Traffic Impact Study for the 2151 Appian Way Multi-Family Housing Project

Prepared for the City of Pinole

Submitted by
W-Trans

April 7, 2022

TRAFFIC ENGINEERING
TRANSPORTATION PLANNING
Balancing Functionality and Livability since 1995
w-trans.com

This page intentionally left blank

Executive Summary

The proposed project includes the construction of 154 multi-family housing units to be located at 2151 Appian Way in the City of Pinole. The project is expected to generate an average of 838 trips per day, including 55 trips during the a.m. peak hour and 68 trips during the p.m. peak hour. The project site is currently occupied by a vacant medical center and is located within the Appian Way Project Area as part of the City's Three Corridors Specific Plan.

Analysis indicates that the study intersections of Appian Way/Mann Drive-Project Access and Appian Way/Tara Hills Drive-Canyon Drive both operate acceptably per the applicable City standards under Existing Conditions and would continue to do so with the addition of project-generated traffic.

The proposed project was determined to comply with land uses and bicycle plans set forth in the Three Corridors Specific Plan. However, it is suggested that the project applicant make a fair share contribution towards multi-modal improvements identified in the Three Corridors Specific Plan.

The project is presumed to have a less-than-significant transportation impact on vehicle miles traveled based on OPR guidelines. However, to further reduce the project's potential impact, transportation demand management measures are recommended such as providing access to transit, provision of bicycle and pedestrian infrastructure improvements, and installation of electric vehicle charging stations.

There are adequate sidewalks and crosswalks for the pedestrians to access the project site. Upon the completion of the project, the proposed driveway with pedestrian crossing would be added as an east leg to the intersection of Appian Way/Mann Drive-Project Access, which may cause conflicts between pedestrian and vehicular traffic. To prevent potential conflicts, split phasing is recommended for the eastbound and westbound approaches of the intersection.

The existing bicycle facilities would be adequate to connect the project site with nearby destinations, upon completion of the bicycle projects in the project area. Additionally, as the project residents would be able to store their bicycles in the assigned private garages, the bicycle parking spaces would be considered adequate. The existing transit facilities serving the project are also adequate, with a WestCAT Route 17 bus stop located on Appian Way.

The project would be accessed via proposed driveways on Appian Way and Canyon Drive. It is noted that the driveway on Appian Way would become an east leg of the Appian Way/Mann Drive intersection. As the existing driveways would no longer be used upon the construction of the project, it is recommended to remove the southbound left-turn pocket serving the existing driveway on Appian Way approximately 350 feet south of the intersection with Mann Drive.

Adequate sight distance is available at each project driveway, on Appian Way and on Canyon Drive, with the exception of the sight lines to the east from the driveway on Canyon Drive due to the presence of the horizontal curve, steep hill, and on-street parking. To improve the sight lines, prohibition of on-street parking and maintenance or trimming vegetation is suggested. Additionally, the on-site circulation and access would have to satisfy City Design Standards and therefore would be expected to function acceptably for emergency response vehicles. The left-turn warrant analysis indicated that the left-turn lane on Canyon Drive at the proposed driveway is not warranted based on Existing plus Project p.m. peak hour volumes.

The proposed parking supply of 354 spaces would be equivalent to the City Code requirement.

Introduction

This report presents an analysis of the potential traffic impacts that would be associated with development of a proposed 154-unit multi-family housing project to be located at 2151 Appian Way in the City of Pinole. The traffic study was completed in accordance with the criteria established by the City 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 transportation impacts of a proposed project, and any associated improvements that would be required in order to mitigate these impacts to an acceptable level under CEQA, the City's General Plan, or other policies. Impacts relative to access for pedestrians, bicyclists, and to transit are addressed in the context of the CEQA criteria. Consistent with SB 743, the project's transportation impacts were analyzed using VMT. While no longer a part of the CEQA review process, vehicular traffic service levels at key intersections were evaluated for consistency with General Plan policies 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 anticipated travel patterns specific to the proposed project, then analyzing the effect the new traffic would be expected to have on the study intersections.

Project Profile

The proposed project includes 154 multi-family residential units on a site occupied by the vacant Doctor's Medical Center Pinole Campus. The project site would be accessed via driveways on Appian Way and Canyon Drive. It is noted that while the site is zoned with a residential mixed-use (RMU) land use in the northern half and commercial mixed-use (CMU) land use in the southern half, as contained in the *Three Corridors Specific Plan,* the project consists of only residential units. This is allowed with certain concessions, such as the affordable housing that is proposed as 15 percent of the units. The project site is located at 2151 Appian Way in the City of Pinole, as shown in Figure 1.

pin009.ai 7/21

Traffic Impact Study for the 2151 Appian Way Multi-Family Housing Project

Figure 1 – Study Area and Existing Lane Configurations

Transportation Setting

Operational Analysis

Study Area and Periods

The study area consists of the following intersections:

1. Appian Way/Mann Drive-Project Access
2. Appian Way/Tara Hills Drive-Canyon Drive

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

Appian Way/Mann Drive-Project Access is a three-legged, signalized intersection with protected left-turn phasing on the northbound Appian Way approach. There are marked crosswalks on the west and south legs. It is noted that, upon completion of the project, the project driveway would be added as an east leg of the intersection.

Appian Way/Tara Hills Drive-Canyon Drive is a four-legged, signalized intersection with protected left-turn phasing on the northbound and southbound Appian Way approaches. The eastbound and westbound approaches both have split phasing and the eastbound approach also includes right-turn overlap phasing. There are marked crosswalks on north, west, and east legs.

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

Collision History

The collision history for the study area was reviewed to determine any trends or patterns that may indicate a safety issue. Collision rates were calculated based on records available from the California Highway Patrol as published in their Statewide Integrated Traffic Records System (SWITRS) reports. The most current five-year period available is April 1, 2015, through March 31, 2020.

As presented in Table 1, the calculated collision rates for the study intersections were compared to average collision rates for similar facilities statewide, as indicated in *2016 Collision Data on California State Highways*, California Department of Transportation (Caltrans). These average rates statewide are for the signalized intersections in the urban environment with the four approaches. The collision rate for Appian Way/Mann Drive-Project access was below the statewide average while the Appian Way/Tara Hills Drive-Canyon Drive had a collision rate slightly above the statewide average. Therefore, the collision records for Appian Way/ Tara Hills Drive-Canyon Drive were further reviewed. The collision rate calculations are provided in Appendix A.

Table 1 – Collision Rates for the Study Intersections			
Study Intersection	**Number of Collisions (2015-2020)**	**Calculated Collision Rate (c/mve)**	**Statewide Average Collision Rate (c/mve)**
1. Appian Wy/Mann Dr-Project Access	2	0.06	0.24
2. Appian Wy/Tara Hills Dr-Canyon Dr	13	**0.28**	0.24

Note: c/mve = collisions per million vehicles entering; **bold** text = higher crash rate than Statewide Average

The 13 recorded collisions that occurred at Appian Way/Tara Hills Drive-Canyon Drive included six rear-end, four sideswipe, one hit-object, one broadside, and one vehicle-pedestrian collision. Five out of six rear-end collisions involved northbound motorists and had a primary collision factor of unsafe speed. Upon reviewing the field conditions, this collision trend is likely due to the topography near the intersection. The incline in the northbound direction, as well as the curvature of the road with a hillside on the inside of the curve, may obstruct the line of sight for drivers who are traveling at speeds above the posted speed limit. As such, it recommended that the City consider installing an advance warning sign stating "Prepare to Stop" that lights up when northbound drivers should prepare to stop. Alternatively, or in addition, it is suggested that the City consider the need for increased enforcement on Appian Way near Tara Hills Drive-Canyon Drive to help reduce the potential for collisions due to unsafe speeds.

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. Within the project vicinity, sidewalks are present along both sides of Appian Way and Canyon Drive as well as on surrounding streets including Mann Drive and Tara Hills Drive. Further, pedestrian crossings are available at the intersections of Appian Way/ Mann Drive and Appian Way/Tara Hills Drive-Canyon Drive, which are signalized intersections with pedestrian phasing, marked crosswalks, and curb ramps.

Bicycle Facilities

The *Highway Design Manual*, Caltrans, 2017, classifies bikeways into the following four 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.
- **Class IV Bikeway** – also known as a separated bikeway, a Class IV Bikeway is for the exclusive use of bicycles and includes a separation between the bikeway and the motor vehicle traffic lane. The separation may include, but is not limited to, grade separation, flexible posts, inflexible physical barriers, or on-street parking.

There are currently Class III bicycle routes on Appian Way near the project site, which is planned to be converted into Class II bicycle lanes between Dalessi Lane and San Pablo Avenue according to the City's *General Plan*, 2010 and *Three Corridors Specific Plan*, City of Pinole, 2010. Class II bicycle lanes are also planned on San Pablo Avenue between Dursey Drive and the East City Limits. Along all the other streets in the project area, bicyclists would ride in the roadway and/or on sidewalks.

Table 2 summarizes the existing and planned bicycle facilities in the project vicinity, as contained in the *City of Pinole General Plan*.

Table 2 – Bicycle Facility Summary

Status Facility	Class	Length (miles)	Begin Point	End Point
Existing				
Appian Wy	III	0.70	I-80	San Pablo Ave
Planned				
Appian Wy	II	1.30	Dalessi Ln	San Pablo Ave
San Pablo Ave	II	1.90	Dursey Dr	East City Limits

Sources: *City of Pinole General Plan Update*, City of Pinole, 2010.

Transit Facilities

Transit services in the City of Pinole and throughout Contra Costa County are provided by Western Contra Costa County Transit (WestCAT). WestCAT Route 16 provides fixed-route bus services in the cities of Hercules and Pinole and serves stops on both sides of Canyon Drive to the east of Appian Way, along the project frontage. The buses for Route 16 operate only on weekdays from 5:30 a.m. to 8:15 p.m. with nearly 30-minute headways.

WestCAT Route 17 also serves the project vicinity but at the time of the analysis, the Route is temporarily out of service due to the COVID-19 pandemic. Prior to the suspension, the Route provided services throughout the City and stopped on Appian Way along the project frontage.

Two bicycles can be carried on all WestCAT buses. Bike rack space is on a first-come, first-served basis.

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. WestCAT ADA Paratransit is designed to serve the needs of individuals with disabilities within the communities of Pinole and Hercules and the unincorporated communities of Montalvin Manor, Tara Hills, Bayview, Rodeo, Crockett, and Port Costa.

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 intersections were analyzed using the "Signalized" methodology published in the *Highway Capacity Manual* (HCM), Transportation Research Board, 6th Edition, 2018. This methodology is based on factors including traffic volumes, green time for each movement, phasing, whether the signals are coordinated or not, truck traffic, and pedestrian activity. Average stopped delay per vehicle in seconds is used as the basis for evaluation in this LOS methodology. For purposes of this study, delays were calculated using signal timing obtained from the City of Pinole.

Table 3 – Signalized Intersection Level of Service Criteria	
LOS A	Delay of 0 to 10 seconds. Most vehicles arrive during the green phase, so do not stop at all.
LOS B	Delay of 10 to 20 seconds. More vehicles stop than with LOS A, but many drivers still do not have to stop.
LOS C	Delay of 20 to 35 seconds. The number of vehicles stopping is significant, although many still pass through without stopping.
LOS D	Delay of 35 to 55 seconds. The influence of congestion is noticeable, and most vehicles have to stop.
LOS E	Delay of 55 to 80 seconds. Most, if not all, vehicles must stop and drivers consider the delay excessive.
LOS F	Delay of more than 80 seconds. Vehicles may wait through more than one cycle to clear the intersection.

Reference: *Highway Capacity Manual*, Transportation Research Board, 6th Edition, 2018

Traffic Operation Standards

Per the City of Pinole's Level of Service standards, the minimum desired service level for Appian Way/Mann Drive-Project Access is low LOS D and it is high LOS E for Appian Way/Tara Hills Drive-Canyon Drive. For the purposes of the analysis, a low LOS D was assumed to be an average intersection delay between 35 and 45 seconds. An intersection delay between 55 and 65 seconds was assumed to be a high LOS E. These Level of Service standards were applied to the overall intersection average delay.

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 on July 8, 2021. As the collected counts are unreliable due to the ongoing effects of the Covid-19 outbreak as well as the lack of school volumes, the traffic volume data was adjusted to reflect non-pandemic "existing" conditions. Using the collected counts as well as historical counts supplied by the City from September 2016, growth factors of 36 and 25 percent were applied to the morning and evening peaks, respectively.

Intersection Levels of Service

Under existing conditions, the study intersections operate acceptably at LOS C or better. The existing traffic volumes are shown in Figure 2. A summary of the intersection Level of Service calculations is contained in Table 4, and copies are provided in Appendix B.

Table 4 – Existing Peak Hour Intersection Levels of Service

Study Intersection *Approach*	AM Peak		PM Peak	
	Delay	LOS	Delay	LOS
1. Appian Wy/Mann Dr-Project Access	10.4	B	7.9	A
2. Appian Wy/Tara Hills Dr-Canyon Dr	34.5	C	30.1	C

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service

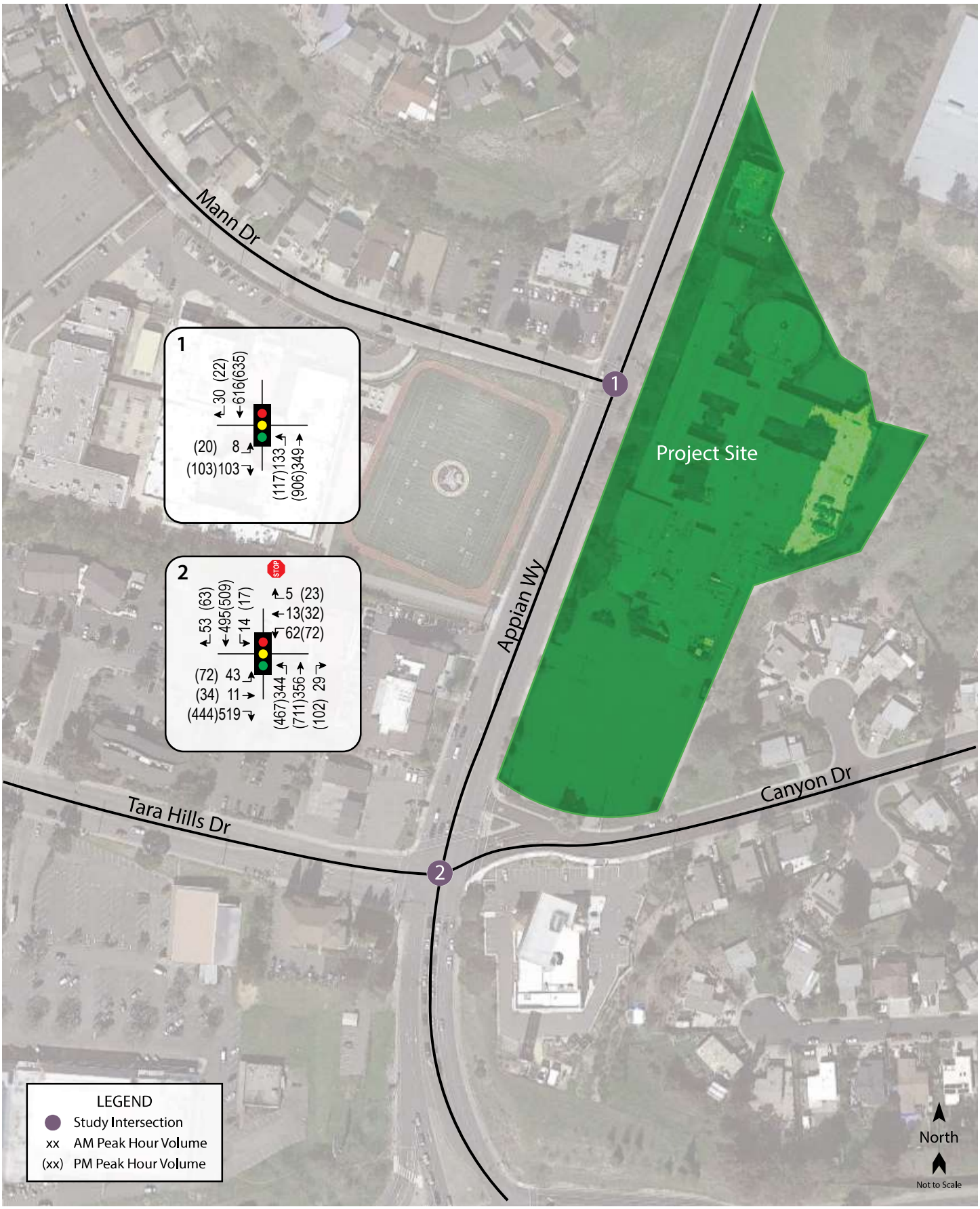
The perception a motorist has of intersection operation as represented by the Level of Service can sometimes be at odds with the calculated values. At signalized intersections drivers on a minor street may encounter longer delays than motorists traveling through on the main street. Based on their experience, these drivers are likely to perceive that the intersection operates poorly. However, because the majority of drivers traveling through the intersection encounter little or no delay, the average for all drivers may fall within an acceptable range despite some approaches or movements having fairly high delays. It is noted that for the intersection of Appian Way/Tara Hills Drive-Canyon Drive, a majority of the trips are through movements north-south together with the eastbound right-turn movement, which is programmed with the right-turn overlap for additional green time during a cycle. As these three movements carry the greatest traffic volumes but have the lowest delays, the overall average delay is substantially lower than is experienced on the minor street approaches.

Project Description

The proposed project includes 154 multi-family residential units with access points on Canyon Drive and Appian Way on a site occupied by the vacant Doctor's Medical Center Pinole Campus. The project site is located within the Appian Way Project Area as part of the City of Pinole's Three Corridors Specific Plan and has a designated residential mixed-use (RMU) land use in the northern half and commercial mixed-use (CMU) land use in the southern half of the site. It is noted that the entire site would be developed only with the proposed multi-family attached units as allowed by the Specific Plan. The proposed project site plan is shown in Figure 3.

Trip Generation

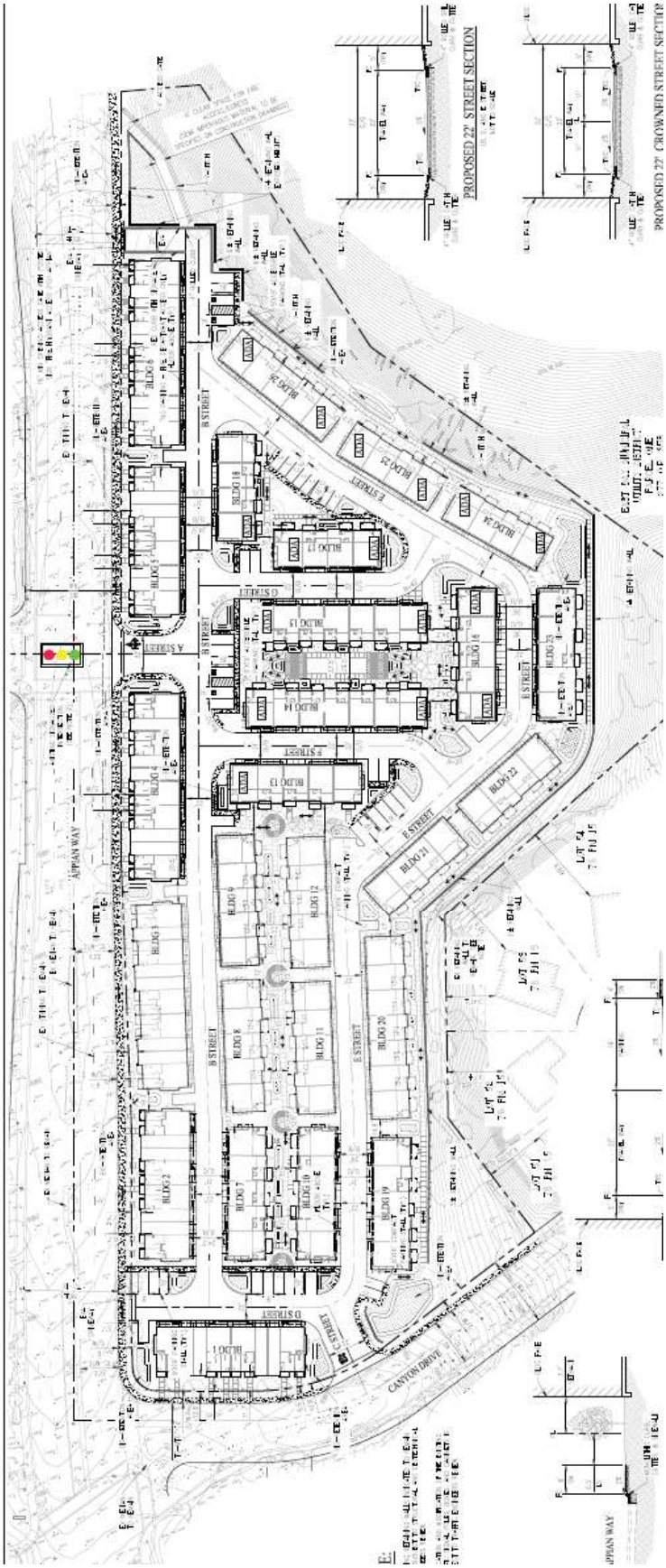
The anticipated trip generation for the project was estimated using standard rates published in the 10th Edition of the *Trip Generation Manual,* 2017 for "Multifamily Housing (Mid-Rise)" (LU #221). Since the medical offices have not been in use since 2006, no trip reduction credit was applied to the previous use. As shown in Table 5, the proposed project would be expected to generate an average of 838 trips per day, including 55 trips during the a.m. peak hour and 68 trips during the p.m. peak hour.



pin009.ai 7/21

Traffic Impact Study for the 2151 Appian Way Multi-Family Housing Project

Figure 2 – Existing Traffic Volumes



Source: cbg Civil engineers 8/9 pin009.ai 7/21

Traffic Impact Study for the 2151 Appian Way Multi-Family Housing Project

Figure 3 – Site Plan

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**
Proposed											
Multifamily Housing	154 du	5.44	838	0.36	55	14	41	0.44	68	41	27

Note: du = dwelling unit

Trip Distribution

The pattern used to allocate new project trips to the street network was based on census data from 2000 as well as knowledge of the area and the surrounding region. The distribution applied includes 85 percent of trips assigned to/from the south on Appian Way where there are access points to I-80. The remaining 15 percent were assigned to/from the north on Appian Way.

Intersection Operation

Existing plus Project Conditions

Upon the addition of project-related traffic to the existing volumes, the study intersections are expected to operate acceptably at LOS C or better. It is noted that Appian Way/Mann Drive-Project Access was evaluated as a four-legged intersection as the project driveway is planned to become an east leg. With the addition of the east leg, it was assumed that both eastbound and westbound would have split phasing while the southbound approach would be modified to include protected left-turn phasing. No changes to the phasing or lane geometry for the northbound approach were assumed. These results are summarized in Table 6. Project traffic volumes are shown in Figure 4. Existing plus Project traffic volumes are shown in Figure 5.

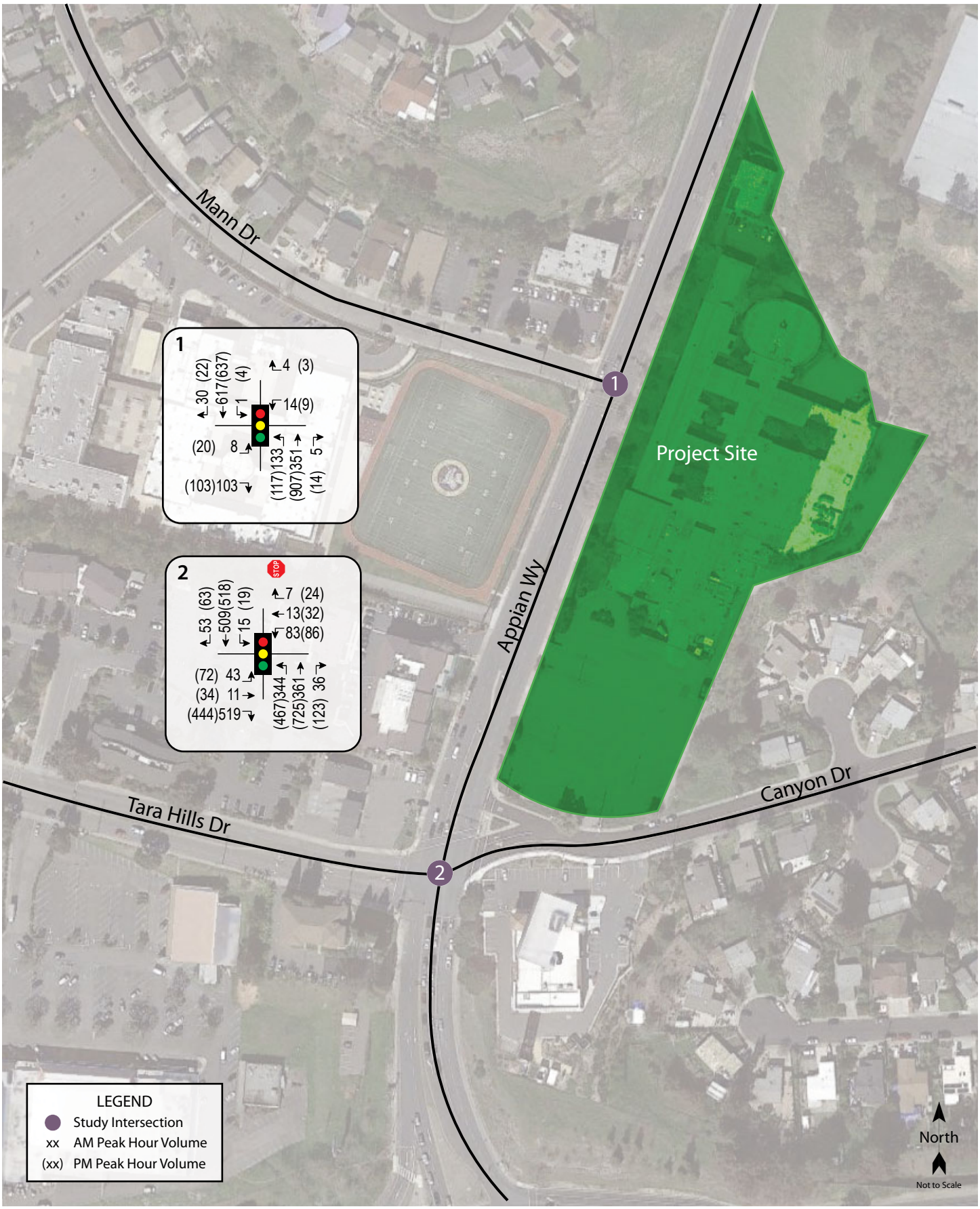
Table 6 – Existing and Existing plus Project Peak Hour Intersection Levels of Service								
Study Intersection ***Approach***	**Existing Conditions**				**Existing plus Project**			
	AM Peak		**PM Peak**		**AM Peak**		**PM Peak**	
	Delay	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**
1. Appian Wy/Mann Dr-Project Access	10.4	B	7.9	A	14.8	B	11.2	B
2. Appian Wy/Tara Hills Dr-Canyon Dr	34.5	C	30.1	C	34.6	C	30.2	C

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service

pin009.ai 7/21

Traffic Impact Study for the 2151 Appian Way Multi-Family Housing Project

Figure 4 – Project Traffic Volumes



pin009.ai 7/21

Traffic Impact Study for the 2151 Appian Way Multi-Family Housing Project

Figure 5 – Existing Plus Project Traffic Volumes

W-Trans

Consistency with Three Corridors Specific Plan

The proposed project was evaluated for consistency with the *Three Corridors Specific Plan,* City of Pinole, 2010. As noted in the Project Description, the project site is designated with a commercial mixed use (CMU) land use in the northern half and residential mixed use (RMU) land use in the southern half. While the RMU land use allows solely residential development, the CMU land use allows up to 100 percent residential development with an affordable housing agreement. Accordingly, 15 percent of the proposed apartment units are planned to be affordable housing units per agreement with the City. The proposed project is therefore permitted for both CMU and RMU land uses.

Additionally, the *Specific Plan* identifies the following improvements on Appian Way in the project vicinity.

- **Between Marlesta Road and Mann Drive**: Improve the roadway to include a five-foot bicycle lane and two 11-foot travel lanes in each direction with a median/turn lane.
- **Between Mann Drive and Dalessi Lane**: Improve the roadway to include a five- to six-foot bicycle lane and two 11-foot travel lanes in each direction with a median/turn lane.

Under Existing plus Project Conditions, it was assumed that the southbound approach at Appian Way/Mann Drive would be modified include a southbound left-turn lane. It is noted that there are currently two travel lanes in each direction with a median on the north leg of the intersection. Per the *Specific Plan,* Appian Way along the project would have 11-foot travel lanes, bike lanes, and a median. It is understood that from curb to curb, Appian Way is 65 feet wide north of the Appian Way/Mann Drive intersection. With five-foot bike lanes, the remaining width would be adequate for 11-foot travel lanes, including the proposed southbound left-turn lane. Since the proposed project complies with the zoning in the *Specific Plan* and the project does not conflict with the plans for bicycle lanes on Appian Way, it is reasonable to conclude that the project is consistent with the *Three Corridors Specific Plan*.

For the project to pay its proportional contribution towards the improvements listed in the *Specific Plan*, the project may be subject to the City's development impact fees as well as the development fee for the West County Subregional Transportation Mitigation Program (STMP). It is recommended that the project applicant make a fair share contribution towards multi-modal improvements identified by the *Three Corridors Specific Plan* based on the funding mechanism established by the City.

Finding – The project description as well as the operational analysis assumptions are consistent with the *Three Corridors Specific Plan*.

Recommendation – It is recommended that the project applicant make a fair share contribution towards the implementation of the multi-modal improvements identified in the *Three Corridors Specific Plan* as established by the City.

Vehicle Miles Traveled (VMT)

Senate Bill (SB) 743 established a change in the metric to be applied for determining traffic impacts associated with development projects. Rather than the delay-based criteria associated with a Level of Service analysis, the increase in Vehicle Miles Traveled (VMT) as a result of a project is now the basis for determining impacts. As of the date of this analysis, the City of Pinole has not yet established thresholds of significance related to VMT. As a result, the project-related VMT impacts were assessed based on guidance provided by the California Governor's Office of Planning and Research (OPR) in the publication *Transportation Impacts (SB 743) CEQA Guidelines Update and Technical Advisory*, 2018. The document indicates that a residential project generating vehicle travel that is 15 or more percent below the existing countywide residential VMT per capita may indicate a less than significant VMT impact.

Based on data from Contra Costa Transportation Authority (CCTA) 2020 travel demand model, the County of Contra Costa has a baseline average residential VMT of 17.3 miles per capita. Applying OPR's guidance, a residential project generating a VMT that is 15 percent or more below this value, or 14.7 miles per capita, would have a less-than-significant VMT impact. The CCTA model includes traffic analysis zones (TAZ) covering geographic areas throughout Contra Costa County. The project site is located within TAZ 10234, which has a baseline VMT per capita of 13.6 miles, which is less than the VMT screening threshold of 14.7. Therefore, the proposed project would be expected to result in a less-than-significant VMT impact.

Finding – The project would be expected to have a less-than-significant transportation impact on vehicle miles traveled.

Alternative Modes

Pedestrian Facilities

Given the proximity to surrounding commercial uses as well as Pinole Middle School, it is reasonable to assume that residents will want to walk and/or use transit to and from the project site. There are connected sidewalks along the project frontages on Appian Way and Canyon Drive as well as on cross streets including Mann Drive and Tara Hills Drive. Further, marked crosswalks with pedestrian signal facilities are available on Appian Way/Mann Drive-Project Access and Appian Way/Tara Hills Drive-Canyon Drive. As a result, the existing network of sidewalks and crosswalks provides adequate access for pedestrians.

Consideration was also given to pedestrians crossing on Appian Way at Mann Drive-Project Access as the project driveway would become an east leg. As the intersection crosswalks would be expected to be used by project residents as well as students attending Pinole Middle School, split phasing is recommended in the east-west direction. With split phasing, the left-turning movements would be separated from the pedestrian phase and oncoming through traffic. While permitted left-turn phasing east-west was considered and would result in lower average vehicular delay, it is not recommended given the conflict between east-west left-turning drivers and the pedestrians in the crosswalks, especially given that drivers on Mann Drive do not currently have any conflicting traffic to deal with, so would be surprised if they had to yield to oncoming traffic from the new leg.

Finding – Existing pedestrian facilities serving the project site are adequate but with the addition of the east leg for the project drive, there is a potential for pedestrian and vehicular conflicts.

Recommendation – Upon construction of the project driveway on Appian Way, it is recommended that split phasing in the eastbound and westbound directions of Mann Drive-Project Access be implemented to prevent conflicts between left-turning drivers and both oncoming through vehicles and pedestrians crossing the intersection.

Bicycle Facilities

There is a Class III bicycle route on Appian Way along project frontage, which is planned to be converted to Class II bicycle lanes. Upon construction of the planned bicycle lanes on Appian Way, as well as on San Pablo Avenue, and with shared use of minor streets in the project vicinity, there would be adequate access for bicyclists to and from the project site.

Bicycle Storage

The required bicycle parking supply was calculated to ensure adequacy under City requirements. Section 17.48.120 of City of Pinole Code requires multi-family residential uses to provide bicycle parking at a rate of one space for every four units. Based on this ratio, 39 bicycle parking spaces are required. Bicycle parking is available within the garages of each dwelling unit. At least one bicycle may be stored within each garage providing for a minimum of 154 bicycle parking spaces which would exceed the City Code requirement.

Finding – The number of bicycle parking spaces provided by the project is adequate.

Transit

WestCAT Route 16 is adequate to accommodate project-generated transit trips and nearby stops are within an acceptable walking distance of the project site. It is noted that the transit service would improve upon the end of the temporary suspension of Route 17.

Finding – Transit facilities serving the project site are adequate and would improve once WestCAT Route 17 starts operating again.

Access and Circulation

Site Access

The project would be accessed via driveways on Appian Way and Canyon Drive. The proposed Appian Way driveway would be the east leg of the Appian Way/Mann Drive intersection, resulting in a four-legged signalized intersection. Additionally, while there is an existing driveway on Canyon Drive, the proposed project driveway would be relocated several feet to the east. Along the project frontage, Appian Way has a posted speed limit of 35 miles per hour (mph), which is reduced to the speed limit of 25 mph while the nearby Pinole Middle School is in session. Canyon Road has a posted speed limit of 25 mph and has one lane in each direction.

Since the proposed project would occupy a previously developed site, consideration was also given to the existing driveways that would no longer be in use with the project. On Appian Way along the project frontage there is a southbound left-turn pocket nearly 350 feet south of Appian Way/Mann Drive-Project Access that was previously used for the medical facilities. Since the driveway would be removed with the project, it is recommended that the applicant work with the City to remove this southbound left-turn lane by either restriping this section or through the installation of a median.

Finding – With the proposed project, one of the existing driveways and access turn lanes to access the site would no longer be needed.

Recommendation – It is recommended that the applicant work with the City to restripe Appian Way along the project frontage to eliminate the left-turn pocket located approximately 350 feet south of Appian Way/Mann Drive-Project Access as the receiving driveway would be removed with the project.

Sight Distance

Sight distances along Appian Way as well as Canyon Drive at project driveways were evaluated based on sight distance criteria contained in the *Highway Design Manual* published by Caltrans. The recommended sight distance at intersections of public streets is based on corner sight distances, while recommended sight distances for minor street approaches that are either a private road or a driveway are based on stopping sight distance. Both use the approach travel speeds as the basis for determining the recommended sight distance. Additionally, the stopping sight distance needed for the following driver to stop if there is a vehicle waiting to turn into a side street or driveway is evaluated based on the stopping sight distance criterion and the approach speed on the major street.

For the posted speed limit of 35 mph for Appian Way, the minimum stopping sight distance needed is 250 feet and the corner sight distance is 385 feet. Based on the review of field condition, sight lines to and from the project driveway on Appian Way extend more than 400 feet in each direction, which is more than adequate for the posted speed limit, especially given that the driveway would be part of a signalized intersection.

For the speed limit of 25 mph on Canyon Drive, 150 feet of stopping sight distance is needed. The sight lines to the west of the project driveway on Canyon Drive are more than 150 feet; however, the sight line to the east was measured to be only 45 feet due to location of the driveway at the crest of a steep hill, its location on the inside of a horizontal curve, and on-street parking on the north side of Canyon Drive. The recommended 150-foot line of sight to the east can be achieved if on-street parking is prohibited between the project driveway and approximately 150 feet to the east, provided that vegetation is also maintained. Given the location of the driveway near the crest of the steep incline and on the inside of a horizontal curve, vegetation east of the driveway has the potential to obstruct sight lines. It is noted that the existing vegetation was observed to be about one foot in height and does not obstruct the line of sight; however, vegetation only slightly taller would partially or fully restrict the line of sight. It is therefore recommended that the vegetation east of the driveway be trimmed and

maintained to be no more than about one foot tall, or no higher than the existing landscaping, to maintain adequate sight lines.

Additionally, due to the straight and flat roadway geometry of Appian Way, adequate stopping sight distance is available for a following driver to notice and react to a preceding motorist slowing to either enter the project site via northbound right turn or the southbound left-turn lane at the signalized intersection. Similarly, there is adequate stopping distance on Canyon Drive for a following driver to notice and react to the preceding driver slowing to turn right or left into the project driveway.

Finding – Adequate sight distances are available on Appian Way at the project driveway. While there are adequate sight lines to the west on Canyon Drive at the project driveway, the sight lines to the east were measured to be less than the minimum stopping sight distance due to on-street parking and horizontal and vertical curves.

Recommendation – On-street parking on Canyon Drive should be prohibited from the project driveway to nearly 150 feet east. Further, vegetation on the east side of the driveway on Canyon Drive should also be trimmed or maintained as very low-lying vegetation of about one foot in height.

Emergency Access

Given that the proposed parking lot design would meet the City design criteria, including the width of the drive aisle and turning radii, as well as receive feedback from the Fire District, the proposed project is not expected to impede emergency vehicle access.

Finding – Site access and on-site circulation would be expected to function acceptably for emergency response vehicles.

Turn Lane Warrant

The need for a left-turn lane on Canyon Drive at the proposed project 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 an update of the methodology developed by the Washington State Department of Transportation and published in the *Method For Prioritizing Intersection Improvements*, January 1997. The NCHRP report references a methodology developed by M. D. Harmelink that includes equations that can be applied to expected or actual traffic volumes to determine the need for a left-turn pocket based on safety issues.

Based on Existing plus Project p.m. peak hour volumes, a left-turn lane is not warranted on Canyon Drive at the project driveway during the critical peak period evaluated. Copies of the warrant spreadsheets are provided in Appendix C.

Finding – A left-turn lane is not warranted on Canyon Drive at proposed project driveway based on volumes during the critical peak period evaluated.

Transportation Demand Management (TDM)

The following section describes a few examples of available Transportation Demand Management (TDM) features available to residents and guests traveling to the proposed project. While the project's potential impact is expected to be less than significant, these TDM measures would encourage use of non-vehicular travel and reduced use of private automobiles for basic transportation.

Transit

Convenient access to transit encourages reduced travel by private automobiles. Bus stops accessing the WestCAT bus service are located within 100 feet of the project site along Canyon Drive. Upon the return of service for WestCAT Route 17, additional bus stops will be available along Appian Way with the nearest stop location less than 100 feet from the project site.

Bicycle and Pedestrian Improvements

Bicycle and Pedestrian infrastructure that promotes a safe walking or riding environment can help reduce vehicle travel. The project will include paved walking paths between each building and the existing sidewalks on Canyon Drive and Appian Way. According to the City's *General Plan* and the *Three Corridors Specific Plan*, Class II bike lanes are planned along the segments of Appian Way and San Pablo Avenue within the immediate vicinity of the project site. Furthermore, several amenities (including the Pinole Middle School, CVS Pharmacy, and the Appian 80 Shopping Center) are located within 1,000 feet of the project and can be accessed via the existing sidewalk network.

Electric Vehicle Charging Stations

While the provision of dedicated parking for Electric Vehicles (EVs) and charging stations does not result in trip or VMT reductions, they do encourage and incentivize the use of electric vehicles which in turn reduces the total greenhouse gas (GHG) emissions of a project.

Parking

The project was analyzed to determine whether the proposed parking supply would be sufficient to satisfy the City Code requirements. The project site as proposed would provide a total of 354 parking spaces comprised of two covered spaces at each dwelling unit, as well as 46 guest spaces located throughout the development.

The City of Pinole parking supply requirements stipulate that 354 spaces are required for this project. This requirement is based on the *City of Pinole Municipal Code, Chapter 17.48.050; Number of Parking Spaces Required* which states that 2 assigned spaces and 0.3 visitor parking spaces are required for each dwelling unit for multi-family developments consisting of two or more bedrooms per unit.

The proposed parking supply of 354 spaces is equal to the number of required spaces as described in the City Code.

Finding – The number of parking spaces provided by the project is adequate.

Conclusions and Recommendations

Conclusions

- The project would be expected to generate an average of 838 daily trips including 55 trips during the a.m. peak hour and 68 p.m. peak hour trips.
- With the addition of the project trips, the study intersections are expected to operate acceptably at LOS C or better.
- The project description and the assumptions for the operational analysis are consistent with the *Three Corridors Specific Plan*.
- The project would be expected to have a less-than-significant impact on VMT per OPR guidelines.
- Existing pedestrian facilities would provide adequate access for project residents. However, there may be conflicts between pedestrian and vehicular traffic upon the addition of the project driveway as a new east leg to the intersection of Appian Way/Mann Drive-Project Access.
- The existing transit facilities are adequate to serve the project site and service would improve once service on WestCAT Route 17 resumes.
- Bicycle facilities would be adequate upon completion of the planned bicycle projects in the project vicinity. The number of bicycle parking spots provided is sufficient to satisfy City code requirements.
- The existing left-turn lane pocket and a driveway on Appian Way would no longer be needed with the proposed project.
- Although adequate sight lines are available on Appian Way at the project driveway, sight lines to the east on Canyon Drive at the project driveway are shorter than the minimum stopping sight distance due to location of the driveway on the inside of a horizontal and near the crest of a very steep incline, as well as the presence of on-street parking. Adequate sight lines are available to the west on Canyon Drive from the project driveway.
- The proposed parking lot and on-site circulation would be expected to function acceptably for emergency response vehicles.
- A left-turn lane is not warranted on Canyon Drive at the project driveway based on volumes during the critical peak period evaluated.
- The project would be located within an area with access to transit and an existing sidewalk network which potentially reduces travel by private automobile.
- The number of parking spaces provided by the project would satisfy City requirements.

Recommendations

- It is recommended that the project applicant make a fair share contribution towards the multi-modal improvements identified in the *Three Corridors Specific Plan* if required by the City.

- To prevent conflicts between the left-turning motorists and either pedestrians or opposing through traffic, it is recommended that split phasing be implemented on the westbound and eastbound approaches to the Appian Way/Mann Drive-Project Access intersection as part of the project.

- It is suggested that the City restripe Appian Way along the project frontage to remove the left-turn pocket located about 350 feet south of Appian Way/Mann Drive-Project Access as the receiving driveway would be eliminated as part of the proposed project.

- On-street parking on the north side of Canyon Drive should be restricted from the project driveway to 150 feet east to provide adequate sight lines for motorists exiting the driveway. The vegetation surrounding the driveway should also be trimmed to be no more than one foot tall to ensure that adequate sight lines are retained.

Study Participants and References

Study Participants

Principal in Charge	Mark E. Spencer, TE
Associate Engineer	Briana Byrne, TE
Assistant Planner	Jade Kim
Graphics	Cameron Wong
Editing/Formatting	Hannah Yung-Boxdell
Quality Control	Dalene J. Whitlock, PE, PTOE

References

2016 Collision Data on California State Highways, California Department of Transportation, 2018
California Legislative Information, leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB35
City of Pinole, California Code of Ordinances, American Legal Publishing Corporation, 2020
City of Pinole General Plan Update, City of Pinole, 2010
Contra Costa Transportation Authority Travel Demand Model, https://ccta.net/projects/travel-demand-model/
Highway Capacity Manual, 6th Edition, Transportation Research Board, 2018
Highway Design Manual, 6th Edition, California Department of Transportation, 2017
Intersection Channelization Design Guide, National Cooperative Highway Research Program (NCHRP) Report No. 279, Transportation Research Board, 1985
Method for Prioritizing Intersection Improvements, Washington State Transportation Center, 1997
Statewide Integrated Traffic Records System (SWITRS), California Highway Patrol, 2015-2020
Technical Advisory on Evaluating Transportation Impacts in CEQA, Governor's Office of Planning and Research, 2018
Three Corridors Specific Plan, City of Pinole, December 2010
Trip Generation Manual, 10th Edition, Institute of Transportation Engineers, 2017
WestCAT Transit, https://www.westcat.org/home/index

PIN009

Table of Contents

This page intentionally left blank

Appendix A

Collision Rate Calculations

This page intentionally left blank

Intersection Collision Rate Worksheet

raffic Study for the 2151 Appian Way Multi-Family Housing Project

Intersection # 1: Appian Way & Mann Drive
Date of Count: Saturday, January 0, 1900

Number of Collisions: 2
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 18000
Start Date: April 1, 2015
End Date: March 31, 2020
Number of Years: 5

Intersection Type: Four-Legged
Control Type: Signals
Area: Urban

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{2 \times 1{,}000{,}000}{18{,}000 \times 365 \times 5}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.06 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.24 c/mve**	**0.5%**	**44.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection # 2: Appian Way & Tara Hills Drive-Canyon Dr
Date of Count: Saturday, January 0, 1900

Number of Collisions: 13
Number of Injuries: 4
Number of Fatalities: 0
Average Daily Traffic (ADT): 25500
Start Date: April 1, 2015
End Date: March 31, 2020
Number of Years: 5

Intersection Type: Four-Legged
Control Type: Signals
Area: Urban

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{13 \times 1{,}000{,}000}{25{,}500 \times 365 \times 5}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.28 c/mve**	**0.0%**	**30.8%**
Statewide Average*	**0.24 c/mve**	**0.5%**	**44.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection Collision Rate Worksheet

raffic Study for the 2151 Appian Way Multi-Family Housing Project

Intersection # 3: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection # 4: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: No Controls
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection Collision Rate Worksheet

raffic Study for the 2151 Appian Way Multi-Family Housing Project

Intersection # 5: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: No Controls
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection # 6: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection Collision Rate Worksheet

raffic Study for the 2151 Appian Way Multi-Family Housing Project

Intersection # 7: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection # 8: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection Collision Rate Worksheet

raffic Study for the 2151 Appian Way Multi-Family Housing Project

Intersection # 9: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection # 10: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection Collision Rate Worksheet

raffic Study for the 2151 Appian Way Multi-Family Housing Project

Intersection # 11: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection # 12: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection Collision Rate Worksheet

raffic Study for the 2151 Appian Way Multi-Family Housing Project

Intersection # 13: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection # 14: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection Collision Rate Worksheet

raffic Study for the 2151 Appian Way Multi-Family Housing Project

Intersection # 15: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection # 16: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection Collision Rate Worksheet

raffic Study for the 2151 Appian Way Multi-Family Housing Project

Intersection # 17: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection # 18: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection Collision Rate Worksheet

raffic Study for the 2151 Appian Way Multi-Family Housing Project

Intersection # 19: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Intersection # 20: &

Date of Count: Saturday, January 0, 1900

Number of Collisions: 0
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 0
Start Date: January 0, 1900
End Date: January 0, 1900
Number of Years: 0

Intersection Type: 0
Control Type: 0
Area: 0

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{0 \times 1{,}000{,}000}{0 \times 365 \times 0}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.00 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.22 c/mve**	**1.0%**	**34.6%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2016 Collision Data on California State Highways, Caltrans

Appendix B

Intersection Level of Service Calculations

This page intentionally left blank

HCM 6th Signalized Intersection Summary
1: Appian Wy & Mann Dr

08/05/2021

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	8	103	133	349	616	30
Future Volume (veh/h)	8	103	133	349	616	30
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	9	112	145	379	670	33
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	12	144	196	2387	1622	80
Arrive On Green	0.10	0.10	0.11	0.67	0.47	0.47
Sat Flow, veh/h	118	1469	1781	3647	3541	170
Grp Volume(v), veh/h	122	0	145	379	345	358
Grp Sat Flow(s),veh/h/ln	1600	0	1781	1777	1777	1840
Q Serve(g_s), s	3.3	0.0	3.5	1.7	5.6	5.6
Cycle Q Clear(g_c), s	3.3	0.0	3.5	1.7	5.6	5.6
Prop In Lane	0.07	0.92	1.00			0.09
Lane Grp Cap(c), veh/h	157	0	196	2387	836	866
V/C Ratio(X)	0.78	0.00	0.74	0.16	0.41	0.41
Avail Cap(c_a), veh/h	874	0	1216	3721	1860	1926
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.3	0.0	18.9	2.6	7.6	7.6
Incr Delay (d2), s/veh	7.9	0.0	5.3	0.1	1.2	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.0	1.5	0.3	1.8	1.9
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	27.2	0.0	24.3	2.8	8.8	8.8
LnGrp LOS	C	A	C	A	A	A
Approach Vol, veh/h	122			524	703	
Approach Delay, s/veh	27.2			8.7	8.8	
Approach LOS	C			A	A	
Timer - Assigned Phs	1	2		4		6
Phs Duration (G+Y+Rc), s	8.8	25.8		9.3		34.6
Change Period (Y+Rc), s	4.0	5.1		5.0		5.1
Max Green Setting (Gmax), s	30.0	46.0		24.0		46.0
Max Q Clear Time (g_c+I1), s	5.5	7.6		5.3		3.7
Green Ext Time (p_c), s	0.4	13.1		0.3		6.9

Intersection Summary	
HCM 6th Ctrl Delay	10.4
HCM 6th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
User approved ignoring U-Turning movement.

HCM 6th Signalized Intersection Summary
2: Appian Wy & Tara Hills Dr/Canyon Dr

08/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	43	11	519	62	13	5	344	356	29	14	495	53
Future Volume (veh/h)	43	11	519	62	13	5	344	356	29	14	495	53
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	47	12	564	67	14	0	374	387	32	15	538	58
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	171	44	687	194	193		439	1959	161	53	1747	779
Arrive On Green	0.12	0.12	0.12	0.11	0.11	0.00	0.13	0.59	0.59	0.03	0.49	0.49
Sat Flow, veh/h	1433	366	2790	1781	1777	1585	3456	3324	274	1781	3554	1585
Grp Volume(v), veh/h	59	0	564	67	14	0	374	206	213	15	538	58
Grp Sat Flow(s),veh/h/ln	1799	0	1395	1781	1777	1585	1728	1777	1821	1781	1777	1585
Q Serve(g_s), s	3.6	0.0	14.3	4.2	0.8	0.0	12.7	6.5	6.5	1.0	10.9	2.3
Cycle Q Clear(g_c), s	3.6	0.0	14.3	4.2	0.8	0.0	12.7	6.5	6.5	1.0	10.9	2.3
Prop In Lane	0.80		1.00	1.00		1.00	1.00		0.15	1.00		1.00
Lane Grp Cap(c), veh/h	214	0	687	194	193		439	1047	1073	53	1747	779
V/C Ratio(X)	0.28	0.00	0.82	0.35	0.07		0.85	0.20	0.20	0.29	0.31	0.07
Avail Cap(c_a), veh/h	214	0	687	496	495		691	1047	1073	134	1747	779
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	0.93	0.93	0.93
Uniform Delay (d), s/veh	48.1	0.0	42.7	49.5	48.0	0.0	51.3	11.5	11.5	57.0	18.3	16.1
Incr Delay (d2), s/veh	0.5	0.0	7.7	0.4	0.1	0.0	3.5	0.4	0.4	1.0	0.4	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	0.0	8.6	1.9	0.4	0.0	5.7	2.6	2.7	0.5	4.6	0.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	48.6	0.0	50.4	49.9	48.1	0.0	54.8	11.9	11.9	58.0	18.7	16.3
LnGrp LOS	D	A	D	D	D		D	B	B	E	B	B
Approach Vol, veh/h		623			81	A		793			611	
Approach Delay, s/veh		50.2			49.6			32.1			19.4	
Approach LOS		D			D			C			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.5	75.8		19.0	19.3	64.1		17.7				
Change Period (Y+Rc), s	4.0	5.1		*4.7	4.0	5.1		4.6				
Max Green Setting (Gmax), s	9.0	44.9		* 14	24.0	29.9		33.4				
Max Q Clear Time (g_c+I1), s	3.0	8.5		16.3	14.7	12.9		6.2				
Green Ext Time (p_c), s	0.0	4.6		0.0	0.5	3.5		0.2				

Intersection Summary	
HCM 6th Ctrl Delay	34.5
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
1: Appian Wy & Mann Dr

08/05/2021

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	20	103	117	906	635	22
Future Volume (veh/h)	20	103	117	906	635	22
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	22	112	127	985	690	24
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	28	142	161	2665	2110	73
Arrive On Green	0.11	0.11	0.18	1.00	0.60	0.60
Sat Flow, veh/h	263	1341	1781	3647	3597	122
Grp Volume(v), veh/h	135	0	127	985	350	364
Grp Sat Flow(s),veh/h/ln	1616	0	1781	1777	1777	1848
Q Serve(g_s), s	5.7	0.0	4.8	0.0	6.8	6.8
Cycle Q Clear(g_c), s	5.7	0.0	4.8	0.0	6.8	6.8
Prop In Lane	0.16	0.83	1.00			0.07
Lane Grp Cap(c), veh/h	171	0	161	2665	1070	1113
V/C Ratio(X)	0.79	0.00	0.79	0.37	0.33	0.33
Avail Cap(c_a), veh/h	462	0	331	2665	1070	1113
HCM Platoon Ratio	1.00	1.00	2.00	2.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.91	0.91	1.00	1.00
Uniform Delay (d), s/veh	30.5	0.0	28.0	0.0	6.9	6.9
Incr Delay (d2), s/veh	7.9	0.0	7.6	0.4	0.8	0.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	0.0	2.1	0.1	2.4	2.4
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	38.4	0.0	35.6	0.4	7.7	7.7
LnGrp LOS	D	A	D	A	A	A
Approach Vol, veh/h	135			1112	714	
Approach Delay, s/veh	38.4			4.4	7.7	
Approach LOS	D			A	A	
Timer - Assigned Phs	1	2		4		6
Phs Duration (G+Y+Rc), s	10.3	47.3		12.4		57.6
Change Period (Y+Rc), s	4.0	5.1		5.0		5.1
Max Green Setting (Gmax), s	13.0	22.9		20.0		39.9
Max Q Clear Time (g_c+I1), s	6.8	8.8		7.7		2.0
Green Ext Time (p_c), s	0.1	7.5		0.3		20.4

Intersection Summary	
HCM 6th Ctrl Delay	7.9
HCM 6th LOS	A

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
User approved ignoring U-Turning movement.

HCM 6th Signalized Intersection Summary
2: Appian Wy & Tara Hills Dr/Canyon Dr

08/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	72	34	444	72	32	23	467	711	102	17	509	63
Future Volume (veh/h)	72	34	444	72	32	23	467	711	102	17	509	63
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	78	37	483	78	35	0	508	773	111	18	553	68
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	178	84	864	176	175		569	1848	265	58	1635	729
Arrive On Green	0.14	0.14	0.14	0.10	0.10	0.00	0.16	0.59	0.59	0.06	0.92	0.92
Sat Flow, veh/h	1227	582	2790	1781	1777	1585	3456	3119	448	1781	3554	1585
Grp Volume(v), veh/h	115	0	483	78	35	0	508	440	444	18	553	68
Grp Sat Flow(s),veh/h/ln	1809	0	1395	1781	1777	1585	1728	1777	1790	1781	1777	1585
Q Serve(g_s), s	8.1	0.0	20.2	5.8	2.5	0.0	20.2	18.8	18.8	1.4	2.5	0.5
Cycle Q Clear(g_c), s	8.1	0.0	20.2	5.8	2.5	0.0	20.2	18.8	18.8	1.4	2.5	0.5
Prop In Lane	0.68		1.00	1.00		1.00	1.00		0.25	1.00		1.00
Lane Grp Cap(c), veh/h	262	0	864	176	175		569	1053	1060	58	1635	729
V/C Ratio(X)	0.44	0.00	0.56	0.44	0.20		0.89	0.42	0.42	0.31	0.34	0.09
Avail Cap(c_a), veh/h	262	0	864	425	424		913	1053	1060	115	1635	729
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	0.95	0.95	0.95
Uniform Delay (d), s/veh	54.6	0.0	40.3	59.5	58.0	0.0	57.3	15.5	15.5	64.0	3.1	3.0
Incr Delay (d2), s/veh	0.9	0.0	0.7	0.7	0.2	0.0	4.4	1.2	1.2	1.1	0.5	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.8	0.0	7.1	2.7	1.2	0.0	9.2	7.9	8.0	0.6	0.9	0.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	55.5	0.0	41.0	60.1	58.2	0.0	61.7	16.7	16.7	65.1	3.7	3.3
LnGrp LOS	E	A	D	E	E		E	B	B	E	A	A
Approach Vol, veh/h		598			113	A		1392			639	
Approach Delay, s/veh		43.8			59.5			33.1			5.3	
Approach LOS		D			E			C			A	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.5	88.0		25.0	27.1	69.5		18.4				
Change Period (Y+Rc), s	4.0	5.1		*4.7	4.0	5.1		4.6				
Max Green Setting (Gmax), s	9.0	58.9		* 20	37.0	30.9		33.4				
Max Q Clear Time (g_c+I1), s	3.4	20.8		22.2	22.2	4.5		7.8				
Green Ext Time (p_c), s	0.0	11.9		0.0	0.9	4.2		0.4				

Intersection Summary	
HCM 6th Ctrl Delay	30.1
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
1: Appian Wy & Mann Dr/Project Access

08/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	8	0	103	14	0	4	133	351	5	1	617	30
Future Volume (veh/h)	8	0	103	14	0	4	133	351	5	1	617	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	9	0	112	15	0	4	145	382	5	1	671	33
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	12	0	148	32	0	8	193	1856	24	3	1445	71
Arrive On Green	0.10	0.00	0.10	0.02	0.00	0.02	0.11	0.52	0.52	0.00	0.42	0.42
Sat Flow, veh/h	119	0	1479	1371	0	365	1781	3592	47	1781	3447	169
Grp Volume(v), veh/h	121	0	0	19	0	0	145	189	198	1	346	358
Grp Sat Flow(s),veh/h/ln	1598	0	0	1736	0	0	1781	1777	1862	1781	1777	1840
Q Serve(g_s), s	3.9	0.0	0.0	0.6	0.0	0.0	4.2	3.1	3.1	0.0	7.5	7.5
Cycle Q Clear(g_c), s	3.9	0.0	0.0	0.6	0.0	0.0	4.2	3.1	3.1	0.0	7.5	7.5
Prop In Lane	0.07		0.93	0.79		0.21	1.00		0.03	1.00		0.09
Lane Grp Cap(c), veh/h	160	0	0	40	0	0	193	918	962	3	745	771
V/C Ratio(X)	0.76	0.00	0.00	0.48	0.00	0.00	0.75	0.21	0.21	0.30	0.46	0.46
Avail Cap(c_a), veh/h	570	0	0	245	0	0	770	2070	2169	218	1535	1590
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	23.3	0.0	0.0	25.7	0.0	0.0	23.0	7.0	7.0	26.5	11.2	11.2
Incr Delay (d2), s/veh	7.1	0.0	0.0	8.5	0.0	0.0	5.8	0.4	0.4	43.5	1.6	1.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.7	0.0	0.0	0.3	0.0	0.0	1.9	1.0	1.0	0.1	2.8	2.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.4	0.0	0.0	34.2	0.0	0.0	28.8	7.4	7.3	70.1	12.8	12.7
LnGrp LOS	C	A	A	C	A	A	C	A	A	E	B	B
Approach Vol, veh/h		121			19			532			705	
Approach Delay, s/veh		30.4			34.2			13.2			12.8	
Approach LOS		C			C			B			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.8	27.4		10.3	4.6	32.6		5.7				
Change Period (Y+Rc), s	4.0	5.1		5.0	4.5	5.1		4.5				
Max Green Setting (Gmax), s	23.0	46.0		19.0	6.5	62.0		7.5				
Max Q Clear Time (g_c+I1), s	6.2	9.5		5.9	2.0	5.1		2.6				
Green Ext Time (p_c), s	0.3	12.8		0.5	0.0	6.9		0.0				

Intersection Summary	
HCM 6th Ctrl Delay	14.8
HCM 6th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.
User approved ignoring U-Turning movement.

HCM 6th Signalized Intersection Summary
2: Appian Wy & Tara Hills Dr/Canyon Dr

08/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	43	11	519	83	13	7	344	361	36	15	509	53
Future Volume (veh/h)	43	11	519	83	13	7	344	361	36	15	509	53
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	47	12	564	90	14	0	374	392	39	16	553	58
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	171	44	687	201	201		439	1906	189	55	1732	773
Arrive On Green	0.12	0.12	0.12	0.11	0.11	0.00	0.13	0.58	0.58	0.03	0.49	0.49
Sat Flow, veh/h	1433	366	2790	1781	1777	1585	3456	3266	323	1781	3554	1585
Grp Volume(v), veh/h	59	0	564	90	14	0	374	212	219	16	553	58
Grp Sat Flow(s),veh/h/ln	1799	0	1395	1781	1777	1585	1728	1777	1812	1781	1777	1585
Q Serve(g_s), s	3.6	0.0	14.3	5.7	0.8	0.0	12.7	6.8	6.9	1.1	11.3	2.3
Cycle Q Clear(g_c), s	3.6	0.0	14.3	5.7	0.8	0.0	12.7	6.8	6.9	1.1	11.3	2.3
Prop In Lane	0.80		1.00	1.00		1.00	1.00		0.18	1.00		1.00
Lane Grp Cap(c), veh/h	214	0	687	201	201		439	1037	1057	55	1732	773
V/C Ratio(X)	0.28	0.00	0.82	0.45	0.07		0.85	0.20	0.21	0.29	0.32	0.08
Avail Cap(c_a), veh/h	214	0	687	496	495		691	1037	1057	134	1732	773
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	0.92	0.92	0.92
Uniform Delay (d), s/veh	48.1	0.0	42.7	49.7	47.6	0.0	51.3	11.8	11.8	56.8	18.7	16.4
Incr Delay (d2), s/veh	0.5	0.0	7.7	0.6	0.1	0.0	3.5	0.4	0.4	1.0	0.4	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	0.0	8.6	2.6	0.4	0.0	5.7	2.8	2.9	0.5	4.8	0.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	48.6	0.0	50.4	50.3	47.6	0.0	54.8	12.3	12.3	57.8	19.1	16.5
LnGrp LOS	D	A	D	D	D		D	B	B	E	B	B
Approach Vol, veh/h		623			104	A		805			627	
Approach Delay, s/veh		50.2			49.9			32.0			19.9	
Approach LOS		D			D			C			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	7.7	75.1		19.0	19.3	63.6		18.2				
Change Period (Y+Rc), s	4.0	5.1		*4.7	4.0	5.1		4.6				
Max Green Setting (Gmax), s	9.0	44.9		* 14	24.0	29.9		33.4				
Max Q Clear Time (g_c+I1), s	3.1	8.9		16.3	14.7	13.3		7.7				
Green Ext Time (p_c), s	0.0	4.8		0.0	0.5	3.6		0.3				

Intersection Summary	
HCM 6th Ctrl Delay	34.6
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

HCM 6th Signalized Intersection Summary
1: Appian Wy & Mann Dr/Project Access

08/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	0	103	9	0	3	117	907	14	4	637	22
Future Volume (veh/h)	20	0	103	9	0	3	117	907	14	4	637	22
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	22	0	112	10	0	3	127	986	15	4	692	24
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	27	0	135	21	0	6	160	2171	33	10	1852	64
Arrive On Green	0.10	0.00	0.10	0.02	0.00	0.02	0.18	1.00	1.00	0.01	0.53	0.53
Sat Flow, veh/h	265	0	1349	1332	0	400	1781	3583	55	1781	3504	121
Grp Volume(v), veh/h	134	0	0	13	0	0	127	489	512	4	351	365
Grp Sat Flow(s),veh/h/ln	1614	0	0	1732	0	0	1781	1777	1861	1781	1777	1848
Q Serve(g_s), s	5.7	0.0	0.0	0.5	0.0	0.0	4.8	0.0	0.0	0.2	8.1	8.1
Cycle Q Clear(g_c), s	5.7	0.0	0.0	0.5	0.0	0.0	4.8	0.0	0.0	0.2	8.1	8.1
Prop In Lane	0.16		0.84	0.77		0.23	1.00		0.03	1.00		0.07
Lane Grp Cap(c), veh/h	161	0	0	28	0	0	160	1076	1127	10	939	977
V/C Ratio(X)	0.83	0.00	0.00	0.47	0.00	0.00	0.79	0.45	0.45	0.42	0.37	0.37
Avail Cap(c_a), veh/h	161	0	0	136	0	0	254	1076	1127	140	939	977
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	0.89	0.89	0.89	1.00	1.00	1.00
Uniform Delay (d), s/veh	30.9	0.0	0.0	34.1	0.0	0.0	28.1	0.0	0.0	34.7	9.7	9.7
Incr Delay (d2), s/veh	29.0	0.0	0.0	11.9	0.0	0.0	7.7	1.2	1.2	26.8	1.1	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.4	0.0	0.0	0.3	0.0	0.0	2.2	0.4	0.4	0.1	3.0	3.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	59.9	0.0	0.0	46.1	0.0	0.0	35.8	1.2	1.2	61.5	10.8	10.8
LnGrp LOS	E	A	A	D	A	A	D	A	A	E	B	B
Approach Vol, veh/h		134			13			1128			720	
Approach Delay, s/veh		59.9			46.1			5.1			11.1	
Approach LOS		E			D			A			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	10.3	42.1		12.0	4.9	47.5		5.6				
Change Period (Y+Rc), s	4.0	5.1		5.0	4.5	5.1		4.5				
Max Green Setting (Gmax), s	10.0	28.9		7.0	5.5	32.9		5.5				
Max Q Clear Time (g_c+I1), s	6.8	10.1		7.7	2.2	2.0		2.5				
Green Ext Time (p_c), s	0.1	9.2		0.0	0.0	17.7		0.0				

Intersection Summary	
HCM 6th Ctrl Delay	11.2
HCM 6th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.

HCM 6th Signalized Intersection Summary
2: Appian Wy & Tara Hills Dr/Canyon Dr

08/05/2021

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	72	34	444	86	32	24	467	725	123	19	518	63
Future Volume (veh/h)	72	34	444	86	32	24	467	725	123	19	518	63
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	78	37	483	93	35	0	508	788	134	21	563	68
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	178	84	864	177	176		569	1787	304	64	1633	728
Arrive On Green	0.14	0.14	0.14	0.10	0.10	0.00	0.16	0.59	0.59	0.07	0.92	0.92
Sat Flow, veh/h	1227	582	2790	1781	1777	1585	3456	3038	517	1781	3554	1585
Grp Volume(v), veh/h	115	0	483	93	35	0	508	461	461	21	563	68
Grp Sat Flow(s),veh/h/ln	1809	0	1395	1781	1777	1585	1728	1777	1777	1781	1777	1585
Q Serve(g_s), s	8.1	0.0	20.2	6.9	2.5	0.0	20.2	20.2	20.2	1.6	2.6	0.5
Cycle Q Clear(g_c), s	8.1	0.0	20.2	6.9	2.5	0.0	20.2	20.2	20.2	1.6	2.6	0.5
Prop In Lane	0.68		1.00	1.00		1.00	1.00		0.29	1.00		1.00
Lane Grp Cap(c), veh/h	262	0	864	177	176		569	1045	1046	64	1633	728
V/C Ratio(X)	0.44	0.00	0.56	0.53	0.20		0.89	0.44	0.44	0.33	0.34	0.09
Avail Cap(c_a), veh/h	262	0	864	425	424		913	1045	1046	115	1633	728
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	0.96	0.96	0.96
Uniform Delay (d), s/veh	54.6	0.0	40.3	59.9	57.9	0.0	57.3	16.0	16.0	63.4	3.2	3.1
Incr Delay (d2), s/veh	0.9	0.0	0.7	0.9	0.2	0.0	4.4	1.4	1.4	1.1	0.6	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.8	0.0	7.1	3.2	1.2	0.0	9.2	8.6	8.6	0.7	0.9	0.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	55.5	0.0	41.0	60.8	58.1	0.0	61.7	17.4	17.4	64.4	3.7	3.3
LnGrp LOS	E	A	D	E	E		E	B	B	E	A	A
Approach Vol, veh/h		598			128	A		1430			652	
Approach Delay, s/veh		43.8			60.1			33.1			5.6	
Approach LOS		D			E			C			A	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.0	87.5		25.0	27.1	69.4		18.5				
Change Period (Y+Rc), s	4.0	5.1		*4.7	4.0	5.1		4.6				
Max Green Setting (Gmax), s	9.0	58.9		* 20	37.0	30.9		33.4				
Max Q Clear Time (g_c+I1), s	3.6	22.2		22.2	22.2	4.6		8.9				
Green Ext Time (p_c), s	0.0	12.5		0.0	0.9	4.3		0.4				

Intersection Summary	
HCM 6th Ctrl Delay	30.2
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.
Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Appendix C

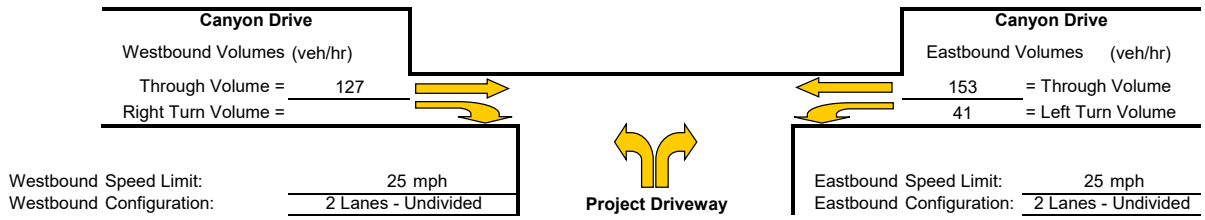
Turn Lane Warrant

This page intentionally left blank

Turn Lane Warrant Analysis - Tee Intersections

Study Intersection: Canyon Drive/Project Driveway
Study Scenario: Existing plus Project PM

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



Westbound Speed Limit: 25 mph
Westbound Configuration: 2 Lanes - Undivided

Eastbound Speed Limit: 25 mph
Eastbound Configuration: 2 Lanes - Undivided

Westbound 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 =	1050.1
Advancing Volume	Va =	127
If AV<Va then warrant is met		No

Right Turn Lane Warranted: **NO**

Westbound 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 =	127
If AV<Va then warrant is met		-

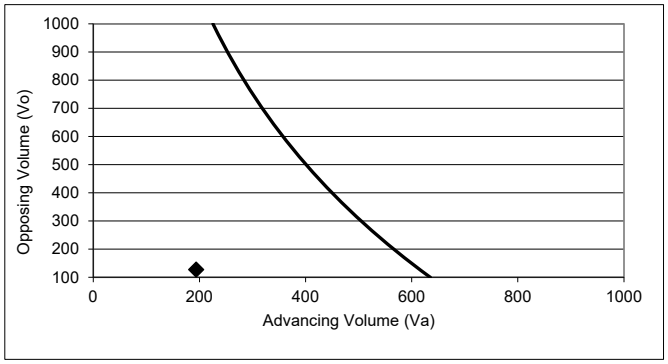
Right Turn Taper Warranted: **NO**

Eastbound Left Turn Lane Warrants

Percentage Left Turns %lt 21.1 %

Advancing Volume Threshold AV 616 veh/hr

If AV<Va then warrant is met



◆ Study Intersection

Two lane roadway warrant threshold for: 25 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.