



Heritage Park Project Traffic Impact Study



Prepared for the Town of Windsor

Submitted by
W-Trans

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Introduction

This report presents an analysis of the potential mobility impacts that would be associated with development of 33 multi-family residential units at 8685 Old Redwood Highway in the Town of Windsor. The traffic study was completed in accordance with the criteria established by the Town of Windsor and is consistent with standard traffic engineering techniques.

Project Description

The project consists of construction of a three-story 33-unit multifamily residential development. In the short-term, the project would be accessible via two driveways, one off Courtyards East and the other connecting from the north to the proposed public street along the project's southerly boundary and connecting to Courtyards East. In the future, the project-built segment of the public street would connect to Old Redwood Highway through the adjacent parcel, providing a direct route to the southern project driveway from Old Redwood Highway. Until then, the street segment would be considered a private road for the proposed project. It should be noted that left turns would be prohibited at the new public street connection at Old Redwood Highway, so it is anticipated that only inbound right turns into the future street connection would be generated from the project site as Courtyards East-2nd Street provides a more direct connection for outbound traffic destined to the east on Old Redwood Highway. The proposed project site plan is shown in Figure 1.

OLD REDWOOD HIGHWAY



SITE SUMMARY

PROJECT ADDRESS: 8685 OLD REDWOOD HIGHWAY
WINDSOR, CA. 95492

NET ACREAGE: 1.43 AC. (61,134 SF) 21.7 DU/AC
DEDICATED ACREAGE: 0.26 AC. (11,154 SF)

TOTAL AREA: 1.66 AC. (72,288 SF) 18.7 DU/AC

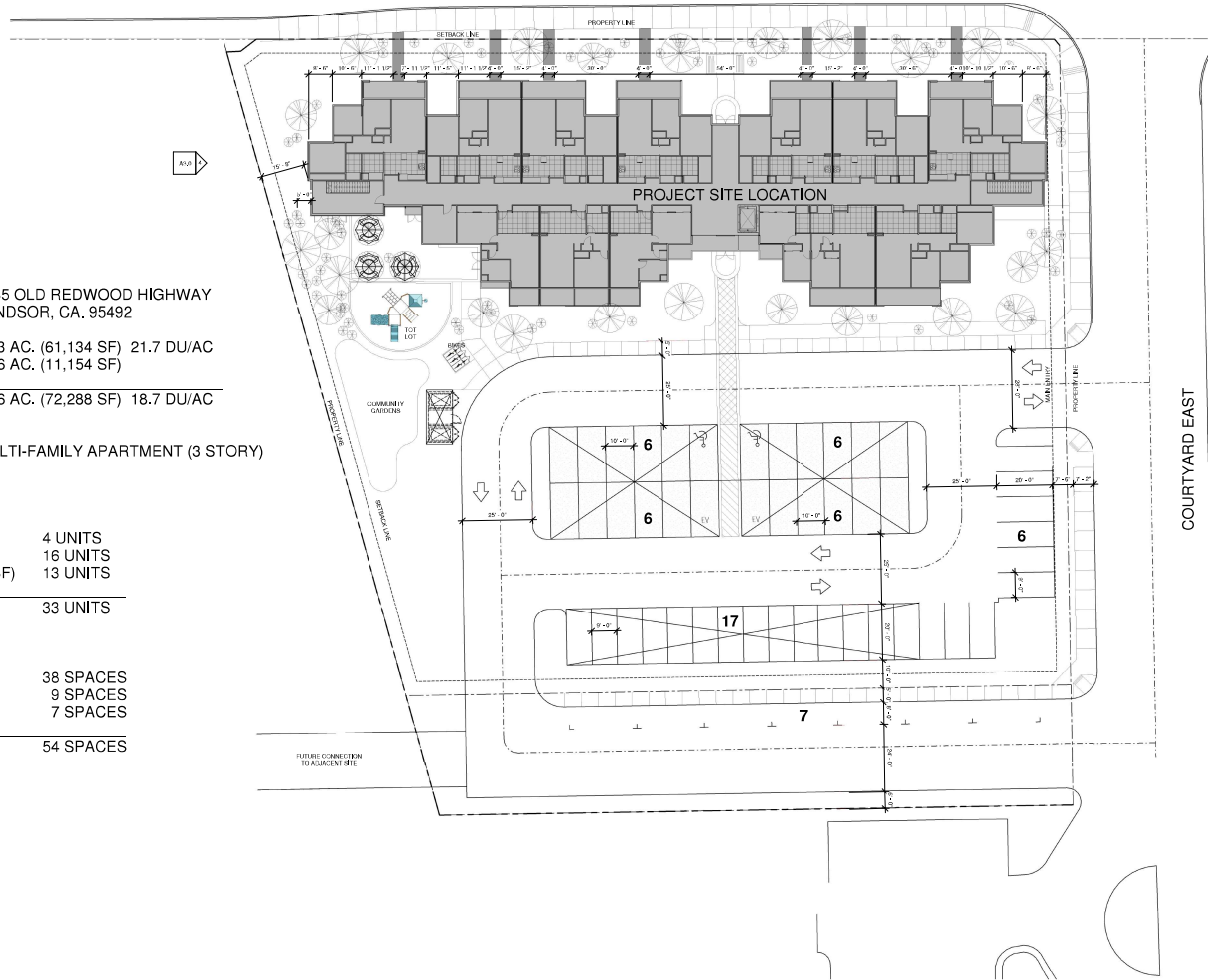
PROPOSED USE: MULTI-FAMILY APARTMENT (3 STORY)

PROPOSED UNITS:

1 BEDROOM (720 SF)	4 UNITS
2 BEDROOM (955 SF)	16 UNITS
3 BEDROOM (1,055 SF)	13 UNITS
TOTAL:	33 UNITS

PARKING:

COVERED	38 SPACES
UNCOVERED	9 SPACES
PARALLEL	7 SPACES
TOTAL:	54 SPACES



0.00
1" = 1'-0"



Pedestrian Facilities

Pedestrian facilities include sidewalks, crosswalks, pedestrian signal phases, curb ramps, curb extensions, and various streetscape amenities such as lighting, benches, etc. Existing pedestrian facilities along the proposed project site frontages as well as within a one-quarter mile distance of the project site were reviewed.

Existing Pedestrian Facilities

In general, a network of connected sidewalks, street lights, and curb ramps exist along the project frontage on Old Redwood Highway and on the east side of Courtyards East; there are no pedestrian facilities along the project side on the west side of Courtyards East. There may be some demand for pedestrians to cross Old Redwood Highway to access the school bus that stops at 3rd Street/Franklin Street. There are crosswalks with pedestrian signal heads across Old Redwood Highway at Lakewood Drive-US 101 Northbound Off-Ramps and at Alden Lane. There was a temporary rectangular rapid flashing beach (RRFB) at Old Redwood Highway/3rd Street during construction of the Holiday Inn; it was removed once the hotel was completed.

Pedestrian Safety

The collision history for the study area was reviewed to determine any trends or patterns that may indicate a safety issue for pedestrians. Collision records available from the California Highway Patrol as published in their Statewide Integrated Traffic Records System (SWITRS) reports were reviewed for the most current five-year period available, which was June 30, 2014 through July 1, 2019 at the time of the analysis. During the five-year study period there were no reported collisions involving pedestrians at the study intersection. There were, however, two pedestrian-involved collisions at Old Redwood Highway/3rd Street. Both collisions involved a pedestrian crossing in the crosswalk on Old Redwood Highway, which has since been removed. One of the collisions resulted in a serious injury, while the other did not result in an injury. Additionally, there was one collision involving a pedestrian in the crosswalk at the west leg of Old Redwood Highway/Lakewood Drive. The collision included a vehicle turning right onto Lakewood Drive, and resulted in a non-severe injury.

Project Impact on Pedestrian Facilities

Given the proximity of the Windsor Town Green and commercial areas to the west of the site, it is reasonable to assume that some residents will want to walk, bicycle, and/or use transit for trips to and from the project site. Additionally, there may be some demand to cross Old Redwood Highway to access the school bus stop at Franklin Street/3rd Street.

Project Site – Sidewalks and street lighting exist along the project frontage on Old Redwood Highway and based on the site plan, sidewalks would be included within the site and along the project side of Courtyards East.

Courtyards East is classified as a Residential Street in the Town's General Plan. Per the Town's *Complete Street Design Guidelines* (CSDG), a five-foot landscape zone and six-foot sidewalk are required for this type of street. As proposed, the site plan includes construction of a seven-foot two-inch wide sidewalk on the west side of Courtyards East but does not include a landscape zone. The sidewalk along the west side of Courtyards East as shown on the plans would be adequate; however, due to the lack of a landscape zone, the criteria set forth in the CSDG are not met. It is recommended that a five-foot landscape zone that meets CSDG requirements for a Residential Street be included along with the proposed sidewalk. There are no existing streetlights on either side of Courtyards East near the project site, so it is recommended that street lighting be included on the planned sidewalks along the project side of Courtyards East.

The project also includes five-foot wide sidewalk along the northern side of the project street. Based on the Town's standards, sidewalk must have a minimum width of six feet, so the sidewalk on the project street is inadequate as proposed. Additionally, since the project street would be classified as either a Residential Street or a Narrow Residential Street, per the Town's CSDG, a five-foot landscape zone is recommended in addition to the six-foot wide sidewalk. It is recommended that a six-foot landscape zone that meets CSDG requirements for a Residential Street be included in the plans with the proposed sidewalk. The demand for pedestrian facilities along the new street at full future buildout is not anticipated to be high compared to Old Redwood Highway, so sidewalk only on the northern side of the street is expected to be adequate.

Within the project vicinity, Old Redwood Highway is classified as a five-lane boulevard in the *Town of Windsor 2040 General Plan*. According to the standards in the CSDG, six feet for a landscaping buffer and six to eight feet for sidewalk are required along the project frontage. According to the site plan, the sidewalk along the project frontage on Old Redwood Highway would be eight feet wide. However, the site plan does not include a landscape zone. According to the CSDG, "Landscape zones may be planter strips or tree wells. Tree wells are essential adjacent to commercial and multifamily land uses, and a combination of the two, and optional elsewhere." It is recommended that the applicant improve the existing sidewalk long the project frontage on Old Redwood Highway to include sidewalk with a minimum width of six feet and either a six-foot landscape zone or tree wells. It should be noted that the CSDG specifies that curb width is included in the landscape zone width. While there are no protected crosswalks across Old Redwood Highway at the project frontage, there are two signalized intersections with pedestrian crossing phases within one-quarter mile of the site at the signalized intersections with Lakewood Drive-US 101 Northbound Off-Ramps and Alden Lane.

Finding – Pedestrian facilities serving the project site would be inadequate on the northern side of the project street and along Courtyards East as proposed; however, on-site circulation would be adequate with the construction of sidewalks throughout the project site.

Recommendation – The applicant should include street lighting as part of the planned sidewalk improvements along Courtyards East and the southern road connector. Additionally, the applicant should widen the sidewalk on the northern side of the project street to a minimum of six feet. Along the project side of Courtyards East as well as the north side of the new project street, the applicant should include a five-foot wide landscape zone adjacent to the proposed sidewalk to meet CSDG requirements for a residential street.

Recommendation – The applicant should update the site plan to include a landscape zone on the project frontage on Old Redwood Highway that meets the Town's CSDG requirements for a five-lane boulevard.

Access to Transit

The nearest bus stops served by Sonoma County Transit buses are located on both sides of Old Redwood Highway at 4th Street. Additionally, there is a school bus stop at Franklin Street/3rd Street and in front of the project site at Old Redwood Highway/Courtyards East. The walking routes to these nearby transit stops were reviewed for adequacy of pedestrian access.

For routes served on the south side of Old Redwood Highway, pedestrians can use the existing sidewalks to gain access. However, to reach the bus stop as well as commercial destinations on the north side of Old Redwood Highway requires either crossing at an uncontrolled and unmarked crossing or walking to the nearest signalized crossings located approximately 1,167 feet to the east at Alden Lane or 850 feet to the west at Lakewood Drive.

As there was previously a crosswalk supplemented with an RRFB at 3rd Street the intersection was reviewed to determine if a crosswalk with an RRFB or other type of pedestrian crossing should be reinstalled based on the methodologies included in *Improving Pedestrian Safety at Unsignalized Crossings*, National Cooperative Highway Research Program (NCHRP) Report 562, Transportation Research Board, 2006 and the California Manual on Uniform Traffic Control Devices, 2014 (HAWK warrant). As there is not currently a crossing at Old Redwood

Highway/3rd Street, pedestrian counts would not reflect any current or potential demand, so since demand would reasonably increase with the project if adequate facilities were available, a range between 10 and 20 pedestrians per hour were assumed to cross at this location. Based on a review of these pedestrian warrant methodologies, the addition of enhanced crossing facilities such as an RRFB are indicated and recommended for a crosswalk at this location. Due to previous safety concerns at this location, further striping modifications to create a No Passing zone are also indicated. The NCHRP worksheet and HAWK warrant are provided in Appendix A.

Finding – The project would be anticipated to generate the demand for pedestrian crossings at the intersection of Old Redwood Highway/3rd Street. Existing pedestrian facilities at this intersection are inadequate to serve pedestrian crossings in a safe manner.

Recommendation – The applicant should install a crosswalk with high visibility signage and striping including an RRFB flashing warning device and restriping on Old Redwood Highway to create a No Passing zone through the intersection.

Bicycle Facilities

The *Highway Design Manual*, Caltrans, 2017, classifies bikeways into 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.

Existing and proposed bicycle facilities within one-half mile of the proposed project site, as contained in the *Windsor Bicycle and Pedestrian Master Plan*, were reviewed.

Existing Bicycle Facilities

In the project area Class II bike lanes exist on Old Redwood Highway between US 101 Northbound Off-Ramps and the Southern Town Limits. According to the *Windsor Bicycle and Pedestrian Master Plan*, a bicycle route is planned along 3rd Street between Jensen Lane and Old Redwood Highway. 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 *Windsor Bicycle and Pedestrian Master Plan*.

Table 1 – Bicycle Facility Summary

Status Location	Class	Length (miles)	Begin Point	End Point
Existing Old Redwood Hwy	II	2.10	US 101 NB Off-Ramp	South Town Limits
Planned 3 rd St	III	0.16	Jensen Ln	Old Redwood Hwy

Source: *Windsor Bicycle and Pedestrian Master Plan*, Sonoma County Transportation Authority, 2014

It is noted that the Town is currently considering the feasibility of installing bicycle tracks, or Class IV bikeways, along Old Redwood Highway. It is assumed that such a project would make use of one existing travel lane rather than extending outside the current road right-of-way. As the existing right-of-way along the project frontage is consistent with that throughout the segment, it is assumed that no additional right-of-way would be required for such potential improvements.

Bicyclist Safety

Collision records for the study area were reviewed to determine if there had been any bicyclist-involved crashes. During the five-year study period there was one reported collision involving a bicyclist at the study intersection. The driver made a right-turn northbound on Courtyards East, sideswiping the bicyclist. The collision resulted in a minor injury.

Project Impact on Bicycle Facilities

Existing bicycle facilities, including bicycle lanes on Old Redwood Highway, together with shared use of minor streets provide adequate access for bicyclists.

Bicycle Storage

The Town of Windsor does not specify requirements for the number of secure bicycle parking spaces for residential uses outside the Downtown area. Based on the site plan, there are three bicycle racks proposed on-site, located northwest of the parking lot, and each unit would have a private balcony that can provide sheltered storage for a bicycle.

Finding – Since the Town does not have bicycle parking requirements for residential developments, and every unit would have a balcony capable for storing at least one bicycle, on-site bicycle storage is adequate. Off-site bicycle facilities are adequate to serve project-related demand.

Transit Facilities

Existing transit facilities and routes serviced within one-quarter mile walking distance from the proposed project site were reviewed.

Existing Transit Facilities

Local School Bus

The Windsor Unified School District provides school bus service throughout Windsor to serve all its school campuses. Route 5 provides service along Old Redwood Highway at Courtyards East. This route connects between 7108 Hastings Place and Brooks Elementary School, with stops at Windsor Middle School and Mattie Washburn Elementary School. Morning bus service operates between 7:00 a.m. and 8:15 a.m. and afternoon service operates between 2:00 p.m. and 4:05 p.m.; stops at Old Redwood Highway/Courtyards East are scheduled at 7:37 a.m. and 3:50 p.m.

Route 4 also has a stop on Old Redwood Highway at Courtyards East during the afternoon and has morning pickup at Franklin Street/3rd Street which is approximately 0.13 miles northwest from the project site. This route connects between Los Amigos/Collard Court and Windsor Middle School, with stops at Brooks Elementary School, Cali Calmecac Language Academy, La Petite Academy, and Mattie Washburn Elementary School. Morning bus service operates between 6:52 a.m. and 8:25 a.m. and afternoon service operates between 2:25 p.m. and 4:26 p.m. Morning service includes a scheduled stop at Franklin Street/ 3rd Street at 8:00 a.m., and in the afternoon the bus is scheduled to stop at Old Redwood Highway/ Courtyards East at 2:54 p.m.

Route 2 provides morning service on Franklin Street, connecting between Bell Road/Johnson Street and Mattie Washburn Elementary School, with stops at Windsor High School, Cali Calmecac Language Academy, La Petite Academy, and Brooks Elementary School. Morning bus service operates between 7:00 a.m. and 8:01 a.m., and a scheduled stop on Franklin Street at 7:42 a.m.

Sonoma County Transit

Sonoma County Transit (SCT) provides fixed route bus service in the Town of Windsor and within the County of Sonoma and provides service to the project site with stops on both sides of Old Redwood Highway at 4th Street. SCT Route 60 provides regional service between the Town of Windsor and surrounding communities. The route stops on Old Redwood Highway/Lakewood Drive and operates Monday through Friday with approximately one-half hour to two-hour headways between 5:45 a.m. and 9:40 p.m. Weekend service operates with approximately one- to two-hour headways between 7:30 a.m. and 10:00 p.m.

Two bicycles can be carried on most 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 the Town of Windsor and the greater Sonoma County area.

Project Impact on Transit

Existing public transit routes and school bus routes are adequate to accommodate project-generated transit trips. Existing stops are within an acceptable walking distance of the site. As discussed in the section on pedestrian

facilities, to improve access to transit it is recommended that a crosswalk with an RRFB be installed on Old Redwood Highway at 3rd Street, coupled with changes in striping to prohibit lane changes on Old Redwood Highway approaching the crosswalk.

Finding – Transit facilities serving the project site are generally adequate but would be improved upon implementation of the recommendations identified in the pedestrian facility section.

Vehicular Traffic Facilities

Setting

While the operation of local intersections is no longer evaluated for purposes of determining potential impacts under CEQA, an analysis of the potential impacts on operation was performed to determine consistency with the Town's adopted General Plan policies.

The *Town of Windsor 2040 General Plan*, adopted in April 2018, contains the following policies applicable to the operational analysis.

Policy M-3.16 – Level of Service Application. *The Town shall maintain level of service standards that define the minimum acceptable operating characteristics for intersections and streets. A level of service D (LOS D) is defined as the minimum acceptable level of congestion during the weekday morning and evening peak periods for high-volume facilities such as freeways, crosstown streets, and signalized or all-way stop-controlled intersections. This standard should apply at all these locations except the following intersections, which are regional gateways to the Town's commercial and civic areas, and where a Level of Service E is tolerated by the Town and considered acceptable:*

- Old Redwood Highway/US 101 Northbound off ramp/Lakewood Drive
- Old Redwood Highway/US 101 Southbound ramps
- Old Redwood Highway/Conde Lane/Windsor River Road

At side-street stop-controlled unsignalized intersections, levels of service shall be determined for both controlled movements and for the overall intersection. Controlled movements operating at LOS E or LOS F are allowable if: 1) the intersection is projected to operate at LOS C or better overall, and 2) the projected traffic volume on the controlled movement is 30 vehicles or less per hour on approaches with single lanes, or on multilane approaches, 30 vehicles or less per hour per lane. If an intersection is operating at LOS E or F without project-generated traffic added, the project's impact shall be considered less-than-significant if it does not cause operation to fall from LOS E to LOS F and it increases average delay for the intersection as a whole by 5 seconds or less. Level of service standards shall not apply to minor intersections comprised of only local streets.

A description of the Level of Service methodology applied in the analysis is provided in Appendix B.

Study Area and Periods

The study area consists of the intersection of Old Redwood Highway/2nd Street-Courtyards East. While analysis of the intersection of Old Redwood Highway/US 101 North Off-Ramp-Lakewood Drive was considered as it provides access to the downtown from the east, it was ultimately determined that the project's impact would be minimal as the project would be expected to generate a nominal number of trips through this intersection that would be less than the daily fluctuation that occurs normally. Further, the Town of Windsor adopted the 2040 General Plan in 2018 which included analysis based on the same land use and zoning designation for the project site as the proposed project. Since the project would be already included in the buildout traffic analysis and would likely have a minimal impact on the larger surrounding network no intersections other than the indicated study intersection were analyzed.

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

Old Redwood Highway/2nd Street-Courtyards East is a four-legged intersection with stop controls on the northbound and southbound 2nd Street-Courtyards East approaches. There are crosswalks present at the north and south legs. Bicycle lanes are present along Old Redwood Highway at both approaches.

The locations of the study intersections and the existing lane configurations and controls are shown in Figure 2.

Existing Intersection Operation

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 in September 2019 when local schools were in session.

While the study intersection is operating acceptably overall at LOS A, because the northbound approach is operating below LOS D during both peak periods and serves more than 30 vehicles, according to the Town's guidelines, this is unacceptable and therefore warrants additional considerations when evaluating project impacts. A summary of the intersection level of service calculations is contained in Table 2, and copies of the Level of Service calculations are provided in Appendix C. The existing traffic volumes are shown in Figure 3.

Table 2 – Existing Peak Hour Intersection Levels of Service

Study Intersection Approach	AM Peak		PM Peak	
	Delay	LOS	Delay	LOS
1. Old Redwood Hwy/2 nd St-Courtyards E	1.6	A	1.4	A
Northbound (Courtyards E) Approach	43.7	E	56.8	F
Southbound (2 nd St) Approach	19.0	C	20.6	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*; **Bold** text indicates unacceptable operation

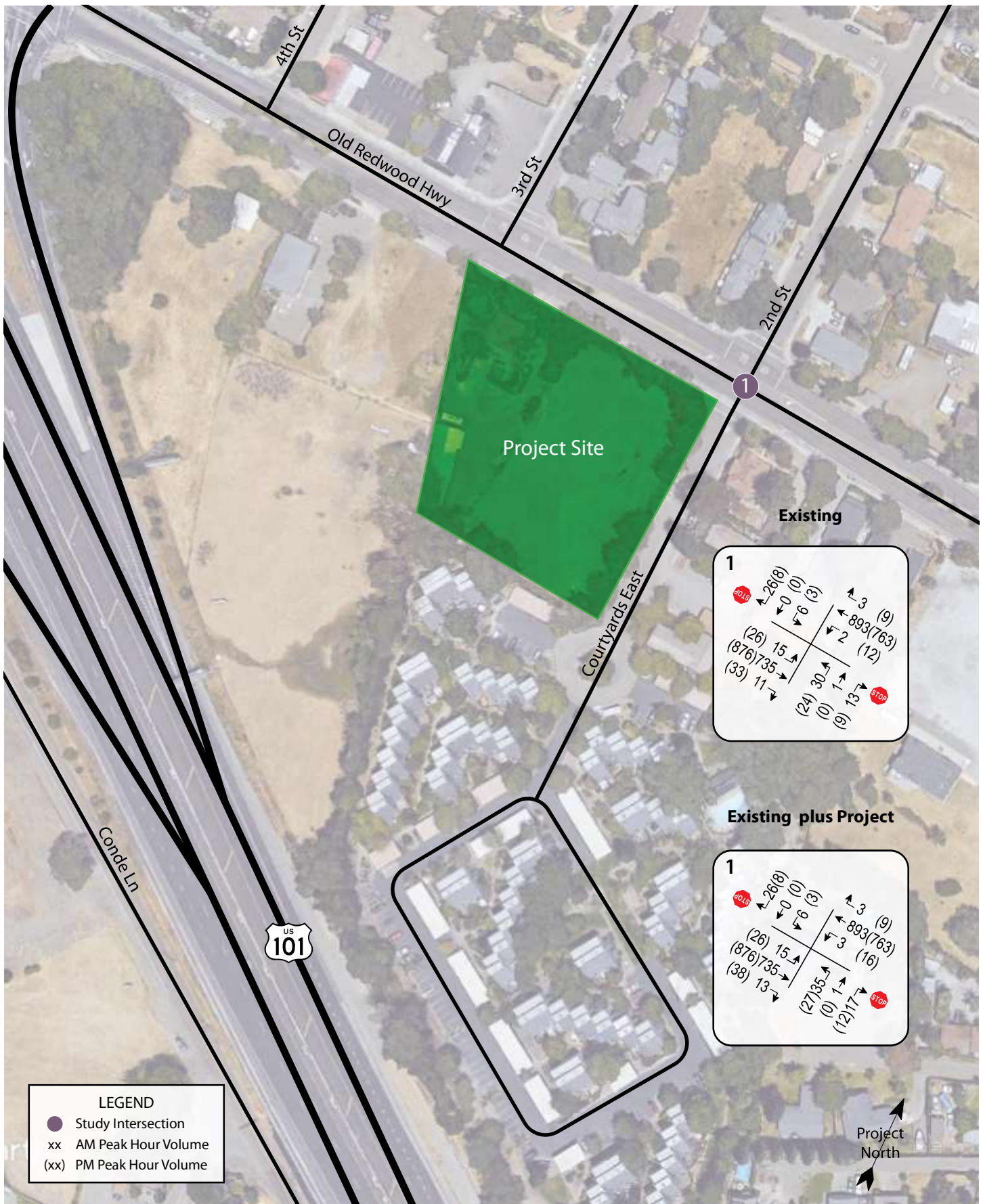
Future Intersection Operation

Segment volumes for the horizon year of 2040 were obtained from the County's gravity demand model maintained by the Sonoma County Transportation Authority (SCTA) and translated to peak hour turning movement volumes at the study intersection using the "Furness" method. The Furness method is an iterative process that employs existing turn movement data, existing link volumes, and future link volumes to project likely future turning movement volumes at intersections.

Under the anticipated Future volumes, the study intersection is expected to operate acceptably at LOS A overall during both studied peak hours. Operation on the northbound approach is anticipated to deteriorate to LOS F during both peak periods, indicating unacceptable operation according to the Town's guidelines. Future volumes are shown in Figure 4 and operating conditions are summarized in Table 3.



Heritage Park Project Traffic Impact Study
Figure 2 – Study Area and Existing Lane Configurations



Heritage Park Project Traffic Impact Study
Figure 3 – Existing and Existing plus Project Traffic Volumes



Heritage Park Project Traffic Impact Study
Figure 4 – Future and Future plus Project Traffic Volumes

Table 3 – Future Peak Hour Intersection Levels of Service

Study Intersection Approach	AM Peak		PM Peak	
	Delay	LOS	Delay	LOS
1. Old Redwood Hwy/2 nd St-Courtyards E	1.8	A	1.6	A
Northbound (Courtyards E) Approach	50.7	F	65.4	F
Southbound (2 nd St) Approach	20.9	C	21.3	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*; **Bold** text indicates unacceptable operation

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*, 10th Edition, 2017 for “Multifamily Housing (Mid-Rise)” (ITE LU 221). While there is one existing single-family residence on-site that would be replaced by the project, trip deductions were not applied to be conservative. As shown in Table 4 the proposed project is expected to generate an average of 180 trips per day, including 12 trips during the a.m. peak hour and 15 during the p.m. peak hour.

Table 4 – 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	33 du	5.44	180	0.36	12	3	9	0.44	15	9	6

Note: du = dwelling unit

Trip Distribution

The pattern used to allocate new project trips to the street network was based on data from the 2010 Census for home-to-work trips. It was assumed that 55 percent of trips would be to/from the west on Old Redwood Highway, with the remaining 45 percent to/from the east.

Project Impact on Intersection Operation

Existing plus Project Conditions

Upon the addition of project-related traffic to the Existing volumes, the study intersection is expected to continue operating acceptably overall, but at LOS E or F on the stop-controlled northbound approach. Because this approach is operating below the adopted LOS D standard, consideration was given to the delay added to the intersection’s operation to determine the significance of the project’s impact. Overall average delay is expected to increase by 0.3 seconds during both peak hours, which is less than the 5.0 seconds used by the Town to indicate a significant increase due to adding project traffic. According to the Town’s guidelines, the project would therefore have a less-than-significant impact. These results are summarized in Table 5. Existing plus project traffic volumes are shown in Figure 3.

Table 5 – 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. Old Redwood Hwy/2 nd St-Courtyards E	1.6	A	1.4	A	1.9	A	1.7	A
NB (Courtyards E) Approach	43.7	E	56.8	F	46.9	E	61.9	F
SB (2 nd St) Approach	19.0	C	20.6	C	19.1	C	20.9	C

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; NB = northbound; SB = southbound; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*; **Bold** text indicates unacceptable operation

Finding – The study intersection is expected to continue operating at the same levels of service overall and at the approaches with the project as without it. Because overall average delay is expected to increase by only 0.3 seconds with project volumes added, which is less than 5.0 seconds, under the Town’s guidelines this is a less-than-significant impact.

Future plus Project Conditions

Redistribution of Project Volumes with Future Improvements

Included in the proposed project is the construction of a road segment that will connect to the site’s southern driveway and Courtyards East. Separate from the project, the Town has plans for a street connection between Old Redwood Highway and Courtyards East through the adjacent undeveloped property and the Holiday Inn. As development on this parcel is not currently proposed, the planned road connection to Courtyards East was only analyzed under Future plus Project Conditions. It is anticipated that 40 percent of inbound trips from the northwest would be redirected to access the project site via the future planned road.

Upon the addition of project-generated traffic to the anticipated Future volumes, and with the planned road connection to Old Redwood Highway, the study intersection is expected to operate acceptably overall but unacceptably on the northbound approach, with no changes to levels of service. The Future plus Project operating conditions are summarized in Table 6. Future plus project traffic volumes are shown in Figure 4.

Table 6 – 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. Old Redwood Hwy/2 nd St-Courtyards E	1.8	A	1.6	A	2.1	A	1.9	A
NB (Courtyards E) Approach	50.7	F	65.4	F	54.0	F	69.5	F
SB (2 nd St) Approach	20.9	C	21.3	C	21.1	C	21.6	C

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; NB = northbound; SB = southbound; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*; **Bold** text indicates unacceptable operation

Finding – The study intersection will continue operating at the same Levels of Service with the project as without it. Because the change in average delay at the intersection overall is less than 5.0 seconds, the project’s impact is considered less than significant.

Collision History

The collision history for the study intersections was reviewed and collision rates were calculated based on records for June 30, 2014 through July 1, 2019.

The calculated collision rate for the study intersection of 0.09 collisions per million vehicles entering (c/mve) was compared to average collision rates for similar facilities statewide, as indicated in *2016 Collision Data on California State Highways*, California Department of Transportation (Caltrans). The study intersection experienced a lower collision rate than the statewide average of 0.15 c/mve for the five-year collision period, indicating that the intersection is operating acceptably in terms of safety. The collision rate calculation is provided in Appendix D.

Site Vehicle Access and Circulation

Site Access

The project site would be accessible via a driveway off Courtyards East and a driveway off the proposed road connector which would also connect to Courtyards East. In the future, the proposed road would connect the site and Courtyards East to the Holiday Inn and Old Redwood Highway. It should be noted that the future planned road extension is not a part of the proposed project.

Sight Distance

Sight distances along Courtyards East at the project driveway and at the planned connector road were evaluated based on sight distance criteria contained in the *Highway Design Manual* published by Caltrans.

Corner Sight Distance

The recommended sight distance at intersections of public streets is based on corner sight distance, with the approach travel speed used as the basis for determining the recommended sight distance. Since the proposed new street would be a dedicated public street, corner sight distance was evaluated. Based on a design speed of 25 mph, the minimum stopping sight distance needed is 275 feet. Sight lines from the location of the new street were limited due to parked vehicles on Courtyards East along the project side. It is recommended that 'no parking' signage be installed along the project side of Courtyards East, which would provide adequate sight lines to the north. Directly south of the road connector is a traffic circle that has a speed limit of 5 mph; it connects Courtyards East to two small parking lots and a private residential road. Sight lines south of the road connector extend 200 feet, and since the roundabout has shrubs under three feet tall and a tree clear of low-hanging branches, sight distance is adequate.

Stopping Sight Distance

For private roads and driveways, the minimum sight distance recommendation is based on stopping sight distance. Sight distances at the proposed driveways and proposed intersection were field measured. Although sight distance requirements are not technically applicable to urban driveways, the stopping sight distance criterion for private street intersections was applied for evaluation purposes. Based on a design speed of 25 mph, the minimum stopping sight distance needed is 150 feet. Sight distance from the proposed driveway off Courtyards East is limited due to the parking that is allowed on Courtyards East. The intersection with Old Redwood Highway is approximately 120 feet from the driveway, and sight lines of vehicles turning right onto Courtyards East from Old Redwood Highway would be limited by parked vehicles. It is recommended that 'no parking' signage be installed one standard vehicle length, or 25 feet, on both sides of the project driveway on Courtyards East to ensure adequate sight lines. Since the southern driveway would be off the proposed road which has not been constructed yet, to ensure adequate sight distance at both driveways, the applicant should design landscaping and signage at the westerly driveway to be located outside of the driver's vision triangle as to not obstruct sight lines.

Findings – Sight distances at the proposed driveways would be adequate with some parking prohibitions, except visibility of vehicles turning right off Old Redwood Highway onto Courtyards East is to 120 feet due to the proximity to the intersection but drivers approaching after making this turn would be traveling at a lower speed, so the sight distance is considered adequate.

Recommendations – The applicant should paint the curb red for a distance of 25 feet on either side of the project driveway and on the north side of the new public street on the west side of Courtyards East fronting the project

site to ensure adequate sight lights. Any planned landscaping or signage at the project driveways or the proposed road connection should be designed to avoid the driver's vision triangle.

Access Analysis

Left-Turn Lane Warrants

It is unreasonable to assume that any project trips would enter the site from the south and turn left into the driveway on Courtyards East. Because all project-related traffic would be expected to come from Old Redwood Highway and therefore enter the site by turning right, the need for a left-turn pocket was not evaluated. It is reasonable to assume that one would not be warranted given the low volume of traffic on Courtyards East combined with the directionality of traffic entering the project site.

Complete Streets Design

The project includes a new road connecting west and eventually to Old Redwood Highway. As proposed, the roadway pavement would be 32 feet wide, eight feet of which would be on-street parallel parking along the north side of the street and the remainder provide two 12-foot lanes. The total road right-of-way as proposed would be 43 feet wide.

The CSGD suggest travel lane widths of 10 feet wide when not adjacent to a gutter. Based on comments from Town staff, it is recommended that the on-street parking be seven feet wide, with a ten-foot wide travel lane next to parking and a 12-foot lane next to the gutter. Based on these requirements, the paved roadway would be 29 feet wide, compared to the 32-foot roadway proposed.

As proposed, the new street would have a driveway curb cut at the connection at Courtyards East, and the project driveway connecting from the north would have curb returns rather than a driveway curb cut. Since there is sidewalk planned along the north side of the new street, the project driveway should either have sidewalk running through it with a driveway curb cut, a painted crosswalk, or another option based on the Town's standards and discretion. Similarly, the street connection to Courtyards East should be reconfigured to take out the driveway curb cut and build at-grade with Courtyards East to adhere to Town standards.

In the future this new street would be extended and connect to Old Redwood Highway through the Holiday Inn through a public access easement. Based on staff comments and project assumptions, the street would likely have an average daily traffic (ADT) of between 200 and 2,000 vehicles. Dimensions for the proposed residential street were evaluated based on the Town of Windsor's *Complete Street Design Guidelines* (CSDG), published 2013, and requirements for both a Residential Street and a Narrow Residential Street were evaluated.

Finding – The proposed street configuration does not meet the Town's required street design guidelines.

Recommendation – The applicant should work with Town staff to ensure the street configuration meets their standards. The proposed sidewalk on the north side of the project street should be widened to a minimum of six feet. The project driveway off the new street should have a driveway curb cut and be redesigned based on Town standards, and the street connection to Courtyards East should be redesigned to be at grade and standard curb returns.

Parking

The project was analyzed to determine whether the proposed parking supply would be sufficient for the anticipated parking demand. The project site as proposed would provide a total of 54 standard parking spaces for the apartment complex, and an additional seven on-street parking spaces along the proposed new street.

The Town of Windsor typically stipulates the Town's parking requirements for new developments; however, since the project is proposed as an affordable housing development, parking requirements are established in Senate Bill (SB) 35. SB 35 states that local governments cannot enforce parking requirements that exceed one parking space per unit for developments that meet the affordable housing requirements. Based on the number of proposed units, the proposed parking supply has a surplus of 21 off-street parking spaces than required under SB 35.

During the site visit there were approximately five passenger cars and a 2-axle large truck parked along the project side of Courtyards East. Since red curb is proposed adjacent to the project driveway and the new street connection, approximately three of the on-street parking spaces on Courtyards East would be eliminated. The east side of Courtyards East was not fully parked during the same time, and the new street is proposed to include seven on-street parking spaces which would more than replace the three parking spaces proposed to be eliminated.

Finding – The proposed parking supply would be more than sufficient based on Senate Bill 35 parking requirements.

Conclusions and Recommendations

Conclusions

- The proposed project includes construction of 33 affordable multifamily housing units to be located on a parcel at the corner of Old Redwood Highway/Courtyards east that is currently occupied by a single dwelling.
- With the construction of the project, sidewalks along the west side of Courtyards East and the northern side of the project street are proposed. Based on CSDG standards, the proposed sidewalk on the north side of the project street is not wide enough to meet the street type requirements. While the proposed sidewalk on Courtyards East is wide enough to meet CSDG standards, it does not include a five-foot wide landscape zone as required. The existing sidewalk on Old Redwood Highway at the project frontage does not meet the requirements for a five-lane boulevard, as specified in the CSDG.
- The project would be anticipated to generate the demand for pedestrian crossings at the intersection of Old Redwood Highway/3rd Street. Existing pedestrian facilities at this intersection are inadequate to serve pedestrian crossings in a safe manner.
- Bicycle and transit facilities are adequate to meet expected demand, though pedestrian facilities connecting to the nearest transit facilities are not adequate. Based on the assumption of a minimum of 20 pedestrians in one peak hour, a crosswalk supplemented with a HAWK signal is warranted on Old Redwood Highway at 3rd Street.
- The project is expected to generate 180 trips daily, with 12 trips during the a.m. peak hour and 15 during the p.m. peak hour. Based on the recent five-year collision period, the study intersection had a collision rate that is lower than the statewide average.
- Under Existing conditions Old Redwood Highway/2nd Street-Courtyards East is operating acceptably overall at LOS A during both peak periods, but unacceptably on the northbound approach. With the addition of project generated traffic, the intersection would continue operating at LOS A overall and LOS E or F on the northbound approach. Because the increase in overall average delay is expected to be less than 5.0 seconds, the impact is less-than-significant.
- Under Future conditions, including completion of a new street connection between Courtyards East and Old Redwood Highway, the study intersection is expected to operate at LOS A overall during both peak hours and unacceptably on the side-street approach from the south. Upon adding project generated traffic, the intersection would continue to operate acceptably overall with a minimal, less than 5.0-second increase in delay, indicating a less-than-significant impact.
- Sight distances from the proposed driveway location on Courtyards East and the new street would be adequate upon implementation of recommended parking restrictions. A left-turn lane on Courtyards East at the project driveway is not warranted.
- The proposed configuration of the new street on the south side of the project does not meet Town requirements. The proposed driveway off the new street and the new street connection at Courtyards East should be redesigned.
- The proposed parking supply is more than adequate to meet requirements under SB 35.

Recommendations

- The applicant should install a crosswalk with high visibility signage and striping including an RRFB flashing warning device and restriping on Old Redwood Highway to create a No Passing zone through the intersection.
- The applicant should improve the existing sidewalk on the project frontage on Old Redwood Highway to include sidewalk with a minimum width of six feet and a six-foot landscape zone.
- The applicant should install streetlights along Courtyards East and the new street. The proposed sidewalk along the northern side of the project street should be widened to a minimum of six feet. Additionally, a five-foot landscape zone should be included with the proposed sidewalk along the west side of Courtyards East and north side of the new street.
- It is recommended that parking be prohibited next to the project driveway on Courtyards East and to the west of the project driveway on the new street; this could be accomplished by installing 'no parking' signage. Any planned landscaping or signage at either of the project driveways or the new street connection at Courtyards East should be designed to be located outside of the driver's vision triangle.
- The new street should be designed to meet Town standards, including use of curb returns at the connection with Courtyards East and the use of a curb cut for the project driveway on the new street. The road configuration on the project street could be redesigned with seven feet for on-street parking, a ten-foot lane adjacent to parking and a 12-foot lane next to the gutter, for a total paved width of 29 feet.

Study Participants and References

Study Participants

Principal in Charge	Steve Weinberger, PE, PTOE
Assistant Planner	Julia Walker
Graphics	Katia Wolfe
Editing/Formatting	Alex Scrobonia, Hannah Yung-Boxdell
Quality Control	Dalene J. Whitlock, PE, PTOE

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WIN129





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Appendix A

NCHRP Worksheet and HAWK Warrant



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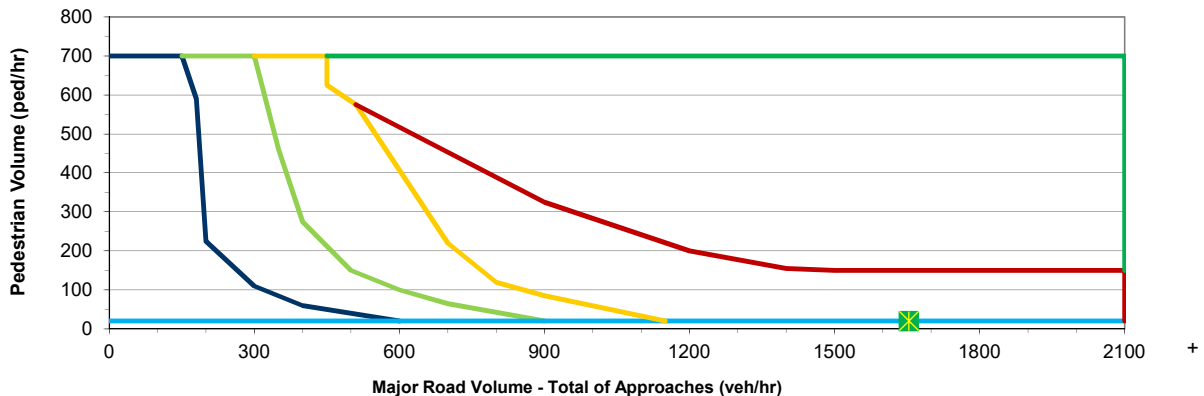
TCRP Report 112 - NCHRP Report 562 - Pedestrian Crossing Treatment Worksheet

Worksheet 1: Peak-Hour, 35 MPH or Less

Analyst and Site Information	
Analyst: Julia Walker	Major Street: Old Redwood Highway
Analysis Date: 15-Jan-20	Minor Street or Location: 3rd Street
Data Collection Date:	Peak Hour: AM Existing
Step 1: Select worksheet (speed reflects posted or statutory speed limit or 85th percentile speed on the major street):	
a) Worksheet 1 - 35 mph or less	
b) Worksheet 2- exceeds 35 mph, communities with less than 10,000, or where major transit stop exists	
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a TCD type of treatment?	
2a Peak-hour pedestrian volume (ped/h), vp	2a 20
o If 2a ≥ 20 ped/h, then go to Step 3. o If 2a < 20 ped/h, then consider median refuge islands, curb extensions, traffic calming, etc. as feasible.	
Step 3: Does the crossing meet the pedestrian volume warrant for a traffic signal?	
3a Major road volume, total of both approaches during peak hour (veh/h), V maj-s	3a 1654
3b o Minimum signal warrant volume for peak hour (use 3a for Vmaj-s), SC	3b 111.30
• SC = 0.00021 Vmaj-s ² - 0.74072 Vmaj-s + 734.125/0.75 OR • [(0.00021 3a ² - 0.74072 3a + 734.125)/0.75]	
3c o If 3b < 133, then enter 133. If 3b ≥ 133, then enter 3b.	3c 133
3d o If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce 3c by up to 50 percent; otherwise enter 3c.	3d 133
o If 2a ≥ 3d, then the warrant has been met and a traffic signal should be considered if not within 300 ft of another traffic signal. Otherwise, the warrant has not been met. Go to Step 4.	
Step 4: Estimate pedestrian delay.	
4a Pedestrian crossing distance, curb to curb (ft), L	4a 65
4b Pedestrian walking speed (ft.s), Sp	4b 3.5
4c Pedestrian start-up time and end clearance time (s), ts	4c 7
4d o Critical gap required for crossing pedestrian (s), tc= (L/Sp) + ts OR [(4a/4b) + 4c]	4d 25.57
4e Major road volume, total of both approaches or approach being crossed if median refuge island is present during peak hour (veh.h), Vmaj-d	4e 1654
4f o Major road flow rate (veh/s), v = Vmaj-d/3600 OR [4e/3600]	4f 0.46
4g o Average pedestrian delay (s/person), dp = (e ^{v_{tc}} - v _{tc} - 1) / v OR [(e ^{4f x 4d} - 4f x 4d - 1) / 4f]	4g 275484.69
4h o Total pedestrian delay (h), Dp=(dp x Vp) / 3600 OR [(4g x 2a) / 3600]	4h 1530.47
(this is estimated delay for all pedestrians crossing the major roadway without a crossing treatment - assumes 05 compliance). This calculated value can be replaced with the actual total pedestrian delay measured at the site.	
Step 5: Select treatment based upon total pedestrian delay and expected motorist compliance.	
5a Expected motorist compliance at pedestrian crossings in region, Comp = high or low	5a LOW

Total Pedestrian Delay Dp (4h) and Comp (5a)	Treatment Category (see Descriptions of Sample Treatments for examples)
Dp ≥ 21.3h (Comp = high or low) OR 5.3h ≤ Dp < 21.3 h and Comp = low	USE RED
1.3h ≤ Dp < 21.3h and Comp = high or low) OR 5.3 ≤ Dp < 21.3 h and Comp = high	DO NOT USE ACTIVE OR ENHANCED
Dp < 1.3 h (Comp = high or low)	DO NOT USE CROSSWALK

Roadway Configuration: 66' Wide, <35 mph, Vped =3.5 ft/s



LEGEND
 Study Intersection
 Signal
 Enhanced-High Visibility/Active when Present
 Red
 Enhanced-High Visibility/Active when Present (if high compliance expected) OR Red (if low compliance expected)
 Striped Crosswalk
 No Treatment

DESCRIPTIONS OF TREATMENT TYPE		
RED	ENHANCED-HIGH VISIBILITY/ACTIVE WHEN PRESENT	
	Active When Present	Enhanced/High Visibility
• Midblock Signal	• In Roadway Warning Lights	• In-Street Crossing Signs
	• Passive/Pushbutton Flashing Beacons	• High Visibility Signs/Markings
• Half Signal	• Pedestrian Crossing Flags	• Pedestrian Refuge Islands
	• Rapid Rectangular Flashing Beacons	• Raised Crosswalks
• HAWK		• Curb Extensions
		• Advanced Signage
		• Advanced Stop/Yield Lines
		• Constant Flashing Yellow Beacons

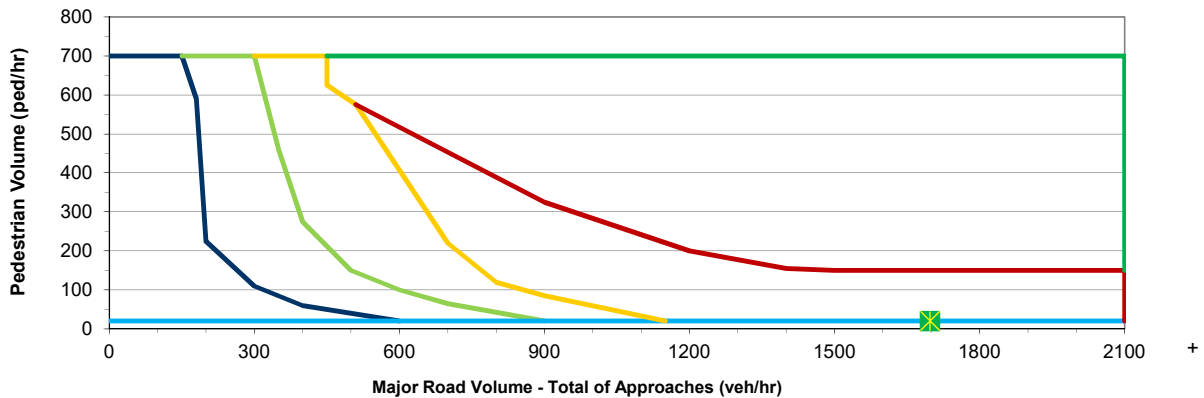
TCRP Report 112 - NCHRP Report 562 - Pedestrian Crossing Treatment Worksheet

Worksheet 1: Peak-Hour, 35 MPH or Less

Analyst and Site Information	
Analyst: Julia Walker	Major Street: Old Redwood Highway
Analysis Date: 15-Jan-20	Minor Street or Location: 3rd Street
Data Collection Date:	Peak Hour: PM Existing
Step 1: Select worksheet (speed reflects posted or statutory speed limit or 85th percentile speed on the major street):	
a) Worksheet 1 - 35 mph or less	
b) Worksheet 2- exceeds 35 mph, communities with less than 10,000, or where major transit stop exists	
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a TCD type of treatment?	
2a Peak-hour pedestrian volume (ped/h), vp	2a 20
o If 2a ≥ 20 ped/h, then go to Step 3. o If 2a < 20 ped/h, then consider median refuge islands, curb extensions, traffic calming, etc. as feasible.	
Step 3: Does the crossing meet the pedestrian volume warrant for a traffic signal?	
3a Major road volume, total of both approaches during peak hour (veh/h), V maj-s	3a 1698
3b o Minimum signal warrant volume for peak hour (use 3a for Vmaj-s), SC	3b 109.14
• SC = 0.00021 Vmaj-s ² - 0.74072 Vmaj-s + 734.125/0.75 OR • [(0.00021 3a ² - 0.74072 3a + 734.125)/0.75]	
3c o If 3b < 133, then enter 133. If 3b ≥ 133, then enter 3b.	3c 133
3d o If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce 3c by up to 50 percent; otherwise enter 3c.	3d 133
o If 2a ≥ 3d, then the warrant has been met and a traffic signal should be considered if not within 300 ft of another traffic signal. Otherwise, the warrant has not been met. Go to Step 4.	
Step 4: Estimate pedestrian delay.	
4a Pedestrian crossing distance, curb to curb (ft), L	4a 65
4b Pedestrian walking speed (ft.s), Sp	4b 3.5
4c Pedestrian start-up time and end clearance time (s), ts	4c 7
4d o Critical gap required for crossing pedestrian (s), tc = (L/Sp) + ts OR [(4a/4b) + 4c]	4d 25.57
4e Major road volume, total of both approaches or approach being crossed if median refuge island is present during peak hour (veh.h), Vmaj-d	4e 1698
4f o Major road flow rate (veh/s), v = Vmaj-d/3600 OR [4e/3600]	4f 0.47
4g o Average pedestrian delay (s/person), dp = (e ^{v_{tc}} - v _{tc} - 1) / v OR [(e ^{4f x 4d} - 4f x 4d - 1) / 4f]	4g 366809.44
4h o Total pedestrian delay (h), Dp = (dp x Vp) / 3600 OR [(4g x 2a) / 3600]	4h 2037.83
(this is estimated delay for all pedestrians crossing the major roadway without a crossing treatment - assumes 05 compliance). This calculated value can be replaced with the actual total pedestrian delay measured at the site.	
Step 5: Select treatment based upon total pedestrian delay and expected motorist compliance.	
5a Expected motorist compliance at pedestrian crossings in region, Comp = high or low	5a LOW

Total Pedestrian Delay Dp (4h) and Comp (5a)	Treatment Category (see Descriptions of Sample Treatments for examples)
Dp ≥ 21.3h (Comp = high or low) OR 5.3h ≤ Dp < 21.3 h and Comp = low	USE RED
1.3h ≤ Dp < 21.3h and Comp = high or low) OR 5.3 ≤ Dp < 21.3 h and Comp = high	DO NOT USE ACTIVE OR ENHANCED
Dp < 1.3 h (Comp = high or low)	DO NOT USE CROSSWALK

Roadway Configuration: 66' Wide, <35 mph, Vped = 3.5 ft/s



LEGEND	DESCRIPTIONS OF TREATMENT TYPE		
X Study Intersection	RED	ENHANCED-HIGH VISIBILITY/ACTIVE WHEN PRESENT	
Signal		Active When Present	Enhanced/High Visibility
Enhanced-High Visibility/Active when Present	• Midblock Signal	• In Roadway Warning Lights	• In-Street Crossing Signs
Red	• Half Signal	• Passive/Pushbutton Flashing Beacons	• High Visibility Signs/Markings
Enhanced-High Visibility/Active when Present (if high compliance expected) OR Red (if low compliance expected)	• HAWK	• Pedestrian Crossing Flags	• Pedestrian Refuge Islands
Striped Crosswalk		• Rapid Rectangular Flashing Beacons	• Raised Crosswalks
No Treatment			• Curb Extensions
			• Advanced Signage
			• Advanced Stop/Yield Lines
			• Constant Flashing Yellow Beacons

Pedestrian Hybrid Beacon (HAWK) Signal Warrant

Low-Speed Roadway

Project Name: Heritage Park TIS

Scenario: AM Existing

Location: Old Redwood Highway/3rd Street

Date of Count: Saturday, January 0, 1900

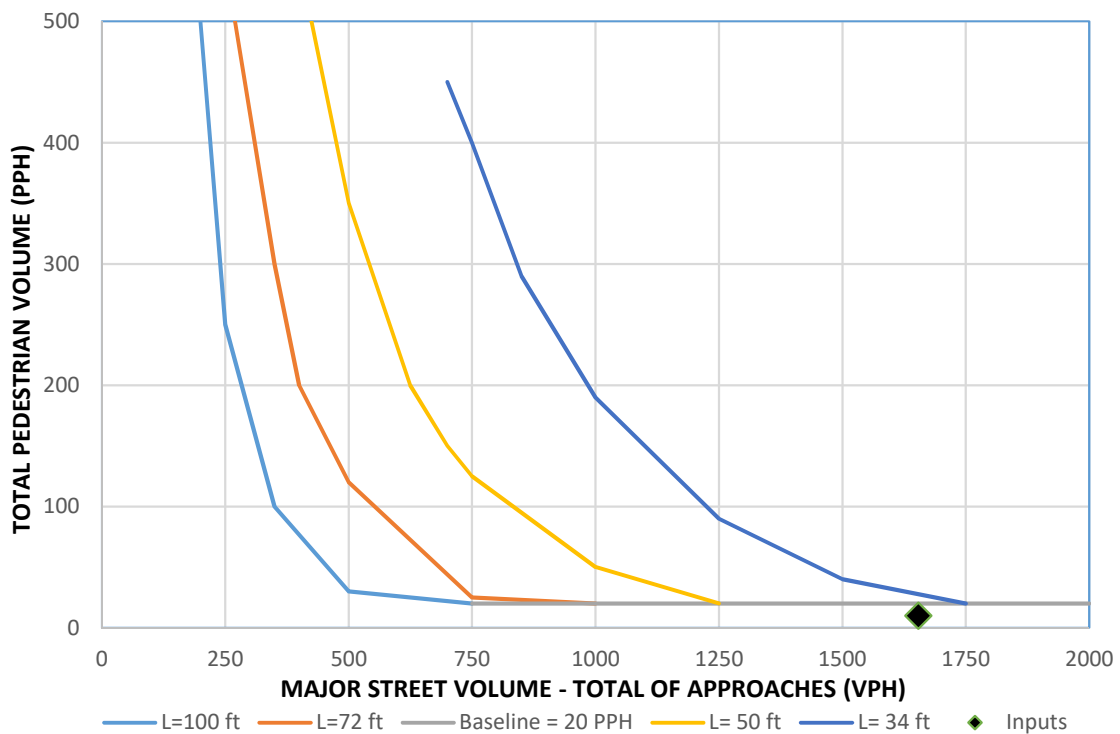
Speed Limit: 35 mph

Crosswalk Length: 65 feet

Major Street Approach Volume: 1,654 VPH

Pedestrians Crossing: 10 PPH

WARRANT MET? No



Note: Installation of a HAWK Signal is warranted when the plotted point (see graph above) falls above the curve representing the corresponding crosswalk length (L).

If the length (L) of the crosswalk does not match one displayed on the graph, interpolate between existing curves to find the position of the curve representing the crosswalk length being analyzed.

Reference: California Manual on Uniform Traffic Control Devices (MUTCD) 2014 Edition

Pedestrian Hybrid Beacon (HAWK) Signal Warrant

Low-Speed Roadway

Project Name: Heritage Park TIS

Scenario: PM Existing

Location: Old Redwood Highway/3rd Street

Date of Count: Saturday, January 0, 1900

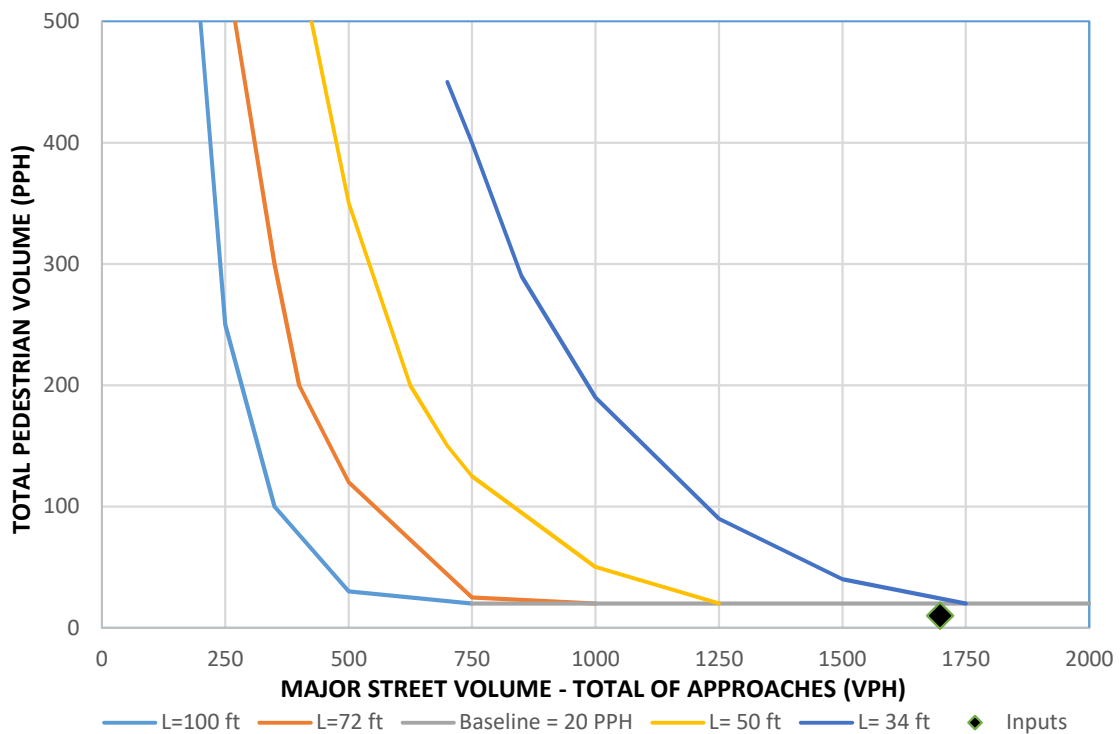
Speed Limit: 35 mph

Crosswalk Length: 65 feet

Major Street Approach Volume: 1,698 VPH

Pedestrians Crossing: 10 PPH

WARRANT MET? No



Note: Installation of a HAWK Signal is warranted when the plotted point (see graph above) falls above the curve representing the corresponding crosswalk length (L).

If the length (L) of the crosswalk does not match one displayed on the graph, interpolate between existing curves to find the position of the curve representing the crosswalk length being analyzed.

Reference: California Manual on Uniform Traffic Control Devices (MUTCD) 2014 Edition

Appendix B

Level of Service Methodology



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Level of Service Methodology

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 “Two-Way Stop-Controlled” intersection capacity methodology published in the *Highway Capacity Manual* (HCM), 6th Edition, Transportation Research Board, 2018. 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 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 1.

Table 1 – 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*, 6th Edition, Transportation Research Board, 2018



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Appendix C

Intersection Level of Service Calculations



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Intersection Level Of Service Report

Intersection 1: Old Redwood Hwy/2nd St-Courtyards E

Control Type:	Two-way stop	Delay (sec / veh):	65.4
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.013

Intersection Setup

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			T T			T T		
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [ft]	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
No. of Lanes in Pocket	0	0	0	0	0	0	1	0	0	1	0	0
Pocket Length [ft]	100.00	100.00	100.00	100.00	100.00	100.00	52.00	100.00	100.00	60.00	100.00	100.00
Speed [mph]	25.00			25.00			35.00			35.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			No			No		

Volumes

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Base Volume Input [veh/h]	30	1	13	6	0	26	15	735	11	2	893	3
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	30	1	13	6	0	26	15	735	11	2	893	3
Peak Hour Factor	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	8	0	3	2	0	7	4	198	3	1	240	1
Total Analysis Volume [veh/h]	32	1	14	6	0	28	16	790	12	2	960	3
Pedestrian Volume [ped/h]	7			4			0			0		

Intersection Settings

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

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.30	0.01	0.02	0.06	0.00	0.05	0.02	0.01	0.00	0.00	0.01	0.00
d_M, Delay for Movement [s/veh]	51.73	65.41	23.88	44.53	54.58	13.47	10.22	0.00	0.00	9.47	0.00	0.00
Movement LOS	F	F	C	E	F	B	B	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	1.37	1.37	1.37	0.39	0.39	0.39	0.07	0.00	0.00	0.01	0.00	0.00
95th-Percentile Queue Length [ft/ln]	34.34	34.34	34.34	9.77	9.77	9.77	1.74	0.00	0.00	0.19	0.00	0.00
d_A, Approach Delay [s/veh]	43.73			18.95			0.20			0.02		
Approach LOS	E			C			A			A		
d_I, Intersection Delay [s/veh]	1.55											
Intersection LOS	F											

Intersection Level Of Service Report

Intersection 1: Old Redwood Hwy/2nd St-Courtyards E

Control Type:	Two-way stop	Delay (sec / veh):	67.0
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.325

Intersection Setup

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			T T			T T		
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [ft]	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
No. of Lanes in Pocket	0	0	0	0	0	0	1	0	0	1	0	0
Pocket Length [ft]	100.00	100.00	100.00	100.00	100.00	100.00	52.00	100.00	100.00	60.00	100.00	100.00
Speed [mph]	25.00			25.00			35.00			35.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			No			No		

Volumes

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Base Volume Input [veh/h]	24	0	9	3	0	8	26	876	33	12	763	9
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	24	0	9	3	0	8	26	876	33	12	763	9
Peak Hour Factor	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	7	0	2	1	0	2	7	241	9	3	210	2
Total Analysis Volume [veh/h]	26	0	10	3	0	9	29	963	36	13	838	10
Pedestrian Volume [ped/h]	7			4			0			0		

Intersection Settings

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

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.32	0.00	0.02	0.03	0.00	0.02	0.04	0.01	0.00	0.02	0.01	0.00
d_M, Delay for Movement [s/veh]	67.04	80.39	29.18	45.06	65.15	12.02	9.80	0.00	0.00	10.40	0.00	0.00
Movement LOS	F	F	D	E	F	B	A	A	A	B	A	A
95th-Percentile Queue Length [veh/ln]	1.36	1.36	1.36	0.15	0.15	0.15	0.12	0.00	0.00	0.06	0.00	0.00
95th-Percentile Queue Length [ft/ln]	33.99	33.99	33.99	3.80	3.80	3.80	2.89	0.00	0.00	1.46	0.00	0.00
d_A, Approach Delay [s/veh]	56.52			20.28			0.28			0.16		
Approach LOS	F			C			A			A		
d_I, Intersection Delay [s/veh]	1.39											
Intersection LOS	F											

Intersection Level Of Service Report

Intersection 1: Old Redwood Hwy/2nd St-Courtyards E

Control Type:	Two-way stop	Delay (sec / veh):	74.9
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.015

Intersection Setup

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			T T			T T		
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [ft]	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
No. of Lanes in Pocket	0	0	0	0	0	0	1	0	0	1	0	0
Pocket Length [ft]	100.00	100.00	100.00	100.00	100.00	100.00	52.00	100.00	100.00	60.00	100.00	100.00
Speed [mph]	25.00			25.00			35.00			35.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			No			No		

Volumes

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Base Volume Input [veh/h]	33	1	14	7	0	29	17	829	12	2	991	3
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	33	1	14	7	0	29	17	829	12	2	991	3
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	8	0	4	2	0	7	4	207	3	1	248	1
Total Analysis Volume [veh/h]	33	1	14	7	0	29	17	829	12	2	991	3
Pedestrian Volume [ped/h]	7			4			0			0		

Intersection Settings

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

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.34	0.01	0.02	0.08	0.00	0.06	0.02	0.01	0.00	0.00	0.01	0.00
d_M, Delay for Movement [s/veh]	59.51	74.87	28.21	48.81	60.49	14.19	10.38	0.00	0.00	9.63	0.00	0.00
Movement LOS	F	F	D	E	F	B	B	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	1.60	1.60	1.60	0.47	0.47	0.47	0.08	0.00	0.00	0.01	0.00	0.00
95th-Percentile Queue Length [ft/ln]	40.06	40.06	40.06	11.75	11.75	11.75	1.90	0.00	0.00	0.19	0.00	0.00
d_A, Approach Delay [s/veh]	50.70			20.92			0.21			0.02		
Approach LOS	F			C			A			A		
d_I, Intersection Delay [s/veh]	1.75											
Intersection LOS	F											

Intersection Level Of Service Report

Intersection 1: Old Redwood Hwy/2nd St-Courtyards E

Control Type:	Two-way stop	Delay (sec / veh):	76.4
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.368

Intersection Setup

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			T T			T T		
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [ft]	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
No. of Lanes in Pocket	0	0	0	0	0	0	1	0	0	1	0	0
Pocket Length [ft]	100.00	100.00	100.00	100.00	100.00	100.00	52.00	100.00	100.00	60.00	100.00	100.00
Speed [mph]	25.00			25.00			35.00			35.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			No			No		

Volumes

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Base Volume Input [veh/h]	27	0	10	3	0	9	29	1009	37	13	847	10
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	27	0	10	3	0	9	29	1009	37	13	847	10
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	7	0	3	1	0	2	7	252	9	3	212	3
Total Analysis Volume [veh/h]	27	0	10	3	0	9	29	1009	37	13	847	10
Pedestrian Volume [ped/h]	7			4			0			0		

Intersection Settings

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

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.37	0.00	0.02	0.03	0.00	0.02	0.04	0.01	0.00	0.02	0.01	0.00
d_M, Delay for Movement [s/veh]	76.38	90.52	34.61	47.41	70.31	12.13	9.84	0.00	0.00	10.63	0.00	0.00
Movement LOS	F	F	D	E	F	B	A	A	A	B	A	A
95th-Percentile Queue Length [veh/ln]	1.57	1.57	1.57	0.16	0.16	0.16	0.12	0.00	0.00	0.06	0.00	0.00
95th-Percentile Queue Length [ft/ln]	39.24	39.24	39.24	3.97	3.97	3.97	2.92	0.00	0.00	1.52	0.00	0.00
d_A, Approach Delay [s/veh]	65.09			20.95			0.27			0.16		
Approach LOS	F			C			A			A		
d_I, Intersection Delay [s/veh]	1.55											
Intersection LOS	F											

Intersection Level Of Service Report

Intersection 1: Old Redwood Hwy/2nd St-Courtyards E

Control Type:	Two-way stop	Delay (sec / veh):	69.3
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.013

Intersection Setup

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			T T			T T		
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [ft]	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
No. of Lanes in Pocket	0	0	0	0	0	0	1	0	0	1	0	0
Pocket Length [ft]	100.00	100.00	100.00	100.00	100.00	100.00	52.00	100.00	100.00	60.00	100.00	100.00
Speed [mph]	25.00			25.00			35.00			35.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			No			No		

Volumes

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Base Volume Input [veh/h]	30	1	13	6	0	26	15	735	11	2	893	3
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	5	0	4	0	0	0	0	0	2	1	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	35	1	17	6	0	26	15	735	13	3	893	3
Peak Hour Factor	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300	0.9300
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	9	0	5	2	0	7	4	198	3	1	240	1
Total Analysis Volume [veh/h]	38	1	18	6	0	28	16	790	14	3	960	3
Pedestrian Volume [ped/h]	7			4			0			0		

Intersection Settings

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

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.36	0.01	0.03	0.06	0.00	0.05	0.02	0.01	0.00	0.00	0.01	0.00
d_M, Delay for Movement [s/veh]	55.54	69.29	27.50	44.99	54.94	13.49	10.22	0.00	0.00	9.49	0.00	0.00
Movement LOS	F	F	D	E	F	B	B	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	1.75	1.75	1.75	0.39	0.39	0.39	0.07	0.00	0.00	0.01	0.00	0.00
95th-Percentile Queue Length [ft/ln]	43.69	43.69	43.69	9.84	9.84	9.84	1.74	0.00	0.00	0.28	0.00	0.00
d_A, Approach Delay [s/veh]	46.93			19.05			0.20			0.03		
Approach LOS	E			C			A			A		
d_I, Intersection Delay [s/veh]	1.87											
Intersection LOS	F											

Intersection Level Of Service Report

Intersection 1: Old Redwood Hwy/2nd St-Courtyards E

Control Type:	Two-way stop	Delay (sec / veh):	73.4
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.385

Intersection Setup

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			T T			T T		
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [ft]	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
No. of Lanes in Pocket	0	0	0	0	0	0	1	0	0	1	0	0
Pocket Length [ft]	100.00	100.00	100.00	100.00	100.00	100.00	52.00	100.00	100.00	60.00	100.00	100.00
Speed [mph]	25.00			25.00			35.00			35.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			No			No		

Volumes

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Base Volume Input [veh/h]	24	0	9	3	0	8	26	876	33	12	763	9
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	3	0	3	0	0	0	0	0	5	4	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	27	0	12	3	0	8	26	876	38	16	763	9
Peak Hour Factor	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	7	0	3	1	0	2	7	241	10	4	210	2
Total Analysis Volume [veh/h]	30	0	13	3	0	9	29	963	42	18	838	10
Pedestrian Volume [ped/h]	7			4			0			0		

Intersection Settings

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

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.39	0.00	0.03	0.03	0.00	0.02	0.04	0.01	0.00	0.03	0.01	0.00
d_M, Delay for Movement [s/veh]	73.39	87.02	34.28	46.26	67.04	12.05	9.80	0.00	0.00	10.47	0.00	0.00
Movement LOS	F	F	D	E	F	B	A	A	A	B	A	A
95th-Percentile Queue Length [veh/ln]	1.71	1.71	1.71	0.16	0.16	0.16	0.12	0.00	0.00	0.08	0.00	0.00
95th-Percentile Queue Length [ft/ln]	42.81	42.81	42.81	3.88	3.88	3.88	2.89	0.00	0.00	2.05	0.00	0.00
d_A, Approach Delay [s/veh]	61.56			20.60			0.27			0.22		
Approach LOS	F			C			A			A		
d_I, Intersection Delay [s/veh]	1.72											
Intersection LOS	F											

Intersection Level Of Service Report

Intersection 1: Old Redwood Hwy/2nd St-Courtyards E

Control Type:	Two-way stop	Delay (sec / veh):	79.1
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.015

Intersection Setup

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			T T			T T		
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [ft]	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
No. of Lanes in Pocket	0	0	0	0	0	0	1	0	0	1	0	0
Pocket Length [ft]	100.00	100.00	100.00	100.00	100.00	100.00	52.00	100.00	100.00	60.00	100.00	100.00
Speed [mph]	25.00			25.00			35.00			35.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			No			No		

Volumes

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Base Volume Input [veh/h]	33	1	14	7	0	29	17	829	12	2	991	3
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	5	0	4	0	0	0	0	0	1	1	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	38	1	18	7	0	29	17	829	13	3	991	3
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	10	0	5	2	0	7	4	207	3	1	248	1
Total Analysis Volume [veh/h]	38	1	18	7	0	29	17	829	13	3	991	3
Pedestrian Volume [ped/h]	7			4			0			0		

Intersection Settings

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

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.40	0.01	0.03	0.08	0.00	0.06	0.02	0.01	0.00	0.00	0.01	0.00
d_M, Delay for Movement [s/veh]	63.64	79.06	32.14	49.34	60.82	14.22	10.38	0.00	0.00	9.64	0.00	0.00
Movement LOS	F	F	D	E	F	B	B	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	1.97	1.97	1.97	0.47	0.47	0.47	0.08	0.00	0.00	0.01	0.00	0.00
95th-Percentile Queue Length [ft/ln]	49.27	49.27	49.27	11.85	11.85	11.85	1.90	0.00	0.00	0.29	0.00	0.00
d_A, Approach Delay [s/veh]	53.96			21.05			0.21			0.03		
Approach LOS	F			C			A			A		
d_I, Intersection Delay [s/veh]	2.07											
Intersection LOS	F											

Intersection Level Of Service Report

Intersection 1: Old Redwood Hwy/2nd St-Courtyards E

Control Type:	Two-way stop	Delay (sec / veh):	82.1
Analysis Method:	HCM 6th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.418

Intersection Setup

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			T T			T T		
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [ft]	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
No. of Lanes in Pocket	0	0	0	0	0	0	1	0	0	1	0	0
Pocket Length [ft]	100.00	100.00	100.00	100.00	100.00	100.00	52.00	100.00	100.00	60.00	100.00	100.00
Speed [mph]	25.00			25.00			35.00			35.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			No			No		

Volumes

Name	Courtyards East			2nd St			Old Redwood Hwy			Old Redwood Hwy		
Base Volume Input [veh/h]	27	0	10	3	0	9	29	1009	37	13	847	10
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	3	0	3	0	0	0	0	0	3	4	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	30	0	13	3	0	9	29	1009	40	17	847	10
Peak Hour Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	8	0	3	1	0	2	7	252	10	4	212	3
Total Analysis Volume [veh/h]	30	0	13	3	0	9	29	1009	40	17	847	10
Pedestrian Volume [ped/h]	7			4			0			0		

Intersection Settings

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

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.42	0.00	0.03	0.04	0.00	0.02	0.04	0.01	0.00	0.03	0.01	0.00
d_M, Delay for Movement [s/veh]	82.09	96.45	39.27	48.49	71.79	12.16	9.84	0.00	0.00	10.68	0.00	0.00
Movement LOS	F	F	E	E	F	B	A	A	A	B	A	A
95th-Percentile Queue Length [veh/ln]	1.88	1.88	1.88	0.16	0.16	0.16	0.12	0.00	0.00	0.08	0.00	0.00
95th-Percentile Queue Length [ft/ln]	46.93	46.93	46.93	4.04	4.04	4.04	2.92	0.00	0.00	2.01	0.00	0.00
d_A, Approach Delay [s/veh]	69.14			21.24			0.26			0.21		
Approach LOS	F			C			A			A		
d_I, Intersection Delay [s/veh]	1.84											
Intersection LOS	F											

Appendix D

Collision Rate Calculations



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Intersection Collision Rate Calculations

Traffic Impact Study for the Heritage Park Project

Intersection # 1: Old Redwood HWY & 2nd Street - Courtyards East

Date of Count: Thursday, July 11, 2019

Number of Collisions: 3

Number of Injuries: 2

Number of Fatalities: 0

ADT: 17400

Start Date: June 30, 2014

End Date: July 1, 2019

Number of Years: 5

Intersection Type: Four-Legged

Control Type: Stop & Yield Controls

Area: Urban

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

$$\text{collision rate} = \frac{3}{17,400} \times \frac{1,000,000}{365 \times 5}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	0.09 c/mve	0.0%	66.7%
Statewide Average*	0.15 c/mve	1.0%	41.9%

ADT = average daily total vehicles entering intersection

c/mve = collisions per million vehicles entering intersection

* 2014 Collision Data on California State Highways, Caltrans



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