	642	513	14
Future Vol, veh/h	17	20	8	642	513	14
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	50	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	19	23	9	730	583	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1339	591	599	0	-	0
Stage 1	591	-	-	-	-	-
Stage 2	748	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	168	507	978	-	-	-
Stage 1	553	-	-	-	-	-
Stage 2	468	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	166	507	978	-	-	-
Mov Cap-2 Maneuver	166	-	-	-	-	-
Stage 1	553	-	-	-	-	-
Stage 2	464	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	21.4	0.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	978	-	261	-	-
HCM Lane V/C Ratio	0.009	-	0.161	-	-
HCM Control Delay (s)	8.7	-	21.4	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0	-	0.6	-	-

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	6	7	9	480	530	14
Future Vol, veh/h	6	7	9	480	530	14
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	50	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	6	7	9	500	552	15

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1078	559	567	0	-	0
Stage 1	559	-	-	-	-	-
Stage 2	519	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	242	529	1005	-	-	-
Stage 1	572	-	-	-	-	-
Stage 2	597	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	240	529	1005	-	-	-
Mov Cap-2 Maneuver	240	-	-	-	-	-
Stage 1	572	-	-	-	-	-
Stage 2	592	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16	0.2	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1005	-	340	-	-
HCM Lane V/C Ratio	0.009	-	0.04	-	-
HCM Control Delay (s)	8.6	-	16	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

Intersection	
Int Delay, s/veh	0.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	26	30	12	688	573	21
Future Vol, veh/h	26	30	12	688	573	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	50	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	30	12	688	573	21

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1296	584	594	0	-	0
Stage 1	584	-	-	-	-	-
Stage 2	712	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	179	512	982	-	-	-
Stage 1	557	-	-	-	-	-
Stage 2	486	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	177	512	982	-	-	-
Mov Cap-2 Maneuver	177	-	-	-	-	-
Stage 1	557	-	-	-	-	-
Stage 2	480	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	21.6	0.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	982	-	273	-	-
HCM Lane V/C Ratio	0.012	-	0.205	-	-
HCM Control Delay (s)	8.7	-	21.6	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0	-	0.8	-	-

Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	9	11	14	573	581	21
Future Vol, veh/h	9	11	14	573	581	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	50	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	9	11	14	573	581	21

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1193	592	602	0	-	0
Stage 1	592	-	-	-	-	-
Stage 2	601	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	206	506	975	-	-	-
Stage 1	553	-	-	-	-	-
Stage 2	547	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	203	506	975	-	-	-
Mov Cap-2 Maneuver	203	-	-	-	-	-
Stage 1	553	-	-	-	-	-
Stage 2	539	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	17.7	0.2	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	975	-	303	-	-
HCM Lane V/C Ratio	0.014	-	0.066	-	-
HCM Control Delay (s)	8.7	-	17.7	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0	-	0.2	-	-

Intersection	
Int Delay, s/veh	0.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	20	8	645	523	14
Future Vol, veh/h	17	20	8	645	523	14
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	50	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	19	23	9	733	594	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1353	602	610	0	-	0
Stage 1	602	-	-	-	-	-
Stage 2	751	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	165	500	969	-	-	-
Stage 1	547	-	-	-	-	-
Stage 2	466	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	163	500	969	-	-	-
Mov Cap-2 Maneuver	163	-	-	-	-	-
Stage 1	547	-	-	-	-	-
Stage 2	462	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	21.8	0.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	969	-	256	-	-
HCM Lane V/C Ratio	0.009	-	0.164	-	-
HCM Control Delay (s)	8.8	-	21.8	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0	-	0.6	-	-

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	6	7	9	490	535	14
Future Vol, veh/h	6	7	9	490	535	14
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	50	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	6	7	9	510	557	15

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1094	565	572	0	-	0
Stage 1	565	-	-	-	-	-
Stage 2	529	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	237	524	1001	-	-	-
Stage 1	569	-	-	-	-	-
Stage 2	591	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	235	524	1001	-	-	-
Mov Cap-2 Maneuver	235	-	-	-	-	-
Stage 1	569	-	-	-	-	-
Stage 2	586	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16.2	0.2	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1001	-	334	-	-
HCM Lane V/C Ratio	0.009	-	0.041	-	-
HCM Control Delay (s)	8.6	-	16.2	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	26	30	12	691	583	21
Future Vol, veh/h	26	30	12	691	583	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	50	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	30	12	691	583	21

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1309	594	604	0	-	0
Stage 1	594	-	-	-	-	-
Stage 2	715	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	176	505	974	-	-	-
Stage 1	552	-	-	-	-	-
Stage 2	485	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	174	505	974	-	-	-
Mov Cap-2 Maneuver	174	-	-	-	-	-
Stage 1	552	-	-	-	-	-
Stage 2	479	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	21.9	0.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	974	-	268	-	-
HCM Lane V/C Ratio	0.012	-	0.209	-	-
HCM Control Delay (s)	8.7	-	21.9	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0	-	0.8	-	-

Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	9	11	14	583	586	21
Future Vol, veh/h	9	11	14	583	586	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	50	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	9	11	14	583	586	21

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1208	597	607	0	-	0
Stage 1	597	-	-	-	-	-
Stage 2	611	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	202	503	971	-	-	-
Stage 1	550	-	-	-	-	-
Stage 2	542	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	199	503	971	-	-	-
Mov Cap-2 Maneuver	199	-	-	-	-	-
Stage 1	550	-	-	-	-	-
Stage 2	534	-	-	-	-	-

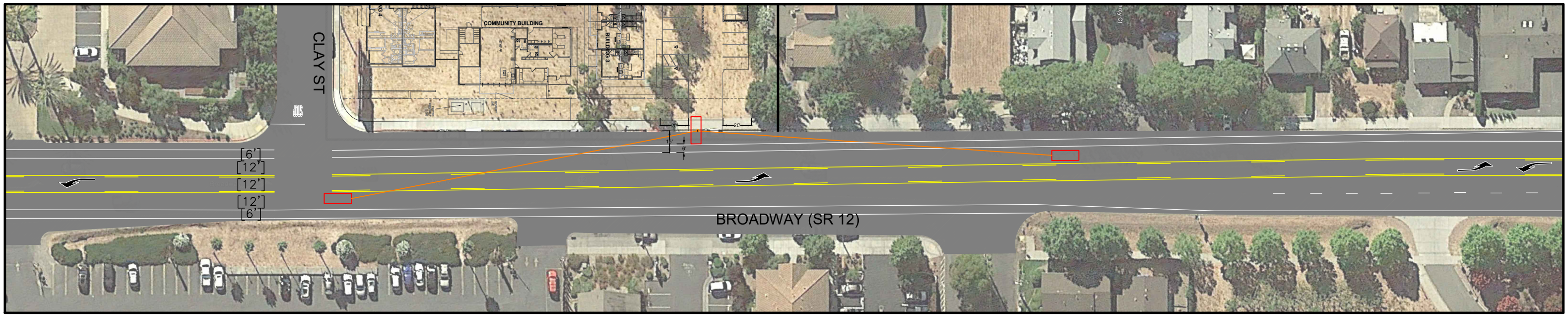
Approach	EB	NB	SB
HCM Control Delay, s	17.9	0.2	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	971	-	298	-	-
HCM Lane V/C Ratio	0.014	-	0.067	-	-
HCM Control Delay (s)	8.8	-	17.9	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0	-	0.2	-	-

Appendix C

Site Access

N.T.S.



Altamira Family Apartments

SON045-1

Sight Distance Exhibit

8 May 2017

Turn Lane Warrant Analysis - Tee Intersections

Study Intersection: Broadway (SR 12)/Project Driveway
Study Scenario: AM Existing plus Project

Direction of Analysis Street: North/South
Cross Street Intersects: From the West

Broadway (SR 12)
Southbound Volumes (veh/hr)
Through Volume = 527
Right Turn Volume = 2

Broadway (SR 12)
Northbound Volumes (veh/hr)
659 = Through Volume
3 = Left Turn Volume

Project Driveway

Southbound Speed Limit: 35 mph
Southbound Configuration: 2 Lanes - Undivided

Northbound Speed Limit: 35 mph
Northbound Configuration: 2 Lanes - Undivided

Southbound Right Turn Lane Warrants

1. Check for right turn volume criteria

Thresholds not met, continue to next step

2. Check advance volume threshold criteria for turn lane

Advancing Volume Threshold	AV =	1035.1
Advancing Volume	Va =	529
If AV<Va then warrant is met		No

Right Turn Lane Warranted: **NO**

Southbound Right Turn Taper Warrants
(evaluate if right turn lane is unwarranted)

1. Check taper volume criteria

NOT WARRANTED - Less than 20 vehicles

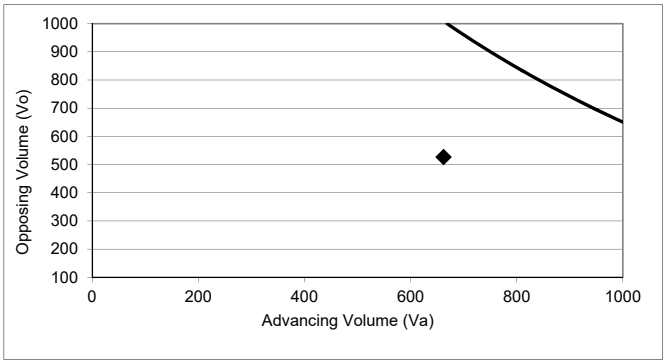
2. Check advance volume threshold criteria for taper

Advancing Volume Threshold	AV =	-
Advancing Volume	Va =	529
If AV<Va then warrant is met		-

Right Turn Taper Warranted: **NO**

Northbound Left Turn Lane Warrants

Percentage Left Turns %lt 0.5 %
Advancing Volume Threshold AV 1153 veh/hr
If AV<Va then warrant is met



◆ Study Intersection
Two lane roadway warrant threshold for: 35 mph
Turn lane warranted if point falls to right of warrant threshold line

Left Turn Lane Warranted: **NO**

Methodology based on Washington State Transportation Center Research Report *Method For Prioritizing Intersection Improvements*, January 1997.
The right turn lane and taper analysis is based on work conducted by Cottrell in 1981.
The left turn lane analysis is based on work conducted by M.D. Harmelink in 1967, and modified by Kikuchi and Chakroborty in 1991.

Turn Lane Warrant Analysis - Tee Intersections

Study Intersection: Broadway (SR 12)/Project Driveway
Study Scenario: PM Existing plus Project

Direction of Analysis Street: North/South
Cross Street Intersects: From the West

Broadway (SR 12)
Southbound Volumes (veh/hr)
Through Volume = 544
Right Turn Volume = 10

Broadway (SR 12)
Northbound Volumes (veh/hr)
489 = Through Volume
10 = Left Turn Volume

Project Driveway

Southbound Speed Limit: 35 mph
Southbound Configuration: 2 Lanes - Undivided

Northbound Speed Limit: 35 mph
Northbound Configuration: 2 Lanes - Undivided

Southbound Right Turn Lane Warrants

1. Check for right turn volume criteria

Thresholds not met, continue to next step

2. Check advance volume threshold criteria for turn lane

Advancing Volume Threshold	AV =	975.1
Advancing Volume	Va =	554
If AV<Va then warrant is met		No

Right Turn Lane Warranted: **NO**

Southbound Right Turn Taper Warrants
(evaluate if right turn lane is unwarranted)

1. Check taper volume criteria

NOT WARRANTED - Less than 20 vehicles

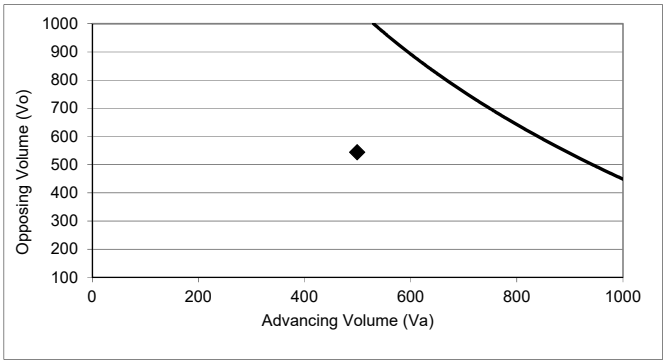
2. Check advance volume threshold criteria for taper

Advancing Volume Threshold	AV =	-
Advancing Volume	Va =	554
If AV<Va then warrant is met		-

Right Turn Taper Warranted: **NO**

Northbound Left Turn Lane Warrants

Percentage Left Turns %lt 2.0 %
Advancing Volume Threshold AV 896 veh/hr
If AV<Va then warrant is met



◆ Study Intersection
Two lane roadway warrant threshold for: 35 mph
Turn lane warranted if point falls to right of warrant threshold line

Left Turn Lane Warranted: **NO**

Methodology based on Washington State Transportation Center Research Report *Method For Prioritizing Intersection Improvements*, January 1997.
The right turn lane and taper analysis is based on work conducted by Cottrell in 1981.
The left turn lane analysis is based on work conducted by M.D. Harmelink in 1967, and modified by Kikuchi and Chakroborty in 1991.

Turn Lane Warrant Analysis - Tee Intersections

Study Intersection: Broadway (SR 12)/Project Driveway
Study Scenario: PM Existing plus Project

Direction of Analysis Street: North/South
Cross Street Intersects: From the West

Broadway (SR 12)
Southbound Volumes (veh/hr)
Through Volume = 607
Right Turn Volume = 10

Broadway (SR 12)
Northbound Volumes (veh/hr)
592 = Through Volume
10 = Left Turn Volume

Project Driveway

Southbound Speed Limit: 35 mph
Southbound Configuration: 2 Lanes - Undivided

Northbound Speed Limit: 35 mph
Northbound Configuration: 2 Lanes - Undivided

Southbound Right Turn Lane Warrants

1. Check for right turn volume criteria

Thresholds not met, continue to next step

2. Check advance volume threshold criteria for turn lane

Advancing Volume Threshold	AV =	975.1
Advancing Volume	Va =	617
If AV<Va then warrant is met		No

Right Turn Lane Warranted: **NO**

Southbound Right Turn Taper Warrants
(evaluate if right turn lane is unwarranted)

1. Check taper volume criteria

NOT WARRANTED - Less than 20 vehicles

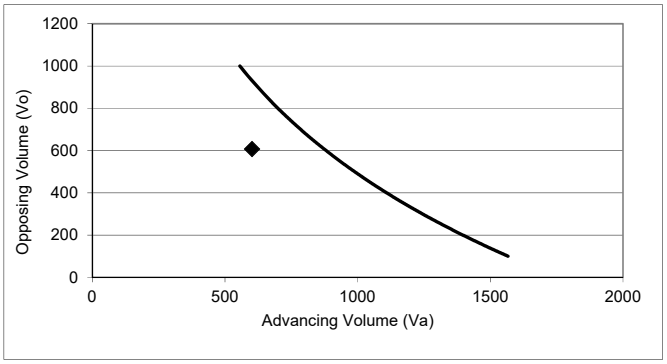
2. Check advance volume threshold criteria for taper

Advancing Volume Threshold	AV =	-
Advancing Volume	Va =	617
If AV<Va then warrant is met		-

Right Turn Taper Warranted: **NO**

Northbound Left Turn Lane Warrants

Percentage Left Turns %lt 1.7 %
Advancing Volume Threshold AV 874 veh/hr
If AV<Va then warrant is met



◆ Study Intersection
Two lane roadway warrant threshold for: 35 mph
Turn lane warranted if point falls to right of warrant threshold line

Left Turn Lane Warranted: **NO**

Methodology based on Washington State Transportation Center Research Report *Method For Prioritizing Intersection Improvements*, January 1997.
The right turn lane and taper analysis is based on work conducted by Cottrell in 1981.
The left turn lane analysis is based on work conducted by M.D. Harmelink in 1967, and modified by Kikuchi and Chakroborty in 1991.

N.T.S.

Altamira Family Apartments

Broadway Two-Way Left-Turn Lane Exhibit

SON045-1

8 May 2017