TRAFFIC ENGINEERING STUDY
For MALLARD LANE TRAFFIC CONTROL PLAN

Prepared for: Phillippi Engineering Inc.

JULY 1, 2024

Prepared by:

Traffic Engineering & Transportation Planning

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Background

There is an existing zebra striped crosswalk on Mallard Lane at the intersection with Pintail Lane that exists only for the south side of the intersection as shown in Figure 1. This intersection is an uncontrolled intersection for Mallard Lane traffic but has stop sign control on both approaches of Pintail Lane / McIntosh Drive. There are two existing bus pullout areas also identified.

Figure 1. Existing Conditions on Mallard Lane in the Study Area

The posted speed limit of Mallard Lane is 30 mph, and it has been observed in the past that there are vehicles traveling between 35 and 40 mph down a steep grade of Mallard lane toward Drake

Court and then onward to Pintail Lane. PRISM Engineering also observed traffic speeds that significantly exceeded these speeds and had a prevailing 85th percentile speed in excess of 40 mph as shown later in this report. Safety for the existing pedestrian crossing at Pintail Lane is a primary existing concern that has been addressed in this traffic study, first by observing traffic speeds on Mallard Lane in an official speed survey data collection, and then also considering the steep grades coupled with sight distance constraints that exist on Mallard Lane.

In our analyses, we considered the practicality and safety considerations for an option to place a new crosswalk on Mallard Lane at the Drake Court intersection. As another alternative we considered and explored the option to expand the traffic control at the Mallard Lane and Pintail Lane / McIntosh Drive intersection to additionally include new stop sign control options for both of the Mallard Lane approaches, and whether additional crosswalks could or should be installed.

In this study, we established existing traffic conditions by counting all turning movements of traffic during the a.m. and p.m. peak hour time periods at three intersections on Mallard Lane:

1. Mallard Lane at Green Wing Lane
2. Mallard Lane at Pintail Lane / McIntosh Drive
3. Mallard Lane at Drake Court

In these counts we also observed all traffic patterns from an aerial vantage point using drone video technology and could easily see where traffic demand and turning movement patterns were on at the three intersections listed above. The vast majority of traffic on Mallard Lane through these three intersections was the through traffic component (approximately 80-85%) compared to traffic to and from the three side streets listed above. We also documented the various mode splits of travel such as bicycles, pedestrians, vehicles, and buses on the roads, and this information is contained in the Appendix under Traffic Counts.

We measured the speed of travel along two critical sections of Mallard Lane within the study area: 1) Mallard Lane between 300 feet south of Drake Court and Drake Court, and 2) Mallard Lane between Drake Court and Pintail Lane / McIntosh Drive.

Another aspect of this study was to physically measure and observe the sight distance constraints along the Mallard Lane corridor in these two sections to help in determining what the relevant safe stopping sight distance measurements would be related to the safe crossing of pedestrian traffic in the existing crosswalk installed on Mallard Lane at Pintail Lane, as seen by a driver traveling downhill and northbound in these two sections of Mallard Lane that are especially critical due to prevailing high speeds of traffic coming down Mallard Lane. The purpose of this analysis was to ensure that at all points a driver would be able to have adequate safe, stopping site distance with the presence of pedestrians in that existing crosswalk. We would determine by analysis that the only safe option for this location would be to install a full four-way stop (AWS) at the intersection of Mallard Lane and Pintail / McIntosh.

Existing Conditions

Data Collection: Traffic Counts

On Wednesday June 5, 2024, PRISM Engineering conducted three am and pm peak hour traffic counts at the intersections of:

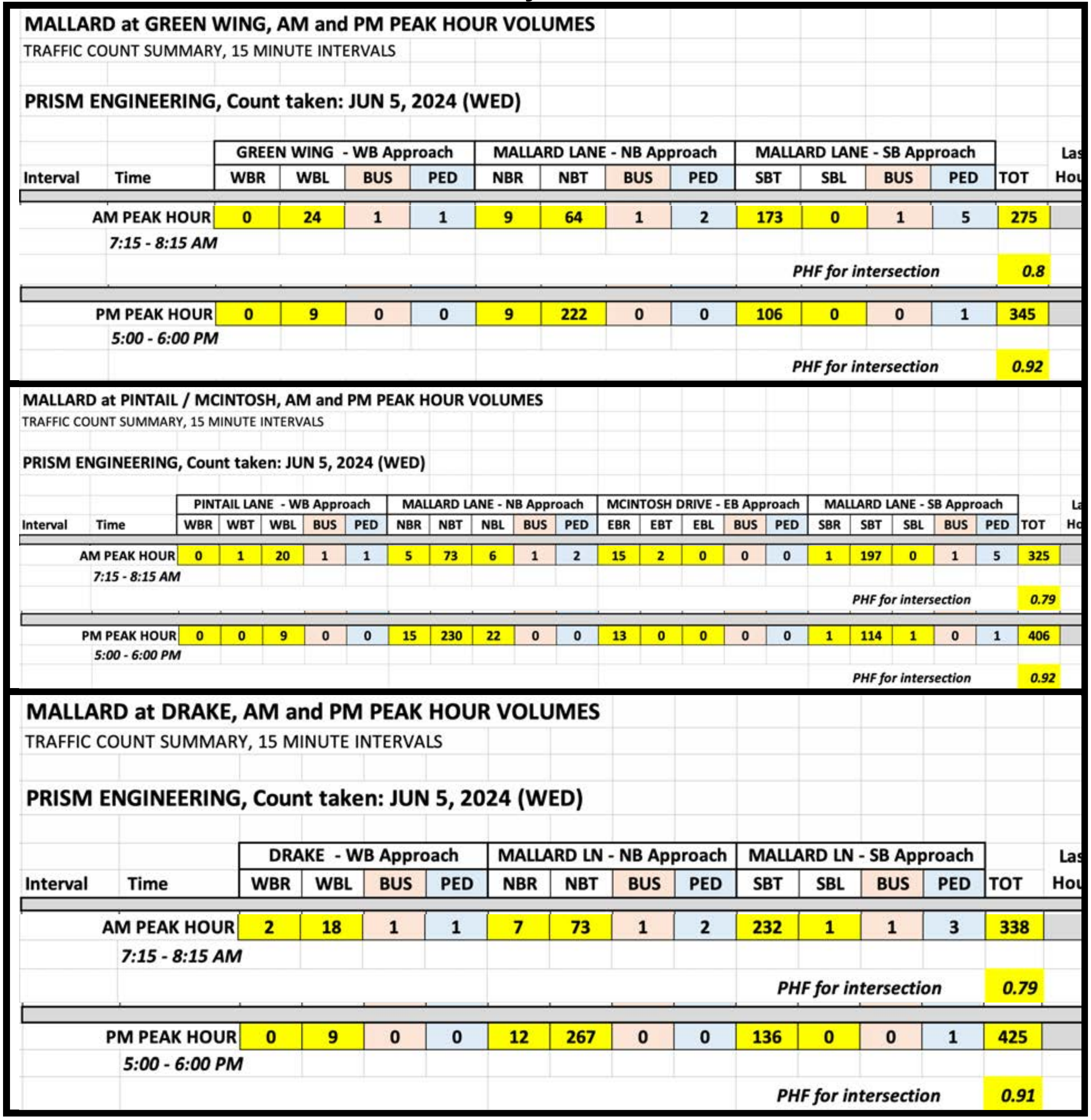
1. Mallard Lane at Green Wing Lane
2. Mallard Lane at Pintail Lane / McIntosh Drive
3. Mallard Lane at Drake Court

We also flew a drone camera to get details on traffic patterns and roadway conditions and configurations on the highway and local roadways. Figure 2 shows the study area which includes the three individual study intersection locations in an aerial photo of the current configuration taken during the pm peak hour speed survey.

Figure 2. Study Area and Analysis Intersections

The traffic counts were videotaped and summarized into turning movements. This information is shown in the following "***Table 1. Traffic Count Summary of AM and PM Peak Hour Traffic"*** for the three intersections which include the turning movement counts for the am and pm peak hours.

Table 1. Traffic Count Summary of AM and PM Peak Hour Traffic



MALLARD at GREEN WING, AM and PM PEAK HOUR VOLUMES

TRAFFIC COUNT SUMMARY, 15 MINUTE INTERVALS

PRISM ENGINEERING, Count taken: JUN 5, 2024 (WED)

		GREEN WING - WB Approach				MALLARD LANE - NB Approach				MALLARD LANE - SB Approach					Las
Interval	Time	WBR	WBL	BUS	PED	NBR	NBT	BUS	PED	SBT	SBL	BUS	PED	TOT	Hou
	AM PEAK HOUR	0	24	1	1	9	64	1	2	173	0	1	5	275	
	7:15 - 8:15 AM														
											PHF for intersection			0.8	
	PM PEAK HOUR	0	9	0	0	9	222	0	0	106	0	0	1	345	
	5:00 - 6:00 PM														
											PHF for intersection			0.92	

MALLARD at PINTAIL / MCINTOSH, AM and PM PEAK HOUR VOLUMES

TRAFFIC COUNT SUMMARY, 15 MINUTE INTERVALS

PRISM ENGINEERING, Count taken: JUN 5, 2024 (WED)

		PINTAIL LANE - WB Approach					MALLARD LANE - NB Approach					MCINTOSH DRIVE - EB Approach					MALLARD LANE - SB Approach						La
Interval	Time	WBR	WBT	WBL	BUS	PED	NBR	NBT	NBL	BUS	PED	EBR	EBT	EBL	BUS	PED	SBR	SBT	SBL	BUS	PED	TOT	Ho
	AM PEAK HOUR	0	1	20	1	1	5	73	6	1	2	15	2	0	0	0	1	197	0	1	5	325	
	7:15 - 8:15 AM																						
																			PHF for intersection			0.79	
	PM PEAK HOUR	0	0	9	0	0	15	230	22	0	0	13	0	0	0	0	1	114	1	0	1	406	
	5:00 - 6:00 PM																						
																			PHF for intersection			0.92	

MALLARD at DRAKE, AM and PM PEAK HOUR VOLUMES

TRAFFIC COUNT SUMMARY, 15 MINUTE INTERVALS

PRISM ENGINEERING, Count taken: JUN 5, 2024 (WED)

		DRAKE - WB Approach				MALLARD LN - NB Approach				MALLARD LN - SB Approach					Las
Interval	Time	WBR	WBL	BUS	PED	NBR	NBT	BUS	PED	SBT	SBL	BUS	PED	TOT	Hou
	AM PEAK HOUR	2	18	1	1	7	73	1	2	232	1	1	3	338	
	7:15 - 8:15 AM														
											PHF for intersection			0.79	
	PM PEAK HOUR	0	9	0	0	12	267	0	0	136	0	0	1	425	
	5:00 - 6:00 PM														
											PHF for intersection			0.91	

Source: PRISM Engineering, Traffic Counts

Traffic conditions at these three study intersections, and on Mallard Lane in general, are at LOS-A, or free flow conditions with little to no delay. Traffic speeds were observed to be much higher than the posted 30 mph speed limit (85th percentile speed was 43 mph for southbound downhill traffic approaching Pintail Lane).

Traffic Speeds on Mallard Lane in the Study Area

Figure 3 below shows the area where traffic speeds were measured in this study using the “Space Mean Speed” methodology as defined by the Federal Highway Administration (FHWA). Namely, there was a 300-foot-long segment shown in blue and a 400-foot-long segment shown in red in which speeds were averaged over the length of the segment.

The 85th percentile speed in the blue area, SPEED ZONE 1, was 41 mph, and in SPEED ZONE 2 it was determined to be 43 mph. However, the posted speed limit is only 30 mph on Mallard Lane throughout the study area.

Figure 3. Speed Survey Zones for Downhill NB Mallard Lane Critical Traffic

"SPACE MEAN SPEED” STUDIES

PRISM Engineering conducted what are known as “Space Mean Speed” studies on Mallard Lane on June 5th, 2024, during the pm peak hour time period, and did this at two locations: 1) Mallard Lane 300 feet s/o Drake Ct. to Drake Ct., and 2) Mallard Lane from Drake Ct. to Pintail Lane. The Federal Highway Administration published the following concerning this kind of speed survey and ranks it as the highest quality of data, even though it is harder to obtain the data (excerpts shown in **BLUE** below).

U.S. Department of Transportation
Federal Highway Administration

3. Collecting/Analyzing Speed and Crash Data[1]

The need for speed management is generally determined by reviewing actual speeds and crash histories, as well as road user needs. Speed studies also assist in setting or modifying speed limits. Speed and crash information support quantifying the impact of installed countermeasures or practices. This chapter discusses speed and crash studies that are applicable to rural communities at both the transition zones and in town center areas.

Generally, a speeding or speed-related crash problem is documented before resources are committed to implementing countermeasures. Agencies should also ensure speed limits are appropriately and consistently set (and properly signed, per the guidance laid out in Chapter 2)..

3.1 Speed Studies

3.1.1 Collecting Speed Data

The most common method to assess speeding issues is through ***spot speed studies****. Spot speed is measured* ***at a specific point along a roadway segment*** *as shown in Figure 3-1.*

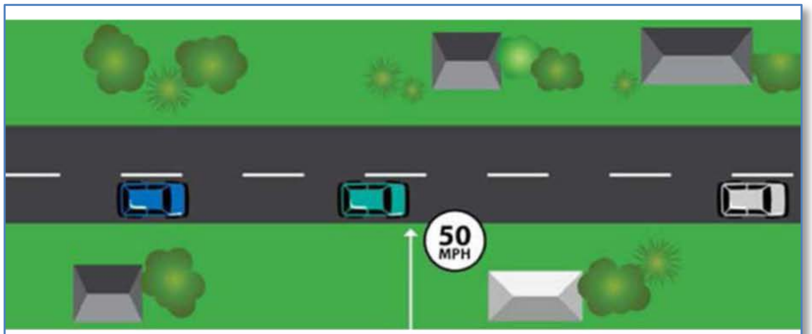


Figure 3-1 Measuring Spot Speed. (Image Source: FHWA)

Using this method, speed is recorded at one particular location and only indicates speed at that point. When taking multiple spot speed measurements from a single location over time, and averaging them together, the resultant value is frequently referred to as "time mean speed," "mean speed," or simply, "average speed."

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[1] https://highways.dot.gov/safety/speed-management/speed-management-eprimer-rural-transition-zones-and-town-centers/3

> ***A more robust method of speed measurement** can be done wherein speed is measured at various points along a road segment and then **averaged**, as shown in Figure 3-2.*
>
> *This methodology is typically referred to as "space mean speed," and can provide a more complete picture of speed behavior through a corridor.*

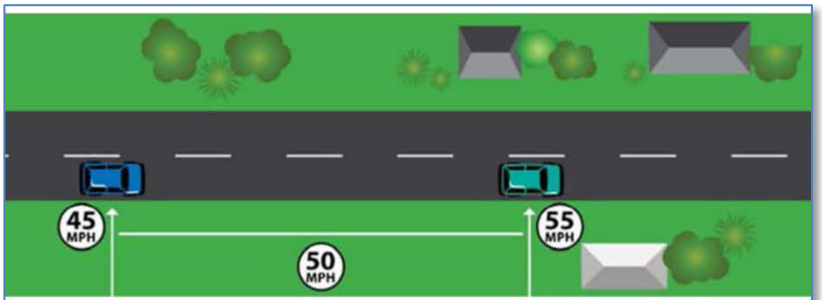


Figure 3-2 Measuring Average Speed.
(Image Source: FHWA)

> ***An alternative method of computing SPACE MEAN SPEED can be done by calculating speed directly using a known length of roadway, and the measured amount of time it takes a vehicle to traverse the segment."***

This last method is the method that PRISM Engineering used to measure speeds from field data collection drone aerial video. PRISM Engineering has radar equipment to measure spot speed, however, with drone technology and the resultant aerial video of traffic flows, a much more accurate picture of speeds is possible. We were able to measure the ***average*** vehicle speeds in defined roadway segments as shown in Figure 3. The measurements were taken in the office later by watching a prepared video with secondhand clock on a computer. This aerial view eliminated any visual line of sight obstruction that could have occurred from other vehicles on the road which is often the case in the field. In addition, there was no radar survey vehicle present on Mallard Lane because all vehicle speed views were taken from the drone.

PRISM Engineering conducted the more robust speed profile method ("Space Mean Speed") by utilizing a flying video camera, or drone, and took about an hour of aerial video of the segment of Mallard Lane 300 feet s/o Drake Ct. to past the Green Wing Lane intersection. We measured traffic mean speed along two segments as follows:

1) Mallard Lane 300 feet s/o Drake Ct. to Drake Ct. (a 300-foot distance shown in blue shade on Figure 3)

2) Mallard Lane from Drake Ct. to Pintail Ln. (a 400-foot distance shown in red shade on Figure 3)

We utilized a computer video with frame-to-frame precision (60 frames per second) and lining up sample cars at the beginning of each survey segment, a begin time was noted in a spreadsheet corresponding to the sample. Letting the video play next until the survey vehicle crossed the end point of the segment, the video was paused at this point, and it was possible to record the end time from the video timeline. This was the elapsed time, and it was used in the spreadsheet to calculate the average speed for the segment using the known distance for each segment in Figure 3. This more robust method as per the FHWA most likely resulted in an even slower average speed, rather than the high point source speed that often comes from a radar speed survey where the highest peak value is written down for each sample. The average speed method on the segment is more representative of the vehicle speed over time and eliminates anomalies in high or low speed measurements.

PRISM Engineering created a spreadsheet containing these values for 50 samples of the northbound (downhill) traffic on Mallard Lane and summarized the data by running it through equations that calculated the 85%th percentile, average speed, pace speed, etc., and these results are shown in the following graphics that show the speed survey curve in a graph, as well as the calculated values.

SPOT SPEED ENGINEERING STUDY prepared by PRISM Engineering

Date: 6/5/24

City of Placerville

Location: MALLARD LANE NB from DRAKE to 300' S/O DRAKE

Time: 6:00 PM

Posted Speed: 30 MPH

Weather: Clear, Dry.

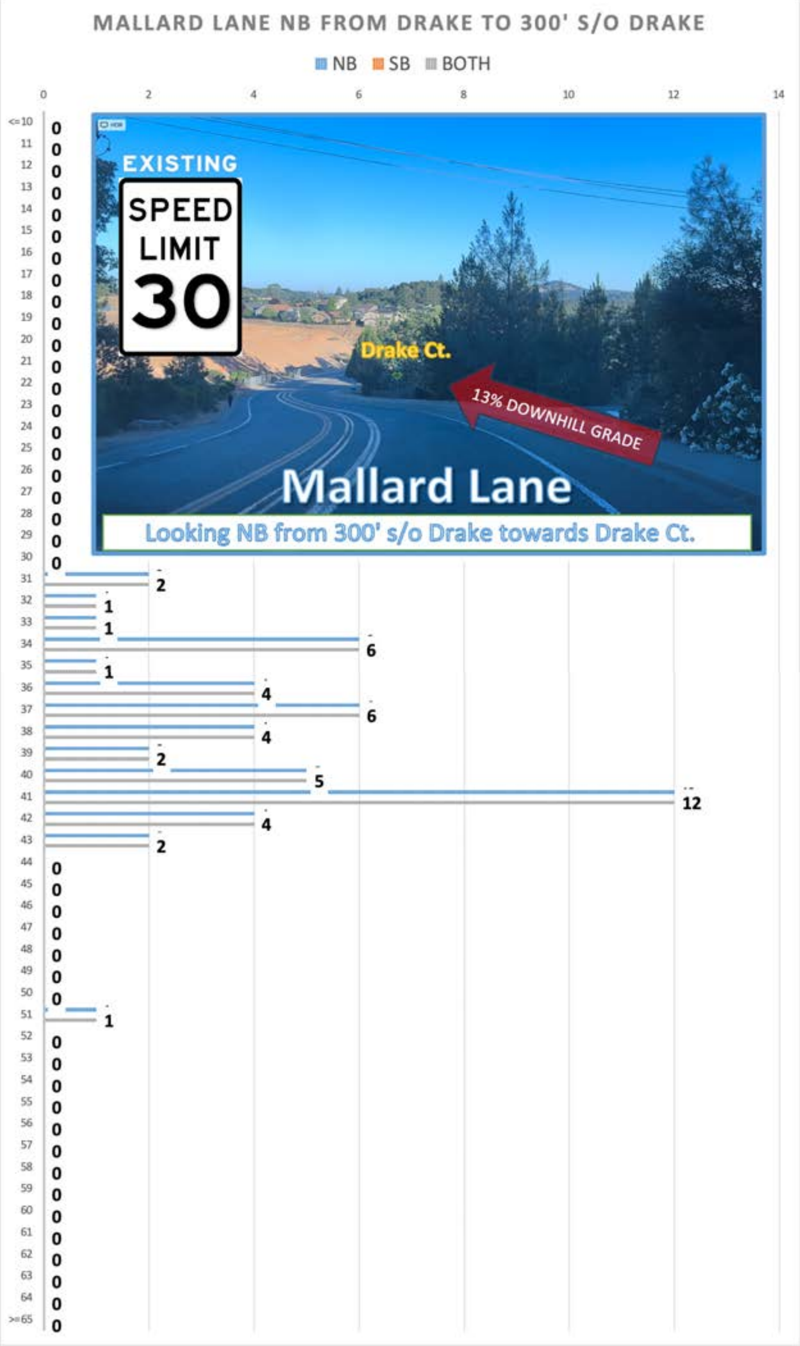
Pace Speed: 34 - 43 MPH

85th %: 41 MPH

MPH	NB	SB	BOTH		Cumulative %	Pace
<=10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						2
23						3
24						4
25						10
26						11
27						15
28						21
29						25
30						27
31	2		2	2	4%	32
32	1		1	3	6%	42
33	1		1	4	8%	45
34	6		6	10	20%	46
35	1		1	11	22%	40
36	4		4	15	29%	39
37	6		6	21	41%	35
38	4		4	25	49%	29
39	2		2	27	53%	25
40	5		5	32	63%	23
41	12		12	44	86%	18
42	4		4	48	94%	7
43	2		2	50	98%	3
44				50	98%	1
45				50	98%	1
46				50	98%	1
47				50	98%	1
48				50	98%	1
49				50	98%	1
50				50	98%	1
51	1		1	51	100%	1
52				51	100%	
53				51	100%	
54				51	100%	
55				51	100%	
56				51	100%	
57				51	100%	
58				51	100%	
59				51	100%	
60				51	100%	
61				51	100%	
62				51	100%	
63				51	100%	
64				51	100%	
>=65				51	100%	
TOTAL	51		51			

85th % (41)

<<< PACE SPEED >>> (34 - 43)



SPOT SPEED ENGINEERING STUDY prepared by PRISM Engineering

Date: 6/5/24 City of Placerville Location: MALLARD LANE NB from DRAKE to PINTAIL

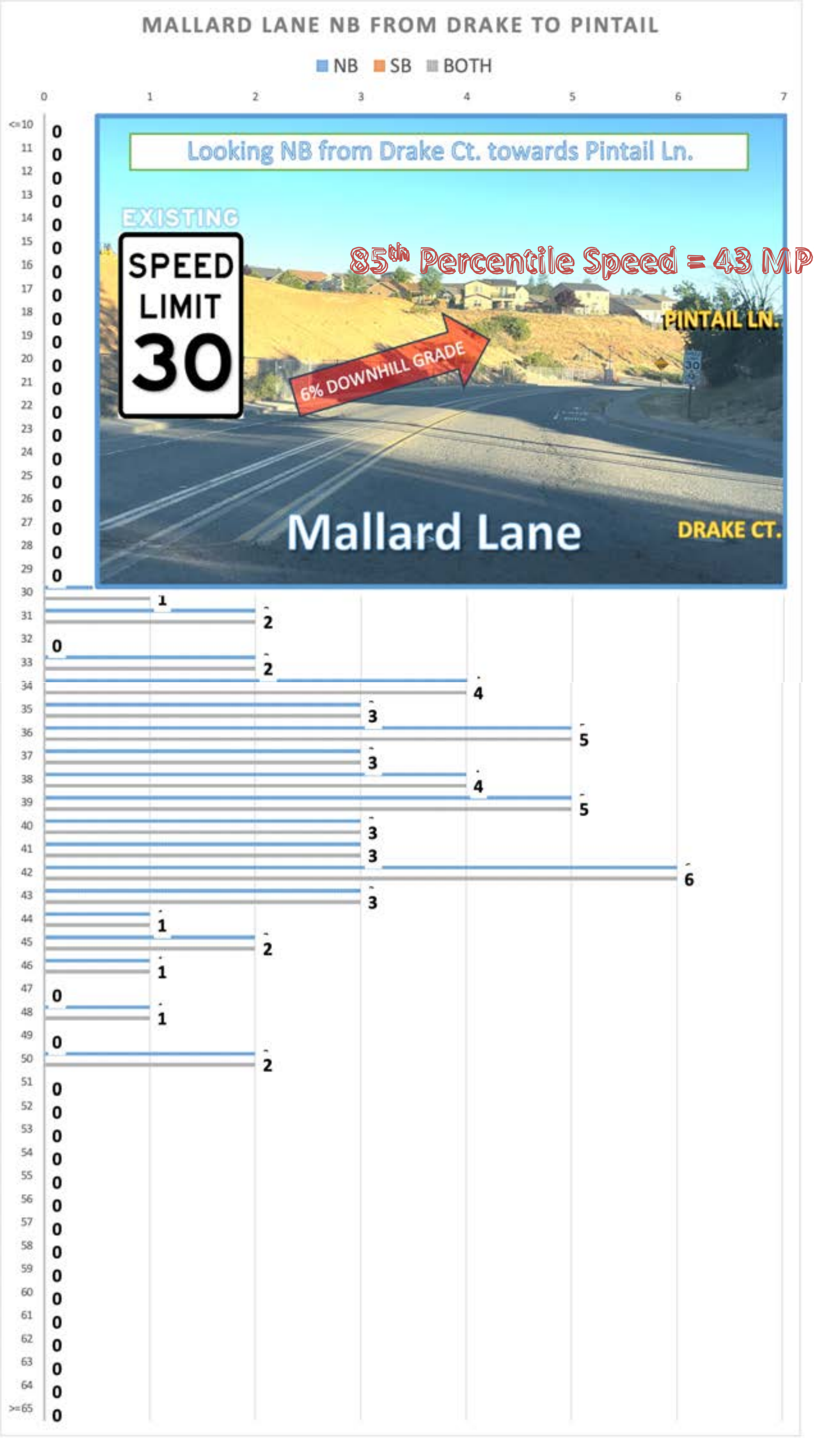
Start: 6:00 PM Posted Speed: 30 MPH Weather: Clear. Dry. Pace Speed: 34-43 MPH **85th %: 43 MPH**

MPH	NB	SB	BOTH		Cumulative %	Pace
<=10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						1
22						3
23						3
24						5
25						9
26						12
27						17
28						20
29						24
30	1		1	1	2%	29
31	2		2	3	6%	31
32				3	6%	32
33	2		2	5	10%	38
34	4		4	9	18%	39
35	3		3	12	24%	36
36	5		5	17	33%	35
37	3		3	20	39%	31
38	4		4	24	47%	28
39	5		5	29	57%	25
40	3		3	32	63%	20
41	3		3	35	69%	19
42	6		6	41	80%	16
43	3		3	44	86%	10
44	1		1	45	88%	7
45	2		2	47	92%	6
46	1		1	48	94%	4
47				48	94%	3
48	1		1	49	96%	3
49				49	96%	2
50	2		2	51	100%	2
51				51	100%	
52				51	100%	
53				51	100%	
54				51	100%	
55				51	100%	
56				51	100%	
57				51	100%	
58				51	100%	
59				51	100%	
60				51	100%	
61				51	100%	
62				51	100%	
63				51	100%	
64				51	100%	
>=65				51	100%	
TOTAL	51		51			

<<< PACE SPEED >>>

85th %

Chart Area



Stopping Sight Distance Analysis

The safe stopping sight distance values used[2] in Chapter 6 of the MUTCD, Chapter 2 of the Caltrans Highway Design Manual, and Chapter 3 of the AASHTO Green Book each have the same or similar values of how much distance is needed to stop in time to avoid a collision based on the travel speed in mph. For the purposes of this study, the travel speeds are those prevailing speeds (the 85th percentile speed) which were calculated using the "Space Mean Speed" as defined in the previous section. The results of the speed survey show that the 85th percentile speed for SPEED ZONE 1 was 41 mph, and the 85th percentile speed for SPEED ZONE 2 approaching the crosswalk was 43 mph, or over 11 mph and 13 mph higher than the posted speed limit for Mallard Lane. The Caltrans **Sight Distance Standards Table 201.1** is shown here for reference as to what are the stopping sight distances needed to avoid a collision based on prevailing vehicle speeds.

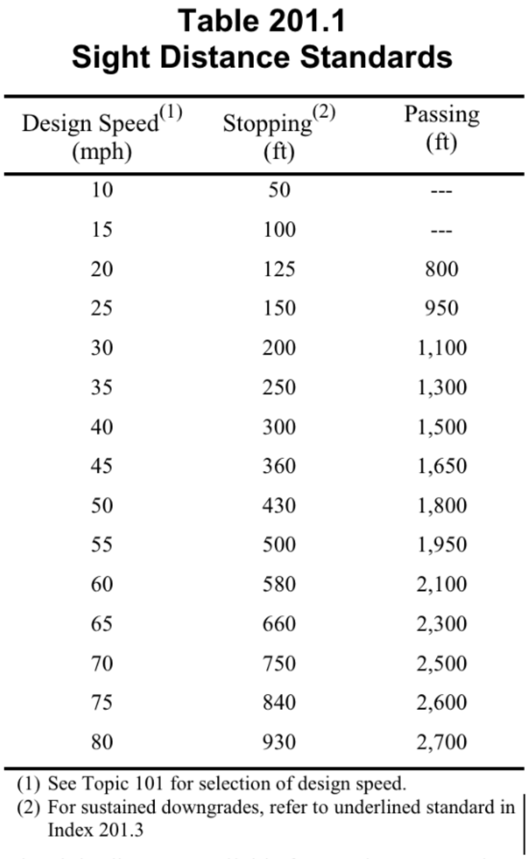


Table 201.1
Sight Distance Standards

Design Speed(1) (mph)	Stopping(2) (ft)	Passing (ft)
10	50	---
15	100	---
20	125	800
25	150	950
30	200	1,100
35	250	1,300
40	300	1,500
45	360	1,650
50	430	1,800
55	500	1,950
60	580	2,100
65	660	2,300
70	750	2,500
75	840	2,600
80	930	2,700

(1) See Topic 101 for selection of design speed.
(2) For sustained downgrades, refer to underlined standard in Index 201.3

As can be seen from this table which values are also defined in the MUTCD and AASHTO publications, It would take about 300 feet to stop in time when traveling at 40 mph. Sight distance constraints also play a role in these thresholds, because if the line-of-sight distance is less than the value shown in Table 201.1 then there is a problem. If a downhill grade exists, it is aggravated.

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[2] See MUTCD Chapter 6, Table 6C-2, Stopping Sight Distance as a Function of Speed. See AASHTO Table 3-1, Stopping Sight Distance on Level Roadways. See Caltrans Highway Design Manual, Table 201.1, Sight Distance Standards.

The Caltrans Highway Design Manual defines equations for the purpose of increasing the stopping sight distance needed if there is a downhill grade involved. PRISM Engineering used a drone to measure elevations at certain locations in the field (along Mallard Lane) to get a benchmark at Pintail Lane / McIntosh Drive, and another on both sides of Mallard Lane at Drake Court, and at a point 300 feet to the south of Drake Lane near to the overhead power lines and the utility box on the west side of the road. Details on this process can be found in the appendix. Our field measurements of roadway grade of the as-built condition of Mallard Lane closely correlate with the values shown on the plans in Figure 4 below.

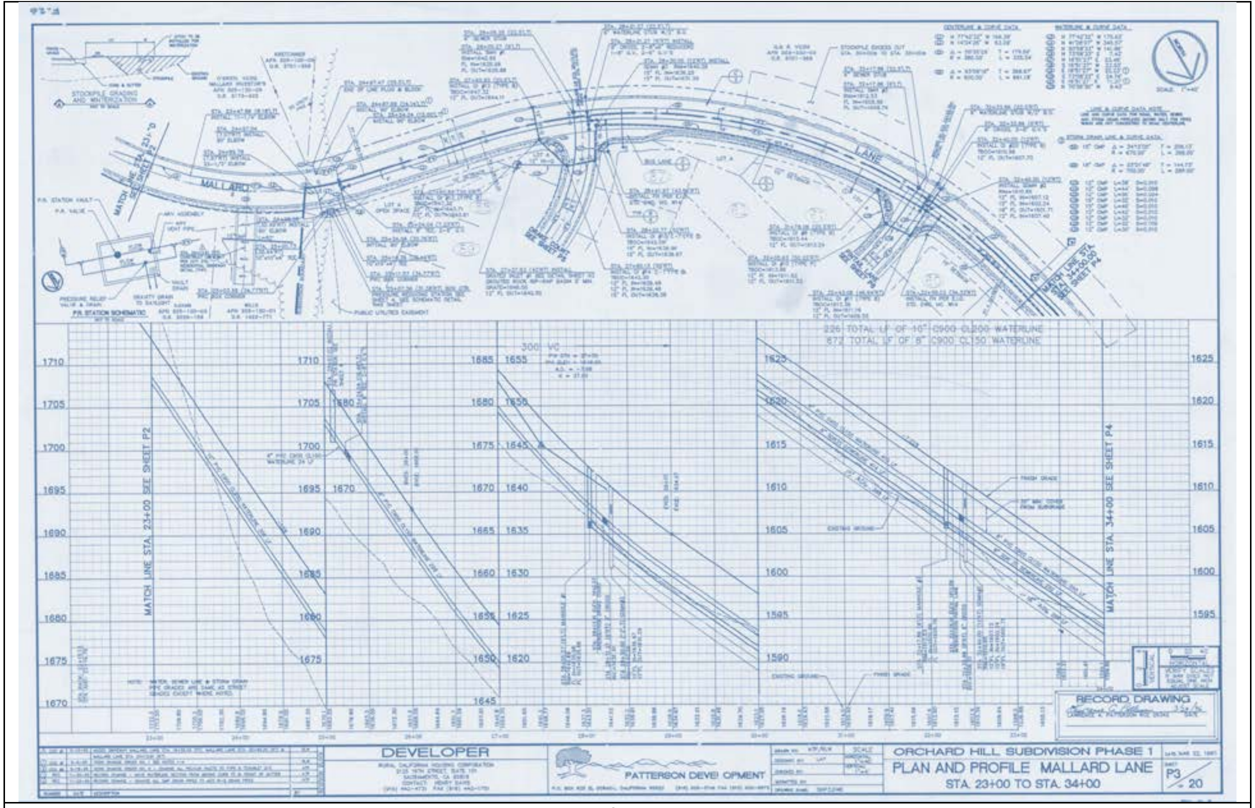

Figure 4. Plan and Profile Mallard Lane[3]

The speed survey results shown previously also show the grade of the road and are given in Figure 5 which follows. The measured grade for SPEED ZONE 1 and SPEED ZONE 2 as shown in Figure 3 are as follows:

- SPEED ZONE 1 average grade = 13% downhill grade
- SPEED ZONE 2 average grade = 6% downhill grade

Using the formulas in the Caltrans Highway Design Manual Chapter 2 for Stopping Sight Standards (refer to underlined standard in Index 201.3) these downhill grades would increase the values shown in Table 201.1 above by up to 20% when grades are steeper than 3%.

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[3] Received from City of Placerville .

Figure 5. Mallard Lane Measured Grade for SPEED ZONE 1 and SPEED ZONE 2

The HDM defines this increase as relevant to a roadway condition where the grade is more than 3% and longer than a mile. Since the speed zones are much shorter than this in our study, the principle applies that it is more difficult to stop in time when there is a grade steeper than 3%, and the Mallard Lane grades being 13% downhill in SPEED ZONE 1 and 6% downhill grade in SPEED ZONE 2, there will need to be a higher value than those shown in Table 202.1. Since the available sight distance (visual line of sight as measured and verified in the field) is less than the standard values shown in Table 201.1, this principle of downhill grade impacting stopping sight distance is even more relevant and pertinent to the need for increased safety since the stopping sight distance for 40 mph is 300 feet. Calculating for 43 mph prevailing 85th percentile speed taking place in SPEED ZONE 2 (approaching Pintail Lane on a 6% downhill grade), the stopping sight distance needed would be at least **336 feet** (calculated by linear interpolation from values in Table 201.1, and if increase by 20% due to grades exceeding 3%, then 403 feet would be the adjusted stopping sight distance needed. The next section examines the measured line of sight distances for various situations along Mallard Lane in the speed zone areas.

Sight Distance Measurements for SPEED ZONE 1 and SPEED ZONE 2

Measure the distance between two points on the ground

Map Length: 228.65 Feet
Ground Length: 228.65
Heading: 149.65 degrees
☑ Mouse Navigation

Figure 6. Sight Distance Constraint, Turning Left onto Mallard Ln from Pintail Ln

Figure 6 shows the sight distance constraint due to horizontal curvature in Mallard Lane as seen or experienced for a driver turning left from Pintail Lane onto Mallard Lane.
Figure 6 shows that there is also insufficient line of sight distance to stop in time based on the prevailing 85th percentile speed of 43 mph for vehicles heading southbound on Mallard Lane and approaching the zebra crosswalk, crossing the crosswalk at 43 mph. The "pace speed" of SPEED ZONE 2 was calculated to be between 34 mph to 43 mph. The pace speed is defined as "the continuous 10 mph incremental range of speeds in which the largest number of vehicles is contained." Usually if there is some congestion on the road, the pace speed will lag behind the 85th percentile speed, but in the case of traffic on Mallard Lane even during the pm peak hour, the pace speed 10 mph range is topping out at the 85th percentile, indicating that the average driver is speeding.

The speed limit on Mallard Drive is only 30 mph as it should be being a residential neighborhood collector street with vertical and horizontal curves limiting sight distance. However, the majority of drivers are speeding over the 30-mph speed limit, traveling at 34 mph on the low end of the pace speed range to 43 mph on the high end of the pace speed range. 30 mph was the slowest speed observed and only 10% of traffic went slower than 34 mph. There were 15% of vehicles traveling at 45 mph and faster up to a high speed of 50 mph in SPEED ZONE 2, of which there were two drivers traveling this fast in the sample set. This dangerous speed, and even the 85th percentile speed of 43 mph could mean the fatality of a pedestrian should that scenario present itself. A study from the AAA Foundation for Traffic Safety found that a vehicle going 42 mph is five times more likely to kill a pedestrian it hits than if it were going 25 mph. Roughly 10% of people struck by vehicles traveling at 23 mph die, but that number increases to 50% when the speed of the vehicle is 42 mph. If a vehicle is going 58 mph, the pedestrian has a 90% chance of dying[4].

There is a significant speeding problem on Mallard Lane. It is doubtful that occasional speed enforcement would have a lasting effect to deter speeding given the very high level of speeders on this road. In my view, traffic speeds on Mallard Lane are escalated because of the 13% downhill grade (extremely steep) in the downhill southbound direction towards Drake Court, and then on to the Pintail Lane intersection and crosswalk where speeds are at the highest levels (43 mph 85th percentile). This potentially dangerous situation requires a more proactive approach to effectively slow traffic down.

The Traffic Engineering community in general frowns on the use of a STOP SIGN to serve as a traffic calming device such as a speed bump to slow traffic, because it tends to build driver disrespect and potential disregard for the STOP SIGN, and some will drive through without stopping. This situation can in turn create more danger as some pedestrians might feel "safe" that the sign is protecting them in a crosswalk. However, this case on Mallard Lane is very different as there is a very real horizontal sight distance deficiency for the average speeds of traffic (the 34-43 mph pace speed comprised of 75% of all southbound drivers in SPEED ZONE 2).

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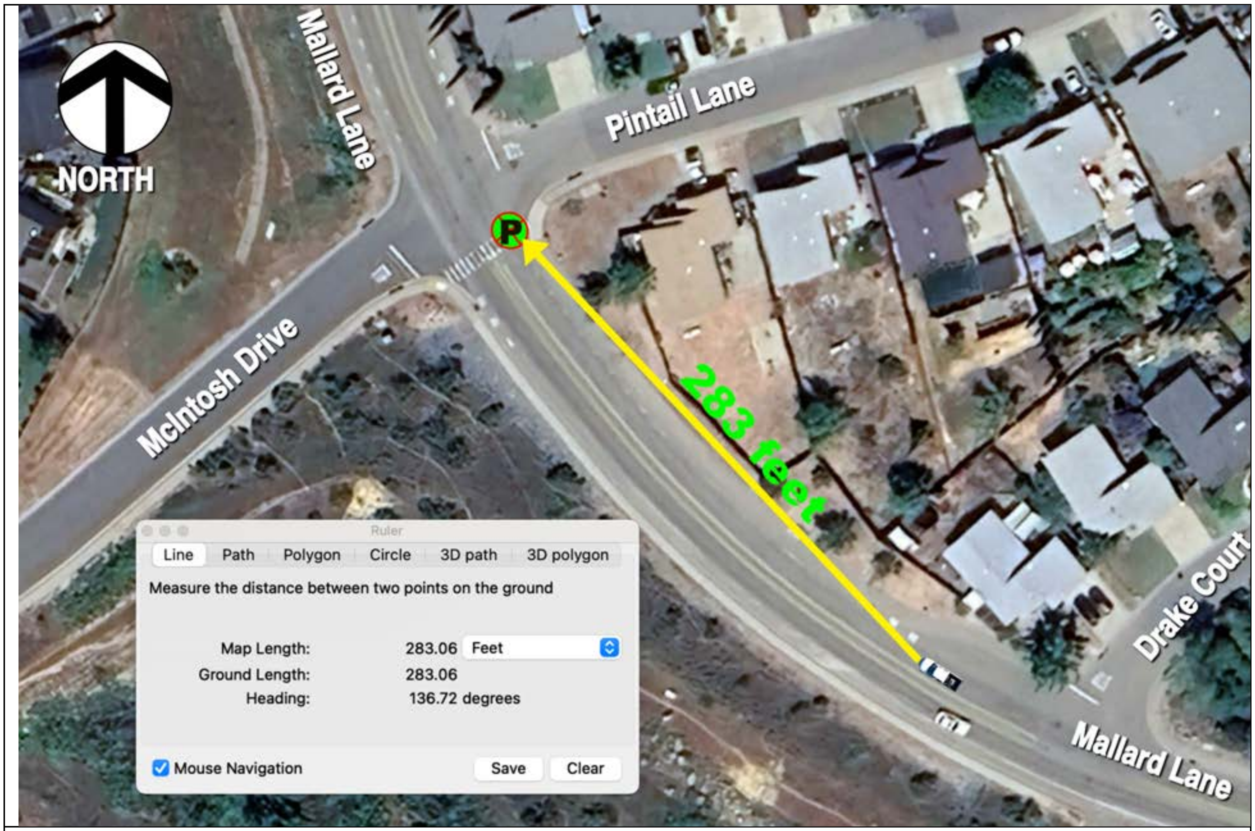
[4] AAA FTS Foundation for Traffic Safety, ***Impact Speed and a Pedestrian's Risk of Severe Injury or Death***.

Any pedestrians using the crosswalk could easily be unseen and therefore in danger as they cross the street in the crosswalk, especially from the Pintail Lane side and headed west to the McIntosh Drive side. A pedestrian just entering the crosswalk cannot be seen from about 283 feet away as shown in Figure 7 below. A car headed southbound even traveling at the posted 30 mph speed limit cannot stop in time as they would need 300 feet to do so at this speed. Most cars would need nearly 400 feet of distance to stop if they are traveling over 40 mph.



Measure the distance between two points on the ground

Map Length: 283.06 Feet
Ground Length: 283.06
Heading: 136.72 degrees

☑ Mouse Navigation

Figure 7. 283' Sight Distance Constraint, Approaching Pedestrian in Crosswalk

Certainly, a car traveling at 30 mph would be able to slow enough to prevent a potentially fatal situation for a pedestrian getting hit, but it is not guaranteed, as there is still a 10% chance of severe injury even when a vehicle is going as slow as 16 mph at the time of colliding with a pedestrian. Since the majority (75%) of southbound vehicles on Mallard Lane are traveling much faster than the 30-mph posted speed limit, a change in traffic control is the answer to this very real danger and potential liability to the City of Placerville. It would be necessary to install a STOP SIGN control on Mallard Lane for both the NB and SB approaches at the Pintail Lane / McIntosh Drive intersection.

Traffic Signal Warrant Analysis

Another alternative investigated for the intersection of Mallard Lane at Pintail Lane / McIntosh Drive was to install a traffic signal. The following Figure 3 shows the CAMUTCD method / chart for determining if a traffic signal is warranted from traffic volumes at an unsignalized intersection. This table was adapted and expanded by PRISM Engineering to accommodate lower volumes for the MAJOR STREET.

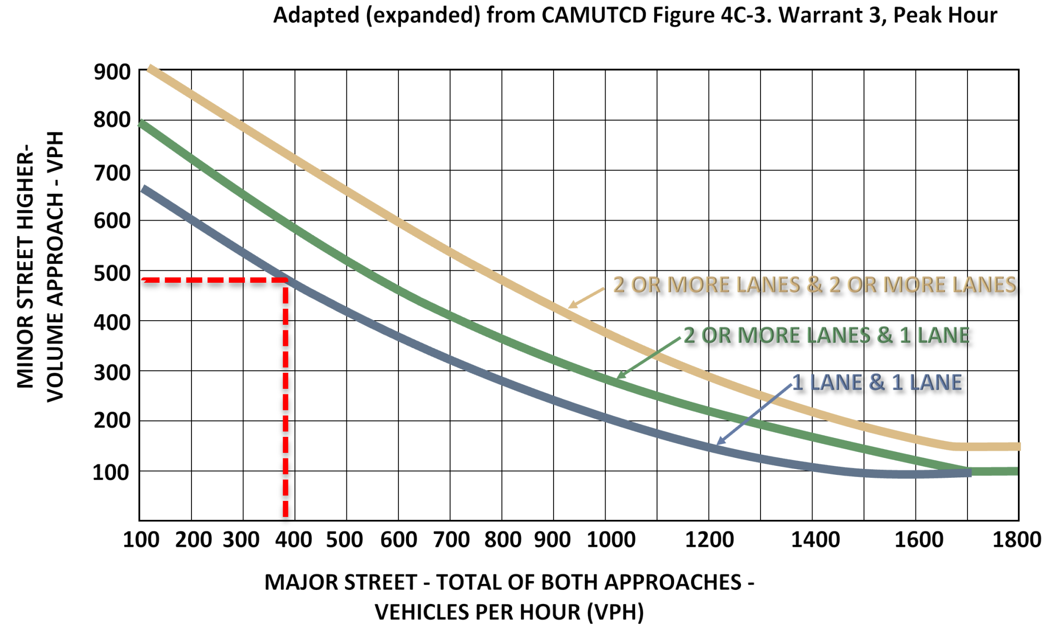


Figure 8. CAMUTCD Chart: Traffic Signal Warrant 3 Values for Peak Hour
Source: CAMUTCD and PRISM Engineering

PRISM Engineering used the values in Figure 8 above to rule out the idea of installing a signal, since the existing volumes are nowhere near the minimum levels or warrants that could justify a consideration for this treatment. The total volume of both approaches on Mallard Lane at Pintail/McIntosh is **383** vehicles, and this corresponds to the side street volume threshold of **480** vehicles for the highest side street approach. However, the actual highest side street volume is only 13 vph, or about 467 vehicles short of the minimum needed. A signal will never be warranted at this location. Therefore, the only other traffic control would be either a roundabout or a stop sign control to slow traffic down. Since the grade is steep and speeds are high, a roundabout would be a potential liability that could be a factor in a vehicle losing control. It is my opinion that the STOP SIGN traffic control is the best and least expensive option for slowing (stopping) traffic on Mallard Lane to increase safety for pedestrians that would cross Mallard Lane at Pintail / McIntosh.

Signing and Striping Schematic Plans

The safety focus area for the signing and striping modifications is shown in Figure 9 (next page) which shows the existing conditions of steep downgrade portion of Mallard Lane within the study area, as well as the side street approaches. The figure is drawn to scale (scale is shown on plan sheet) and we utilized the latest drone photos taken on June 5, 2024, by PRISM Engineering to show detail. The signing and striping schematic drawings are shown in subsequent figures for a much larger area to show where advance warning signs will be placed, etc.

PRISM Engineering followed the CAMUTCD ver. 2014 manual for guidance and standards on the application of these signing and striping improvements. Relevant information from this document is contained in this report.

Justification for All-Way Stop intersection control at Mallard and Pintail/McIntosh

This justification was made based on this engineering study, speed surveys, sight distance constraints surveys, and other criteria as recommended by the MUTCD. The CAMUTCD ver. 2014 has the following support and guidance on Multi-way Stop Applications. Engineering considerations by PRISM are shown in red.

> ***Section 2B.07 Multi-Way Stop Applications***
>
> ***Support****:*
>
> *01 Multi-way stop control can be useful as a safety measure at intersections if certain traffic conditions exist.* ***(the safety aspect of an AWSC at Mallard and Pintail is significant due to high speeds)***
>
> *Safety concerns associated with multi-way stops include pedestrians, bicyclists, and all road users expecting other road users to stop. Multi-way stop control is used where the volume of traffic on the intersecting roads is approximately equal.*
>
> *02 The restrictions on the use of STOP signs described in Section 2B.04 also apply to multi-way stop applications.*
>
> ***Guidance****:*
>
> *03 The decision to install multi-way stop control should be based on an engineering study.*
> *04 The following criteria should be considered in the engineering study for a multi-way STOP sign installation:*
>
> *A. Where traffic control signals are justified, the multi-way stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.* ***(signals considered and ruled out since warrants are not met)***
>
> *B. Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions.*
>
> *C. Minimum volumes:*

1. The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day; and ***(the combined volume for Mallard NB and SB in pm peak hour is 383 vph)***

2. The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour; but

3. If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2. ***(The 85th percentile speed for NB traffic is 43 mph on Mallard Lane at Pintail Lane)***

D. Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.

***Option**:*

05 Other criteria that may be considered in an engineering study include: ***(we utilized these criteria)***

A. The need to control left-turn conflicts; ***(not applicable)***

B. The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes; ***(applicable)***

C. Locations where a road user, after stopping, cannot see conflicting traffic and is not able to negotiate the intersection unless conflicting cross traffic is also required to stop; and ***(extremely applicable)***

D. An intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multi-way stop control would improve traffic operational characteristics of the intersection. ***(not applicable)***

Based on this review of the information in the MUTCD, the installation of an All-Way Stop control at Pintail / McIntosh is justified. Our engineering studies also back this decision based on our findings in the field where we measured the prevailing speeds on Mallard Lane to be 43 mph at the 85th percentile. It is a fact that 75% drivers on Mallard Lane going downhill in the SB direction are traveling at speeds higher than the posted 30 mph speed limit. In addition, the pace speed range is topping at the 85th percentile indicating that the majority of drivers are traveling at 34 mph or higher. Due to severe sight distance constraints in the horizontal direction (road curvature), as well as the factor of the steep 13% downgrades, there is not enough stopping sight distance on this road for the average driver to be able to stop in time to avoid colliding with a vehicle but more importantly with a potential pedestrian in the crosswalk at Pintail Lane.

Figure 9. Existing Conditions for Striping and Pavement Markings

Bike Lane Considerations

There is an existing protected bike lane in both directions of Mallard Lane from Green Valley Road on the south to about 300 feet north of Davis Court on the north end of the bike lanes. The asphalt paved portion of the bike lane is 4.5 feet with a 1.5-foot-wide gutter to the curb. It is not ideal to have a bicycle travel at the edge of the pavement where it meets the gutter if the joint is not perfect, as a cyclist might lose control. So, the effective width of the existing bike lane is narrow at 4.5 feet from the gutter to the stripe. Ideally, a minimum of

Placerville is currently using what the WORD LEGENDS style of markings for bike lanes as defined on CA MUTCD **Figure 9C-3. Word, Symbol and Arrow Pavement Markings for Bicycle Lanes**. The existing condition of the bike lane striping and pavement markings is poor and severely faded or worn away. Figure 10 shows this situation on Mallard Lane just north of Drake Court after the bus turnout location.

Figure 10. Existing Bike Lane Conditions on Mallard Lane

Source: PRISM Engineering Drone Photos June 5, 2024

Figure 11 shows the condition of the pavement in general, the weeds growing between the old asphalt and the concrete gutter apron, and the corresponding poor condition of the striping and markings looking east towards Drake Court at the intersection.

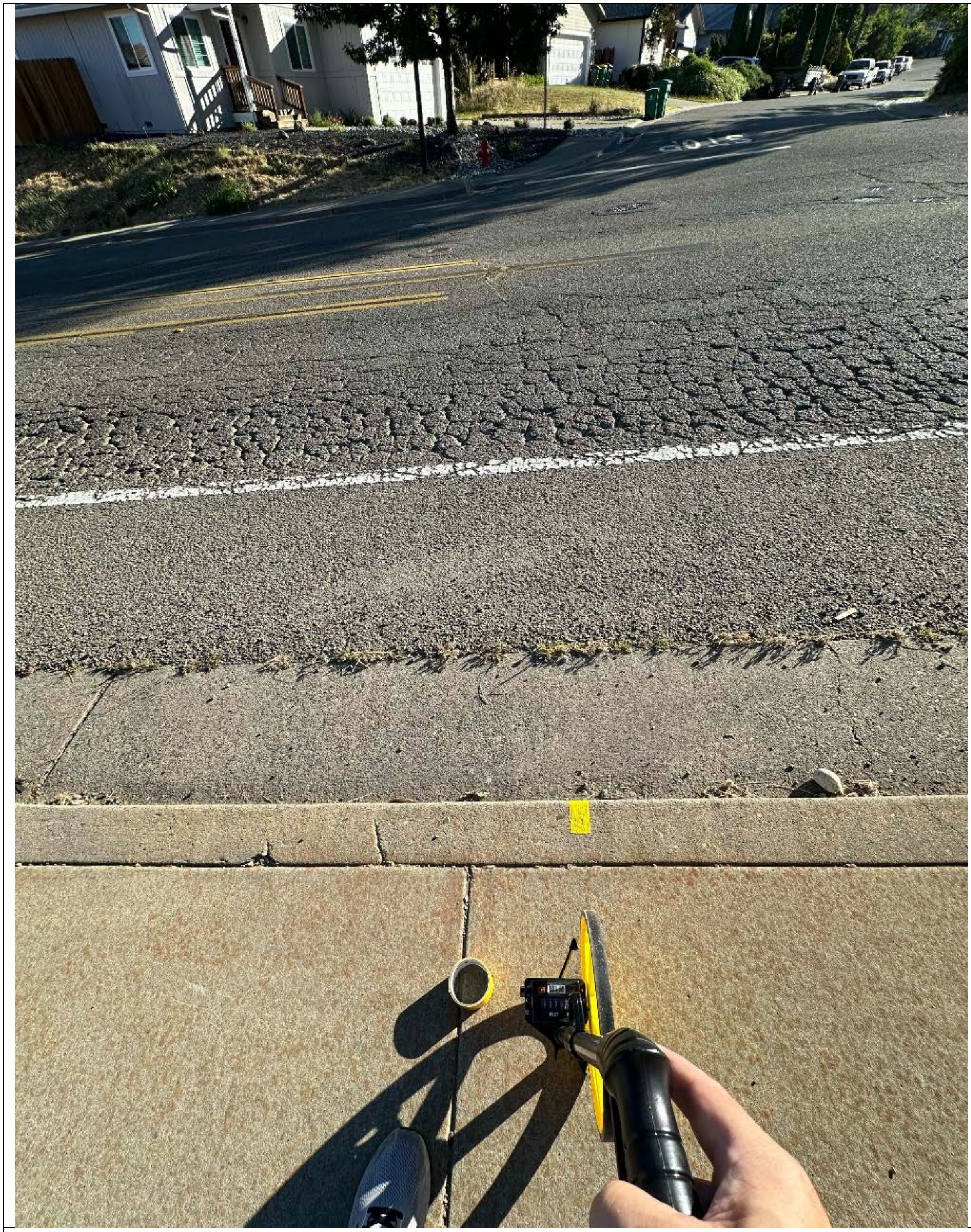


Figure 11. Condition of Pavement Infrastructure and Striping and Markings

Source: PRISM Engineering Drone Photos June 5, 2024

Proposed Mallard Lane Cross Section to Help Calm Traffic, Slow Speeds, and Improve Bike Lanes

There is an opportunity for the City to significantly improve Mallard Lane, which is overdue for a pavement overlay and a more standard and effective use of lane striping and pavement markings. The bike lanes can be significantly improved by installing new striping that effectively adds more width to the bike lane on each side. If the centerline striping is moved back to the very center of Mallard Lane, then with a 40 foot curb-to-curb width extant, and installing a typical 12 foot wide travel lane in each direction with speed reduction markings[5] for the steep NB downhill direction of Mallard Lane (two lanes totaling 24 feet width), there would be 16 feet left over, which would enable a 6.5 width bike lane width on the asphalt pavement with a 1.5 feet concrete gutter apron left over on each side. This would make the bike lane wide enough (8 feet) to even accommodate two cyclists which is ideal.

In the Caltrans Highway Design Manual Chapter 3 on page 300-3 there is **Figure 301.2A, Typical Class II Bikeway (Bike Lane) Cross Sections** which has the following guidance as well for a Class II Bike Lane (my emphasis added in bold):

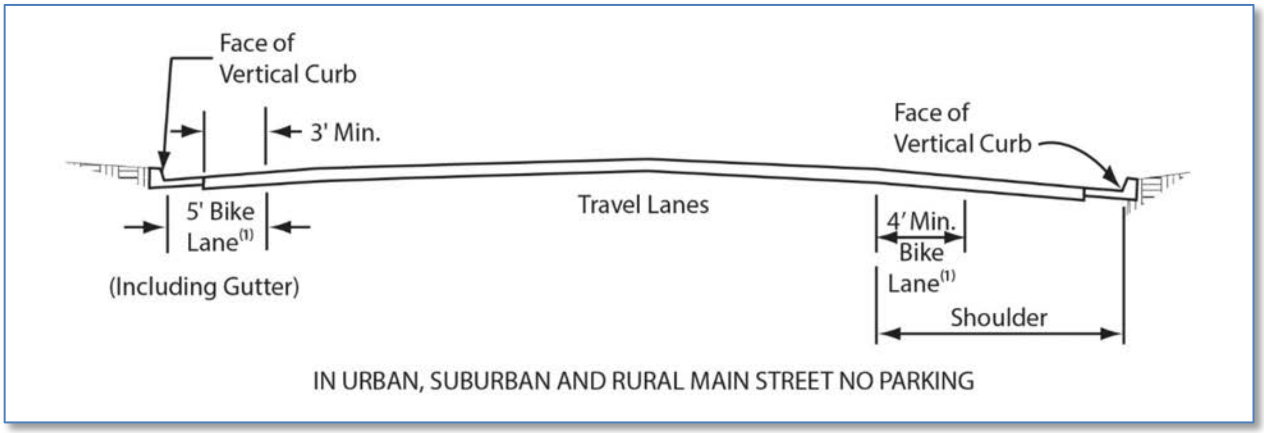


Figure 301.2A, Typical Class II Bikeway (Bike Lane) Cross Sections *(relevant content)*

> *The minimum Class II bike lane width shall be 4 feet, except where:*
>
> - *Adjacent to on-street parking, the minimum bike lane should be 5 feet.*
> - ***Posted speeds are greater than 40 miles per hour***[6]*, the minimum bike lane should be 6 feet, or*
> - *On highways with concrete curb and gutter, a minimum width of 3 feet measured from the bike lane stripe to the joint between the shoulder pavement and the gutter shall be provided.*
>
> *Class II bikeways may be included as part of the shoulder width See Topic 302.*

---

[5] As defined in Speed Reduction Markings CAMUTCD Fig. 3B-28

[6] The 85th percentile speeds on Mallard Lane in the downhill northbound direction is 43 mph. The speed limit is 30 mph, but the pace speed is 34-43 mph and the majority (90%) of drivers go faster than 30 mph.

> ***As grades increase, downhill bicycle speeds can increase, which increases the width needed for the comfort of bicycle operation.*** *If bicycle lanes are to be marked,* ***additional bike lane width is recommended to accommodate these higher bicycle speeds****.*

Based on this Caltrans HDM guidance, the case can be made for having at the very least, a 6-foot-wide bike lane, but due to the extremely steep 13% grade on Mallard lane, an even wider lane is justified due to the corresponding increase in bike speeds going down a steep hill. Since there is a 40-foot curb-to-curb width extant on Mallard Lane and establishing the travel lanes in each direction to no more than 12 feet in width, there is still 16 feet of cross-section width allowing for an 8-foot-wide bike lane striped in each direction. This is easily accomplished and serves the purpose to further protect the cyclists that use Mallard Lane and should enhance safety for bike riders in the area due to an increase in the buffer space between vehicles and bikes.

The following modifications are recommended for Mallard Lane in the study area to enhance Roadway Signing and Striping

Figure 12 has been prepared to show a view of the proposed improvements and modifications for traffic control to achieve the goal of enhancing safety on Mallard Lane, reducing speeding, and protection of pedestrians especially in crosswalks at Pintail Lane / McIntosh Drive.

The following modifications are recommended for Mallard Lane in the study area to enhance safety for pedestrians and to help solve the speeding problem that is happening on Mallard Lane especially in the steep downgrade (13%) portion of northbound Mallard Lane preceding Drake Court and Pintail Lane / McIntosh Drive:

1. Remove all existing striping on Mallard Lane in study area as well as on affected intersection side street approaches at Pintail/McIntosh (preferably with new asphalt overlay)
2. Install new striping for centerlines, bike lanes, etc., eliminating the previous “median” area on Mallard Lane and utilizing a centered double yellow centerline striping treatment as per CAMUTCD CHAPTER 3B. PAVEMENT AND CURB MARKINGS, use no passing yellow centerline DETAIL 21 as shown in CAMUTCD Figure 3A-104 (CA).
3. At the Mallard Lane and Pintail Lane / McIntosh Drive intersection:
    a. Remove all existing signage and pavement markings and striping (preferably by new overlay)
    b. Install new lane striping on Mallard Lane and Pintail / McIntosh intersection approaches as shown in Figure 13 of this report and according to details outlined in the CAMUTCD CHAPTER 3B. PAVEMENT AND CURB MARKINGS
    c. Install new Zebra Style Crosswalks on Mallard Lane NB approach and on Pintail Lane WB approach as shown in Figure 13 of this report and set back at least 6’ from the Mallard Lane curb line as per CAMUTCD Figure 3B-103.
    d. Install new ADA Compliant corner ramps at SE and NE corners, matching existing ADA ramp on SW corner in size and form.

    e. Install new STOP SIGN (R1-1) and corresponding ALL WAY plaque (R1-3P) as per CAMUTCD Figure 2B-1 at all four approaches in proper location as depicted in Figure 13 of this report.
    f. Install new STOP Pavement Legends at all four approaches as shown in Figure 13.
    g. Install new STOP Limit Line at all four approaches as shown in Figure 13.
4. Remove the existing R2-30 (30 mph sign) and R81-CA (Bike Lane)
5. Install Advance Warning Signs for a STOP AHEAD situation (use W3-1 sign as per CAMUTCD Figure 2C-6 and have it sized at 30” x 30” as per the “Conventional Road Single Lane” shown in CAMUTCD Table 2C-2)[7] as depicted in Figure 14 .
6. Install Speed Reduction Markings coming down Mallard Lane towards Drake Court as shown in Figure 14, and a second set of Speed Reduction Markings approaching the Pintail Lane intersection, as defined in CAMUTCD Figure 2B-28.
7. Install Advance Warning Signs for a STOP AHEAD situation (use W3-1 sign as per CAMUTCD Figure 2C-6 and have it sized at 30” x 30” as per the “Conventional Road Single Lane” shown in CAMUTCD Table 2C-2)[8] as depicted in Figure 15 .

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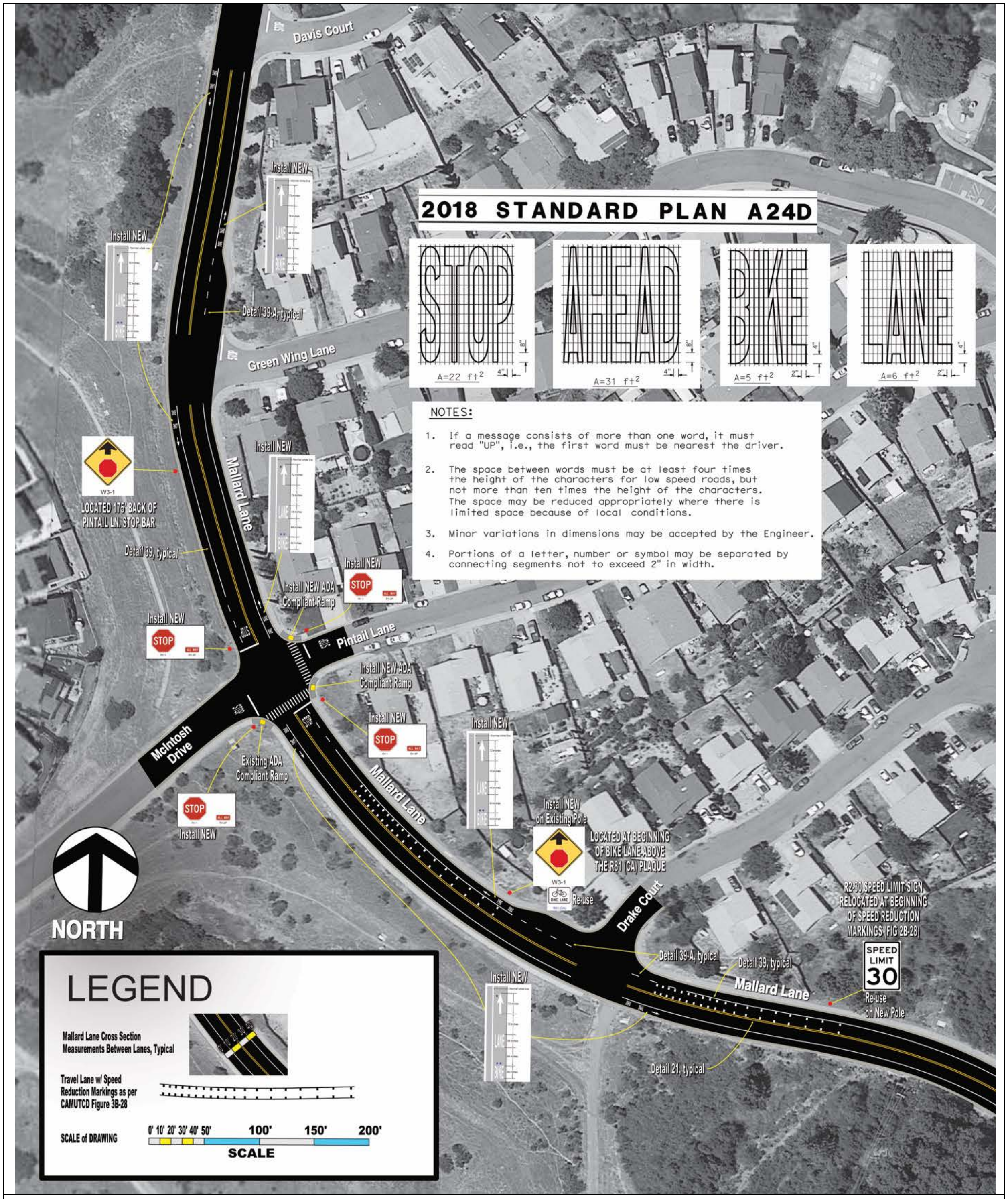
[7] See Appendix ***Relevant Excerpts from CAMUTCD used in this Engineering Study***



NOTES:

1. If a message consists of more than one word, it must read "UP", i.e., the first word must be nearest the driver.
2. The space between words must be at least four times the height of the characters for low speed roads, but not more than ten times the height of the characters. The space may be reduced appropriately where there is limited space because of local conditions.
3. Minor variations in dimensions may be accepted by the Engineer.
4. Portions of a letter, number or symbol may be separated by connecting segments not to exceed 2" in width.

Figure 12. Proposed Improvements and Modifications

Source: PRISM Engineering

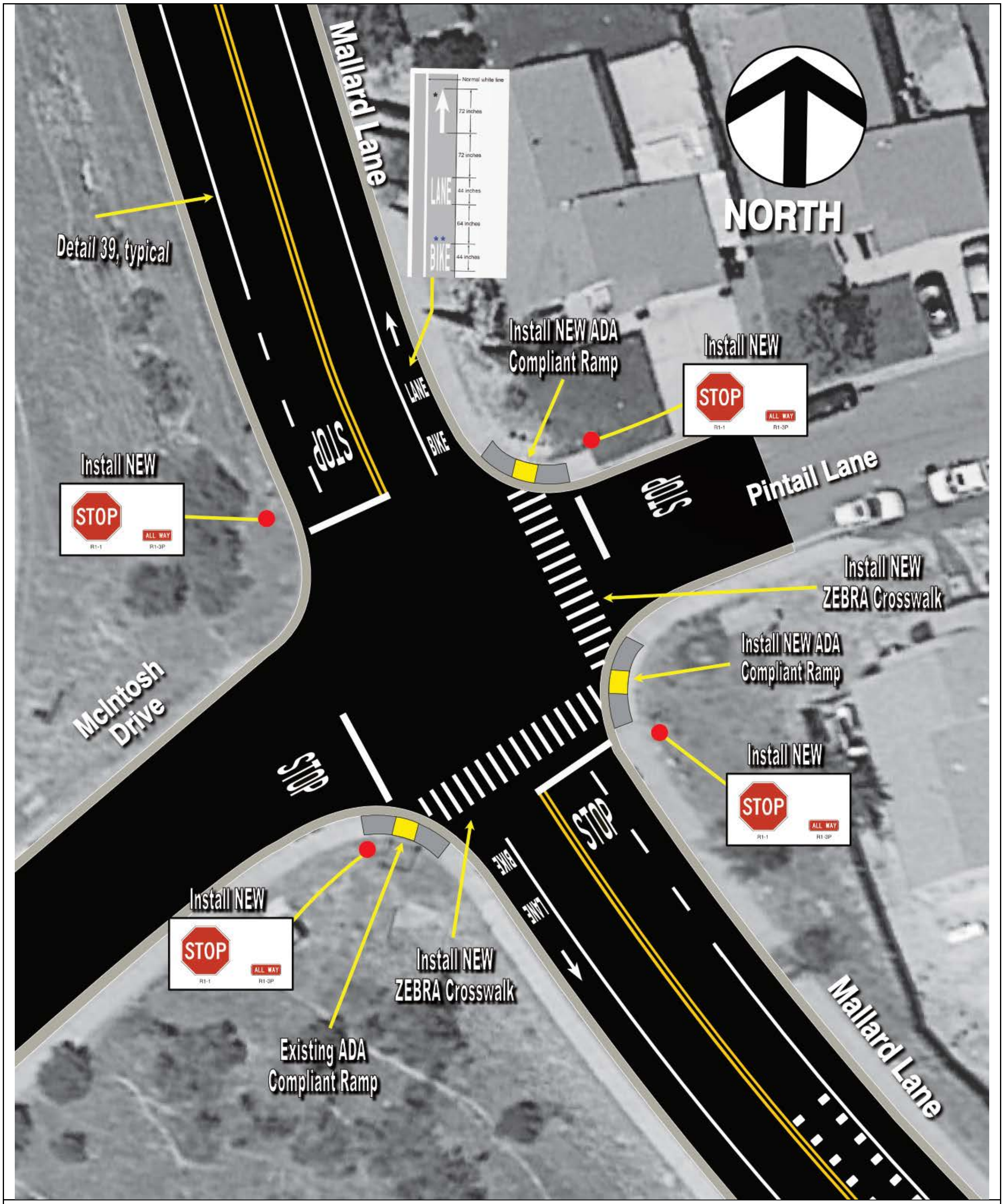


Figure 13. Proposed Improvements at Mallard and Pintail / McIntosh

Source: PRISM Engineering

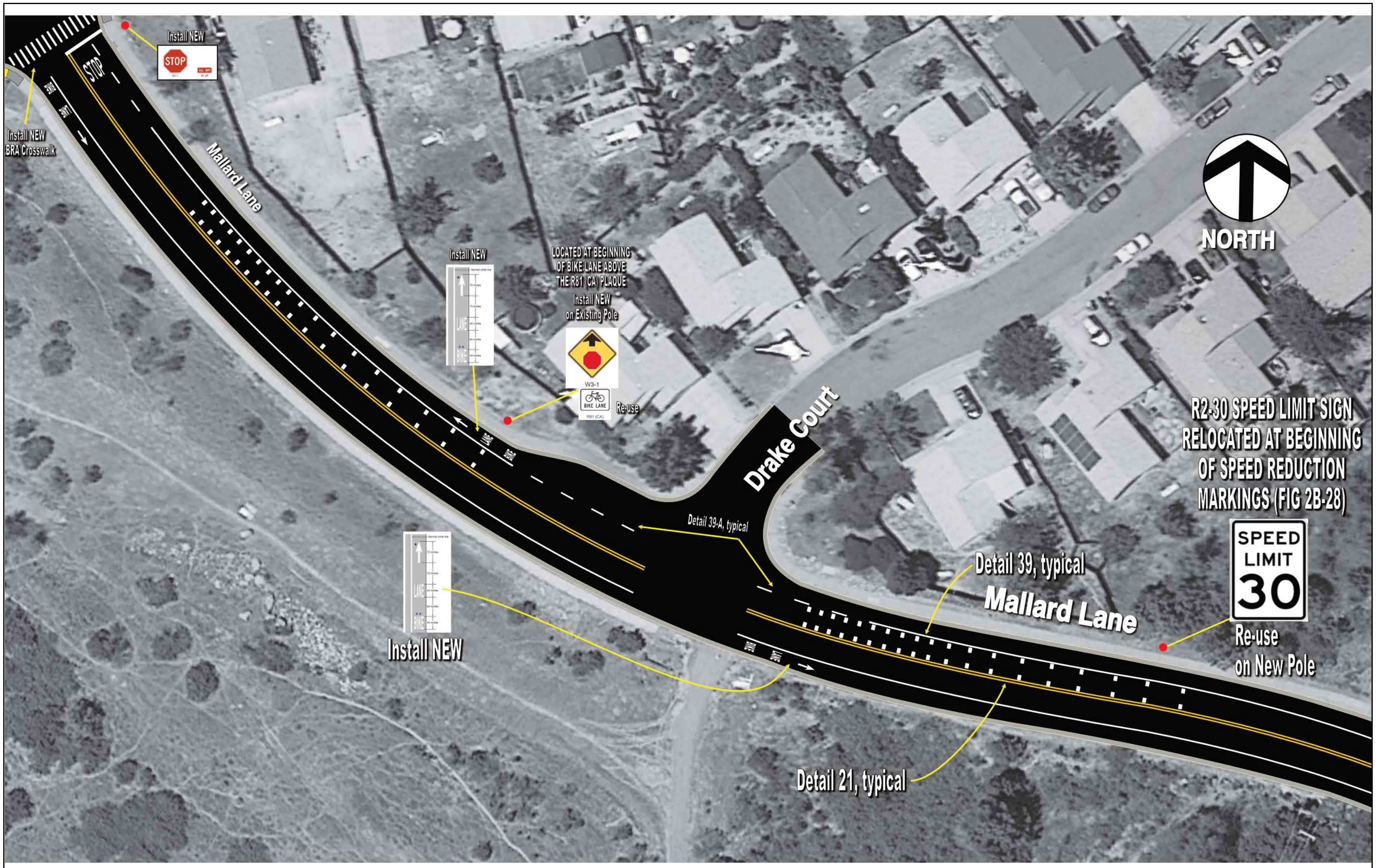


Figure 14. Proposed Improvements on Mallard btwn Drake and Pintail

Source: PRISM Engineering

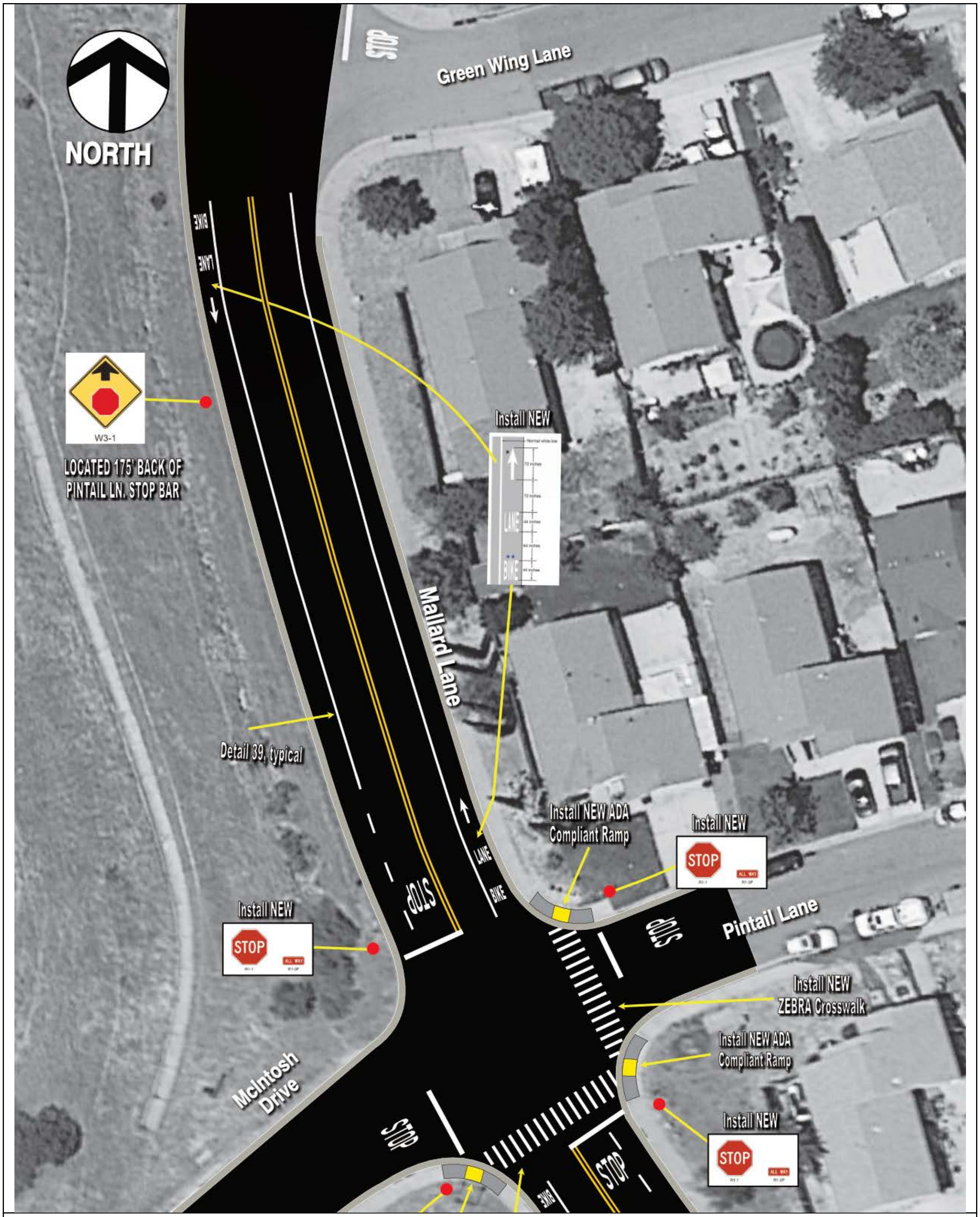
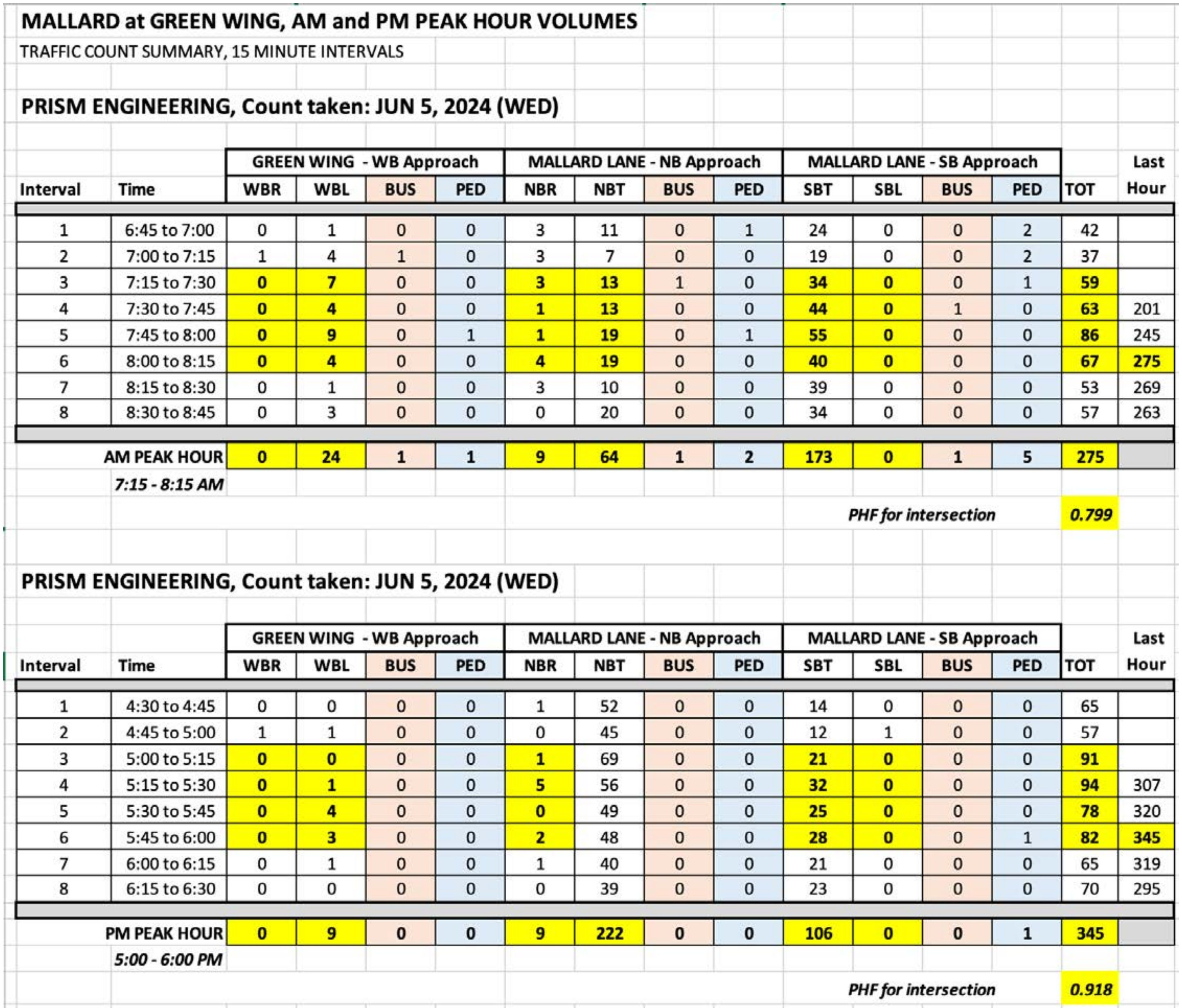


Figure 15. Proposed Improvements on Mallard btwn Pintail and Green Wing

Source: PRISM Engineering

Appendix

A. TRAFFIC COUNTS, Detailed 15-minute interval data for 2 hours. Peak Hour volumes are shown in *YELLOW SHADING*. Bus and Pedestrian count data are shown in *RED* and *BLUE*.



MALLARD at GREEN WING, AM and PM PEAK HOUR VOLUMES

TRAFFIC COUNT SUMMARY, 15 MINUTE INTERVALS

PRISM ENGINEERING, Count taken: JUN 5, 2024 (WED)

		GREEN WING - WB Approach				MALLARD LANE - NB Approach				MALLARD LANE - SB Approach					Last
Interval	Time	WBR	WBL	BUS	PED	NBR	NBT	BUS	PED	SBT	SBL	BUS	PED	TOT	Hour
1	6:45 to 7:00	0	1	0	0	3	11	0	1	24	0	0	2	42	
2	7:00 to 7:15	1	4	1	0	3	7	0	0	19	0	0	2	37	
3	7:15 to 7:30	0	7	0	0	3	13	1	0	34	0	0	1	59	
4	7:30 to 7:45	0	4	0	0	1	13	0	0	44	0	1	0	63	201
5	7:45 to 8:00	0	9	0	1	1	19	0	1	55	0	0	0	86	245
6	8:00 to 8:15	0	4	0	0	4	19	0	0	40	0	0	0	67	275
7	8:15 to 8:30	0	1	0	0	3	10	0	0	39	0	0	0	53	269
8	8:30 to 8:45	0	3	0	0	0	20	0	0	34	0	0	0	57	263
	AM PEAK HOUR	**0**	**24**	**1**	**1**	**9**	**64**	**1**	**2**	**173**	**0**	**1**	**5**	**275**	
	7:15 - 8:15 AM														
										PHF for intersection				***0.799***	

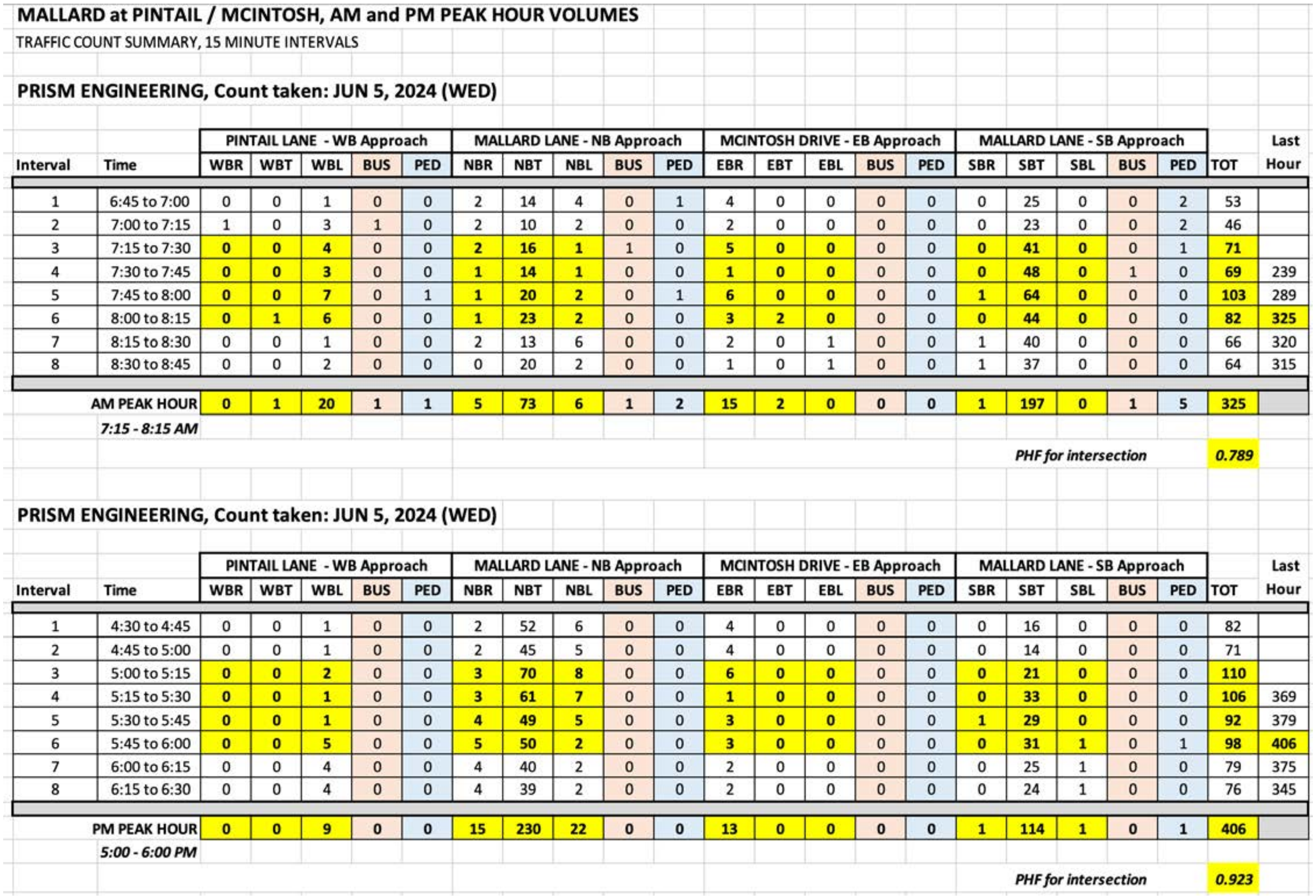
PRISM ENGINEERING, Count taken: JUN 5, 2024 (WED)

		GREEN WING - WB Approach				MALLARD LANE - NB Approach				MALLARD LANE - SB Approach					Last
Interval	Time	WBR	WBL	BUS	PED	NBR	NBT	BUS	PED	SBT	SBL	BUS	PED	TOT	Hour
1	4:30 to 4:45	0	0	0	0	1	52	0	0	14	0	0	0	65	
2	4:45 to 5:00	1	1	0	0	0	45	0	0	12	1	0	0	57	
3	5:00 to 5:15	0	0	0	0	1	69	0	0	21	0	0	0	91	
4	5:15 to 5:30	0	1	0	0	5	56	0	0	32	0	0	0	94	307
5	5:30 to 5:45	0	4	0	0	0	49	0	0	25	0	0	0	78	320
6	5:45 to 6:00	0	3	0	0	2	48	0	0	28	0	0	1	82	345
7	6:00 to 6:15	0	1	0	0	1	40	0	0	21	0	0	0	65	319
8	6:15 to 6:30	0	0	0	0	0	39	0	0	23	0	0	0	70	295
	PM PEAK HOUR	**0**	**9**	**0**	**0**	**9**	**222**	**0**	**0**	**106**	**0**	**0**	**1**	**345**	
	5:00 - 6:00 PM														
										PHF for intersection				***0.918***	

Source: PRISM Engineering

Note:

All traffic counts were taken with video to capture all information for verification and counted in the office. Pedestrians, Bikes, and Buses were also counted, but no bikes were observed during the peak hours at the three study intersections. Most pedestrians did not cross Mallard Lane but did walk on Mallard Lane sidewalks and with small amounts enter/exit side streets i.e. Pintail Lane, others walking on the east sidewalk of Mallard Lane.



MALLARD at PINTAIL / MCINTOSH, AM and PM PEAK HOUR VOLUMES

TRAFFIC COUNT SUMMARY, 15 MINUTE INTERVALS

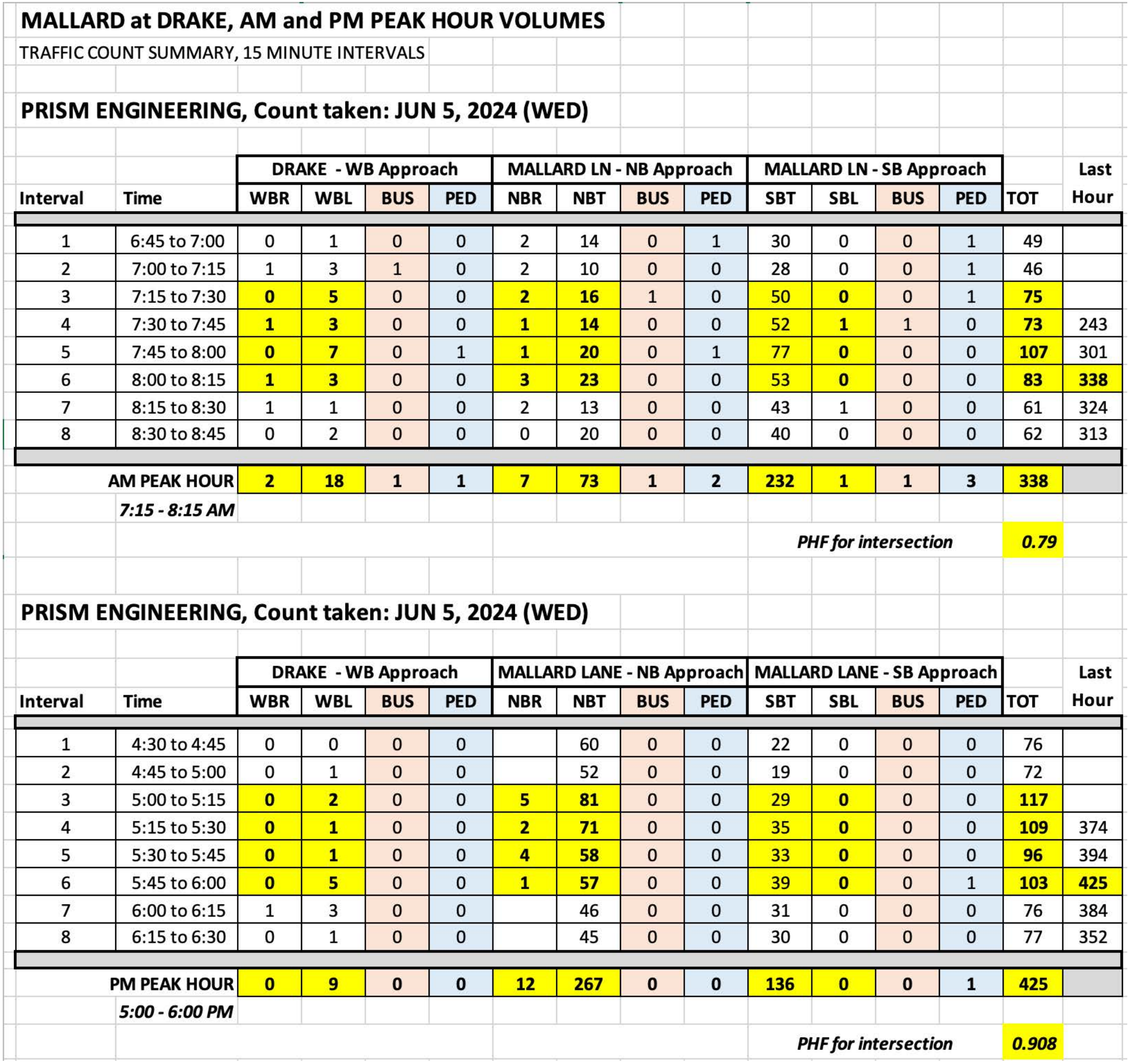
PRISM ENGINEERING, Count taken: JUN 5, 2024 (WED)

		PINTAIL LANE - WB Approach					MALLARD LANE - NB Approach					MCINTOSH DRIVE - EB Approach					MALLARD LANE - SB Approach						Last
Interval	**Time**	**WBR**	**WBT**	**WBL**	**BUS**	**PED**	**NBR**	**NBT**	**NBL**	**BUS**	**PED**	**EBR**	**EBT**	**EBL**	**BUS**	**PED**	**SBR**	**SBT**	**SBL**	**BUS**	**PED**	**TOT**	**Hour**
1	6:45 to 7:00	0	0	1	0	0	2	14	4	0	1	4	0	0	0	0	0	25	0	0	2	53	
2	7:00 to 7:15	1	0	3	1	0	2	10	2	0	0	2	0	0	0	0	0	23	0	0	2	46	
3	7:15 to 7:30	**0**	**0**	**4**	0	0	**2**	**16**	**1**	1	0	**5**	**0**	**0**	0	0	**0**	**41**	**0**	0	1	**71**	
4	7:30 to 7:45	**0**	**0**	**3**	0	0	**1**	**14**	**1**	0	0	**1**	**0**	**0**	0	0	**0**	**48**	**0**	1	0	**69**	239
5	7:45 to 8:00	**0**	**0**	**7**	0	1	**1**	**20**	**2**	0	1	**6**	**0**	**0**	0	0	**1**	**64**	**0**	0	0	**103**	289
6	8:00 to 8:15	**0**	**1**	**6**	0	0	**1**	**23**	**2**	0	0	**3**	**2**	**0**	0	0	**0**	**44**	**0**	0	0	**82**	**325**
7	8:15 to 8:30	0	0	1	0	0	2	13	6	0	0	2	0	1	0	0	1	40	0	0	0	66	320
8	8:30 to 8:45	0	0	2	0	0	0	20	2	0	0	1	0	1	0	0	1	37	0	0	0	64	315
	AM PEAK HOUR	**0**	**1**	**20**	**1**	**1**	**5**	**73**	**6**	**1**	**2**	**15**	**2**	**0**	**0**	**0**	**1**	**197**	**0**	**1**	**5**	**325**	
	7:15 - 8:15 AM																						
																	PHF for intersection					***0.789***	

PRISM ENGINEERING, Count taken: JUN 5, 2024 (WED)

		PINTAIL LANE - WB Approach					MALLARD LANE - NB Approach					MCINTOSH DRIVE - EB Approach					MALLARD LANE - SB Approach						Last
Interval	**Time**	**WBR**	**WBT**	**WBL**	**BUS**	**PED**	**NBR**	**NBT**	**NBL**	**BUS**	**PED**	**EBR**	**EBT**	**EBL**	**BUS**	**PED**	**SBR**	**SBT**	**SBL**	**BUS**	**PED**	**TOT**	**Hour**
1	4:30 to 4:45	0	0	1	0	0	2	52	6	0	0	4	0	0	0	0	0	16	0	0	0	82	
2	4:45 to 5:00	0	0	1	0	0	2	45	5	0	0	4	0	0	0	0	0	14	0	0	0	71	
3	5:00 to 5:15	**0**	**0**	**2**	0	0	**3**	**70**	**8**	0	0	**6**	**0**	**0**	0	0	**0**	**21**	**0**	0	0	**110**	
4	5:15 to 5:30	**0**	**0**	**1**	0	0	**3**	**61**	**7**	0	0	**1**	**0**	**0**	0	0	**0**	**33**	**0**	0	0	**106**	369
5	5:30 to 5:45	**0**	**0**	**1**	0	0	**4**	**49**	**5**	0	0	**3**	**0**	**0**	0	0	**1**	**29**	**0**	0	0	**92**	379
6	5:45 to 6:00	**0**	**0**	**5**	0	0	**5**	**50**	**2**	0	0	**3**	**0**	**0**	0	0	**0**	**31**	**1**	0	1	**98**	**406**
7	6:00 to 6:15	0	0	4	0	0	4	40	2	0	0	2	0	0	0	0	0	25	1	0	0	79	375
8	6:15 to 6:30	0	0	4	0	0	4	39	2	0	0	2	0	0	0	0	0	24	1	0	0	76	345
	PM PEAK HOUR	**0**	**0**	**9**	**0**	**0**	**15**	**230**	**22**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**1**	**114**	**1**	**0**	**1**	**406**	
	5:00 - 6:00 PM																						
																	PHF for intersection					***0.923***	

Source: PRISM Engineering



MALLARD at DRAKE, AM and PM PEAK HOUR VOLUMES

TRAFFIC COUNT SUMMARY, 15 MINUTE INTERVALS

PRISM ENGINEERING, Count taken: JUN 5, 2024 (WED)

		DRAKE - WB Approach				MALLARD LN - NB Approach				MALLARD LN - SB Approach					Last
Interval	**Time**	**WBR**	**WBL**	**BUS**	**PED**	**NBR**	**NBT**	**BUS**	**PED**	**SBT**	**SBL**	**BUS**	**PED**	**TOT**	**Hour**
1	6:45 to 7:00	0	1	0	0	2	14	0	1	30	0	0	1	49	
2	7:00 to 7:15	1	3	1	0	2	10	0	0	28	0	0	1	46	
3	7:15 to 7:30	**0**	**5**	0	0	**2**	**16**	1	0	50	**0**	0	1	**75**	
4	7:30 to 7:45	**1**	**3**	0	0	**1**	**14**	0	0	52	**1**	1	0	**73**	243
5	7:45 to 8:00	**0**	**7**	0	1	**1**	**20**	0	1	77	**0**	0	0	**107**	301
6	8:00 to 8:15	**1**	**3**	0	0	**3**	**23**	0	0	53	**0**	0	0	**83**	**338**
7	8:15 to 8:30	1	1	0	0	2	13	0	0	43	1	0	0	61	324
8	8:30 to 8:45	0	2	0	0	0	20	0	0	40	0	0	0	62	313
	AM PEAK HOUR	**2**	**18**	**1**	**1**	**7**	**73**	**1**	**2**	**232**	**1**	**1**	**3**	**338**	
	7:15 - 8:15 AM														
										PHF for intersection				***0.79***	

PRISM ENGINEERING, Count taken: JUN 5, 2024 (WED)

		DRAKE - WB Approach				MALLARD LANE - NB Approach				MALLARD LANE - SB Approach					Last
Interval	**Time**	**WBR**	**WBL**	**BUS**	**PED**	**NBR**	**NBT**	**BUS**	**PED**	**SBT**	**SBL**	**BUS**	**PED**	**TOT**	**Hour**
1	4:30 to 4:45	0	0	0	0		60	0	0	22	0	0	0	76	
2	4:45 to 5:00	0	1	0	0		52	0	0	19	0	0	0	72	
3	5:00 to 5:15	**0**	**2**	0	0	**5**	**81**	0	0	29	**0**	0	0	**117**	
4	5:15 to 5:30	**0**	**1**	0	0	**2**	**71**	0	0	35	**0**	0	0	**109**	374
5	5:30 to 5:45	**0**	**1**	0	0	**4**	**58**	0	0	33	**0**	0	0	**96**	394
6	5:45 to 6:00	**0**	**5**	0	0	**1**	**57**	0	0	39	**0**	0	1	**103**	**425**
7	6:00 to 6:15	1	3	0	0		46	0	0	31	0	0	0	76	384
8	6:15 to 6:30	0	1	0	0		45	0	0	30	0	0	0	77	352
	PM PEAK HOUR	**0**	**9**	**0**	**0**	**12**	**267**	**0**	**0**	**136**	**0**	**0**	**1**	**425**	
	5:00 - 6:00 PM														
										PHF for intersection				***0.908***	

Source: PRISM Engineering

Relevant Excerpts from CAMUTCD used in this Engineering Study

California MUTCD 2014 Edition
(FHWA's MUTCD 2009 Edition, including Revisions 1 & 2, as amended for use in California)

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Figure 2B-1. STOP and YIELD Signs and Plaques

Section 2B.05 STOP Sign (R1-1) and ALL WAY Plaque (R1-3P)

Standard:

01 When it is determined that a full stop is always required on an approach to an intersection, a STOP (R1-1) sign (see Figure 2B-1) shall be used.

02 The STOP sign shall be an octagon with a white legend and border on a red background.

03 Secondary legends shall not be used on STOP sign faces.

04 At intersections where all approaches are controlled by STOP signs (see Section 2B.07), an ALL WAY supplemental plaque (R1-3P) shall be mounted below each STOP sign. The ALL WAY plaque (see Figure 2B-1) shall have a white legend and border on a red background.

05 The ALL WAY plaque shall only be used if all intersection approaches are controlled by STOP signs.

06 Supplemental plaques with legends such as 2-WAY, 3-WAY, 4-WAY, or other numbers of ways shall not be used with STOP signs.

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Figure 2C-6. Roadway and Weather Condition and Advance Traffic Control Signs and Plaques

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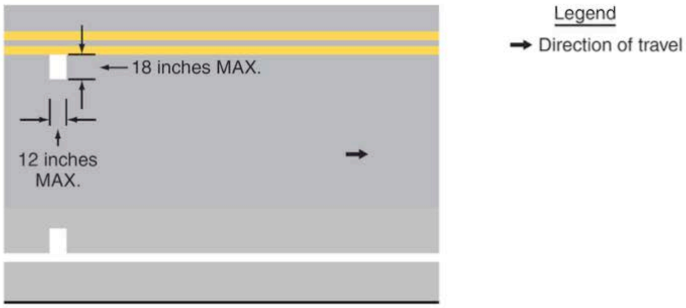
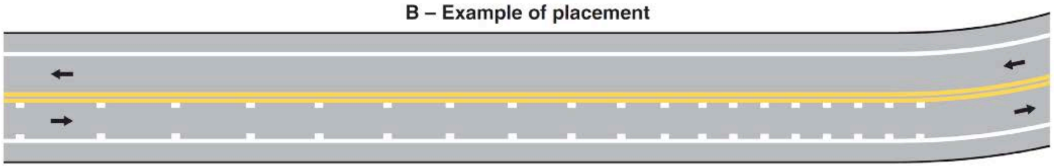
Figure 3B-28. Example of the Application of Speed Reduction Markings

A – Recommended dimensions



B – Example of placement



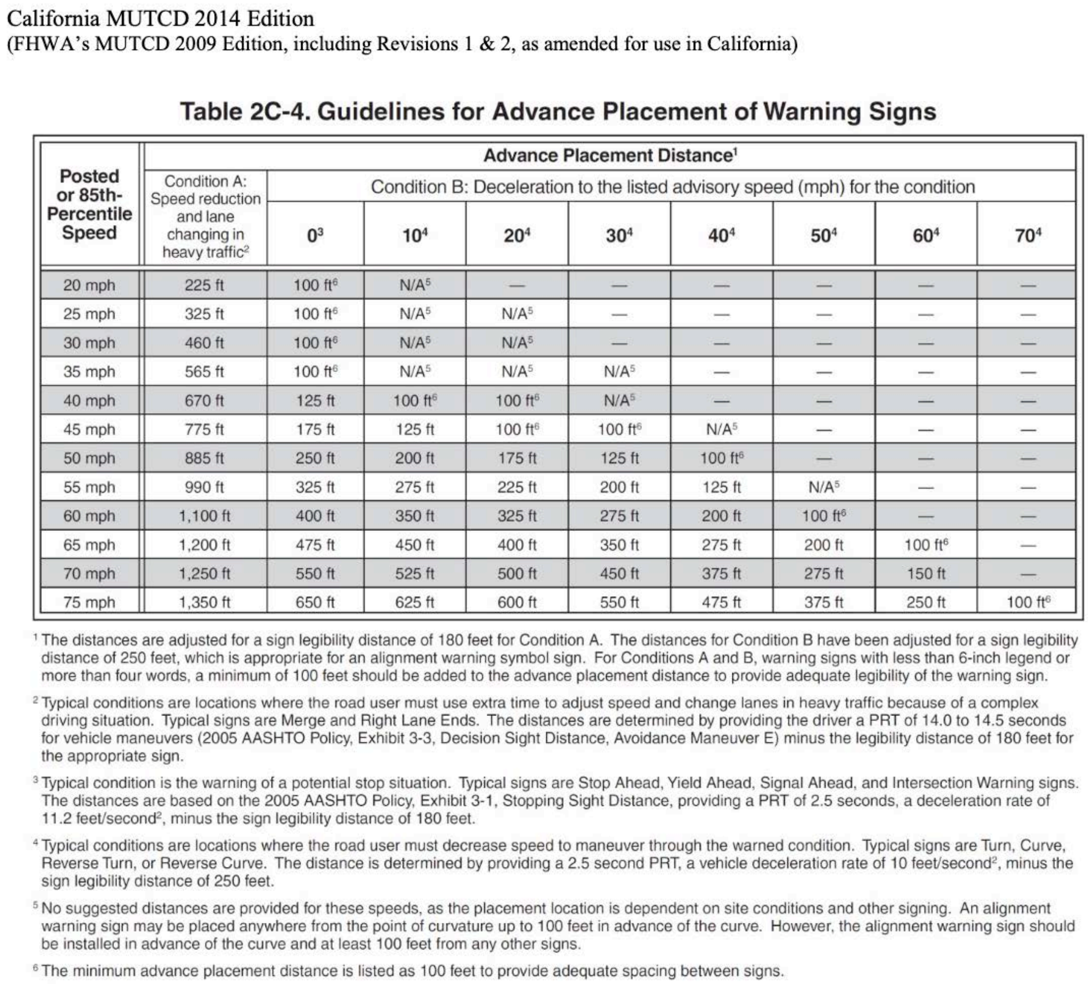


Table 2C-4. Guidelines for Advance Placement of Warning Signs

Posted or 85th-Percentile Speed	Advance Placement Distance[1]								
	Condition A: Speed reduction and lane changing in heavy traffic[2]	Condition B: Deceleration to the listed advisory speed (mph) for the condition							
		0[3]	10[4]	20[4]	30[4]	40[4]	50[4]	60[4]	70[4]
20 mph	225 ft	100 ft[6]	N/A[5]	—	—	—	—	—	—
25 mph	325 ft	100 ft[6]	N/A[5]	N/A[5]	—	—	—	—	—
30 mph	460 ft	100 ft[6]	N/A[5]	N/A[5]	—	—	—	—	—
35 mph	565 ft	100 ft[6]	N/A[5]	N/A[5]	N/A[5]	—	—	—	—
40 mph	670 ft	125 ft	100 ft[6]	100 ft[6]	N/A[5]	—	—	—	—
45 mph	775 ft	175 ft	125 ft	100 ft[6]	100 ft[6]	N/A[5]	—	—	—
50 mph	885 ft	250 ft	200 ft	175 ft	125 ft	100 ft[6]	—	—	—
55 mph	990 ft	325 ft	275 ft	225 ft	200 ft	125 ft	N/A[5]	—	—
60 mph	1,100 ft	400 ft	350 ft	325 ft	275 ft	200 ft	100 ft[6]	—	—
65 mph	1,200 ft	475 ft	450 ft	400 ft	350 ft	275 ft	200 ft	100 ft[6]	—
70 mph	1,250 ft	550 ft	525 ft	500 ft	450 ft	375 ft	275 ft	150 ft	—
75 mph	1,350 ft	650 ft	625 ft	600 ft	550 ft	475 ft	375 ft	250 ft	100 ft[6]

[1] The distances are adjusted for a sign legibility distance of 180 feet for Condition A. The distances for Condition B have been adjusted for a sign legibility distance of 250 feet, which is appropriate for an alignment warning symbol sign. For Conditions A and B, warning signs with less than 6-inch legend or more than four words, a minimum of 100 feet should be added to the advance placement distance to provide adequate legibility of the warning sign.

[2] Typical conditions are locations where the road user must use extra time to adjust speed and change lanes in heavy traffic because of a complex driving situation. Typical signs are Merge and Right Lane Ends. The distances are determined by providing the driver a PRT of 14.0 to 14.5 seconds for vehicle maneuvers (2005 AASHTO Policy, Exhibit 3-3, Decision Sight Distance, Avoidance Maneuver E) minus the legibility distance of 180 feet for the appropriate sign.

[3] Typical condition is the warning of a potential stop situation. Typical signs are Stop Ahead, Yield Ahead, Signal Ahead, and Intersection Warning signs. The distances are based on the 2005 AASHTO Policy, Exhibit 3-1, Stopping Sight Distance, providing a PRT of 2.5 seconds, a deceleration rate of 11.2 feet/second^2, minus the sign legibility distance of 180 feet.

[4] Typical conditions are locations where the road user must decrease speed to maneuver through the warned condition. Typical signs are Turn, Curve, Reverse Turn, or Reverse Curve. The distance is determined by providing a 2.5 second PRT, a vehicle deceleration rate of 10 feet/second^2, minus the sign legibility distance of 250 feet.

[5] No suggested distances are provided for these speeds, as the placement location is dependent on site conditions and other signing. An alignment warning sign may be placed anywhere from the point of curvature up to 100 feet in advance of the curve. However, the alignment warning sign should be installed in advance of the curve and at least 100 feet from any other signs.

[6] The minimum advance placement distance is listed as 100 feet to provide adequate spacing between signs.

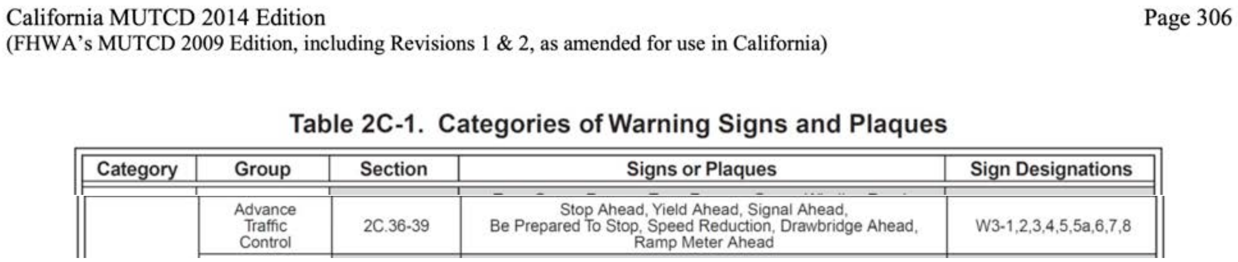


Table 2C-1. Categories of Warning Signs and Plaques

Category	Group	Section	Signs or Plaques	Sign Designations
	Advance Traffic Control	2C.36-39	Stop Ahead, Yield Ahead, Signal Ahead, Be Prepared To Stop, Speed Reduction, Drawbridge Ahead, Ramp Meter Ahead	W3-1,2,3,4,5,5a,6,7,8

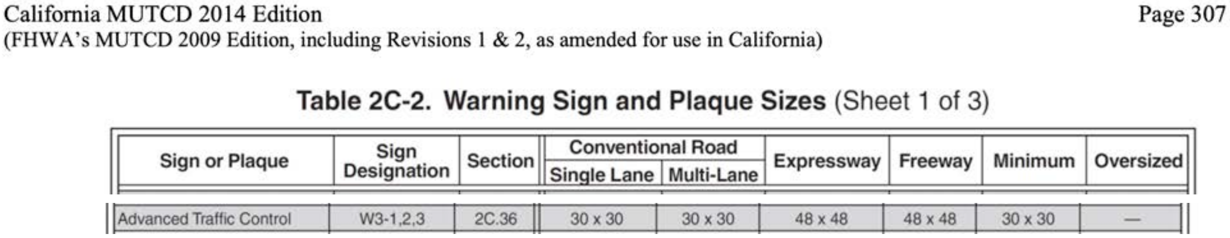


Table 2C-2. Warning Sign and Plaque Sizes (Sheet 1 of 3)

Sign or Plaque	Sign Designation	Section	Conventional Road		Expressway	Freeway	Minimum	Oversized
			Single Lane	Multi-Lane				
Advanced Traffic Control	W3-1,2,3	2C.36	30 x 30	30 x 30	48 x 48	48 x 48	30 x 30	—

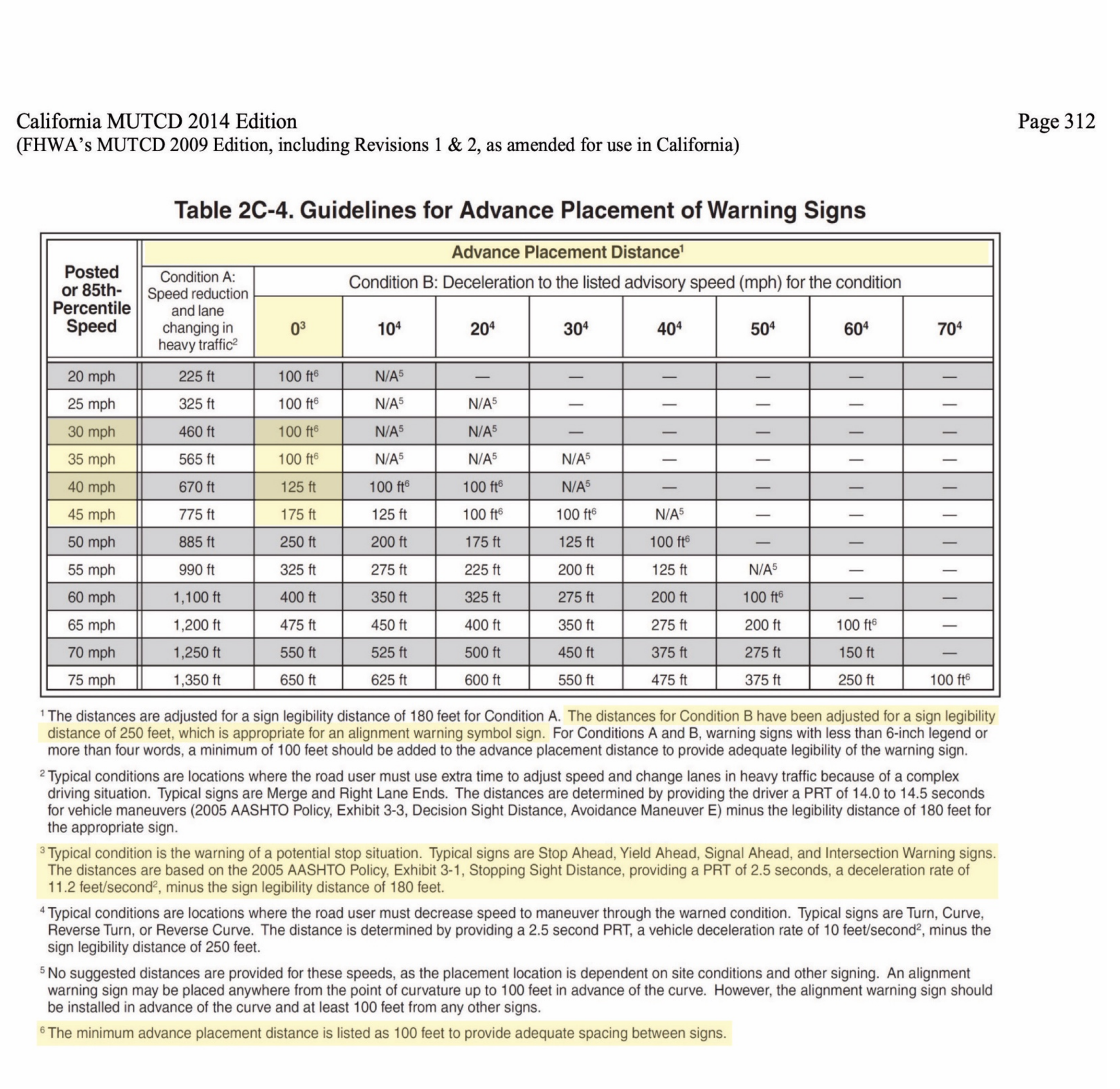


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Table 2C-4. Guidelines for Advance Placement of Warning Signs

Posted or 85th-Percentile Speed	Advance Placement Distance[1]								
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25 mph	325 ft	100 ft[6]	N/A[5]	N/A[5]	—	—	—	—	—
30 mph	460 ft	100 ft[6]	N/A[5]	N/A[5]	—	—	—	—	—
35 mph	565 ft	100 ft[6]	N/A[5]	N/A[5]	N/A[5]	—	—	—	—
40 mph	670 ft	125 ft	100 ft[6]	100 ft[6]	N/A[5]	—	—	—	—
45 mph	775 ft	175 ft	125 ft	100 ft[6]	100 ft[6]	N/A[5]	—	—	—
50 mph	885 ft	250 ft	200 ft	175 ft	125 ft	100 ft[6]	—	—	—
55 mph	990 ft	325 ft	275 ft	225 ft	200 ft	125 ft	N/A[5]	—	—
60 mph	1,100 ft	400 ft	350 ft	325 ft	275 ft	200 ft	100 ft[6]	—	—
65 mph	1,200 ft	475 ft	450 ft	400 ft	350 ft	275 ft	200 ft	100 ft[6]	—
70 mph	1,250 ft	550 ft	525 ft	500 ft	450 ft	375 ft	275 ft	150 ft	—
75 mph	1,350 ft	650 ft	625 ft	600 ft	550 ft	475 ft	375 ft	250 ft	100 ft[6]

[1] The distances are adjusted for a sign legibility distance of 180 feet for Condition A. The distances for Condition B have been adjusted for a sign legibility distance of 250 feet, which is appropriate for an alignment warning symbol sign. For Conditions A and B, warning signs with less than 6-inch legend or more than four words, a minimum of 100 feet should be added to the advance placement distance to provide adequate legibility of the warning sign.

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[6] The minimum advance placement distance is listed as 100 feet to provide adequate spacing between signs.

Highlighted in yellow by PRISM Engineering for emphasis on relevant parts of the table used applying to Mallard Lane installation.

Figure 3A-104 (CA). No Passing Zones - Two Direction

DETAIL 21

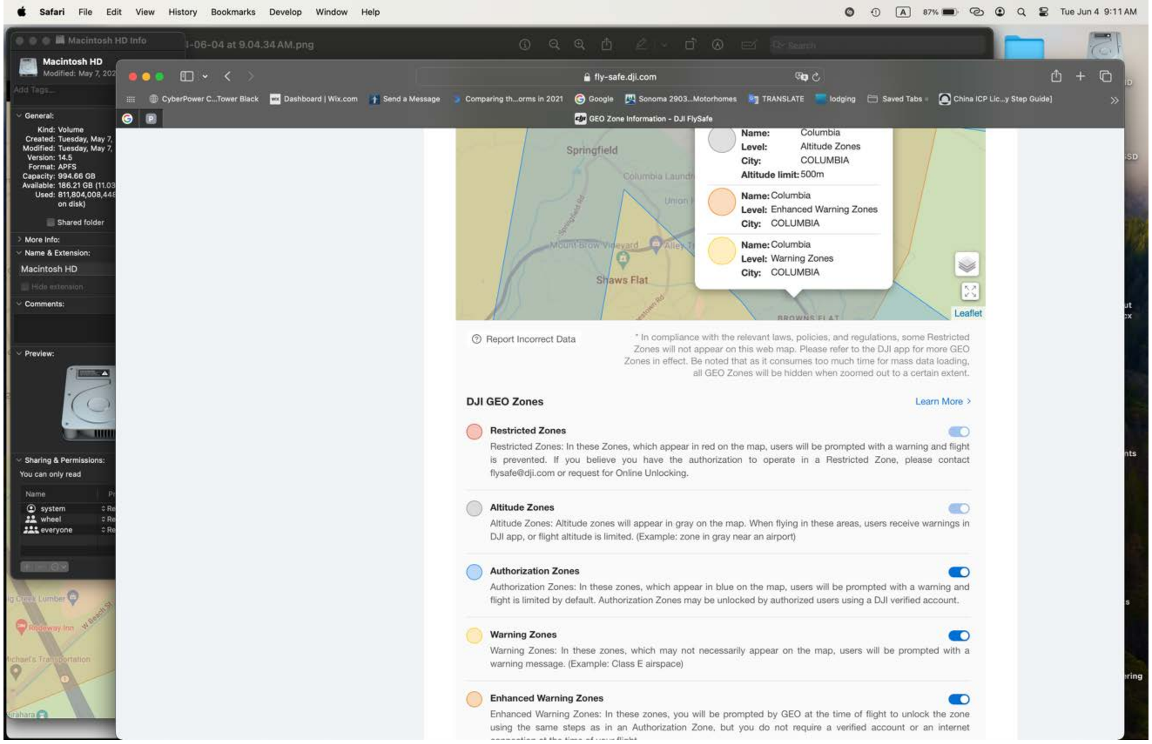
POLICY

Two-direction no-passing pattern for use on two-lane streets and highways (normally used on local streets and highways). See Note 2.

B. Elevation and Mallard Lane Slope Measurements

Drone Safety Measures

Initially checked to ensure that flying drone in the area is legal and safe. The study area is outside of the “Enhanced Placerville Airport Warning Zone” (as shown below in the orange shaded areas of the graphic) for this location on Mallard Ln. northwest of Green Valley Road. Flying a drone is legal and safe.



Name: Columbia
Level: Altitude Zones
City: COLUMBIA
Altitude limit: 500m

Name: Columbia
Level: Enhanced Warning Zones
City: COLUMBIA

Name: Columbia
Level: Warning Zones
City: COLUMBIA

Report Incorrect Data

* In compliance with the relevant laws, policies, and regulations, some Restricted Zones will not appear on this web map. Please refer to the DJI app for more GEO Zones in effect. Be noted that as it consumes too much time for mass data loading, all GEO Zones will be hidden when zoomed out to a certain extent.

DJI GEO Zones

Learn More ›

Restricted Zones

Restricted Zones: In these Zones, which appear in red on the map, users will be prompted with a warning and flight is prevented. If you believe you have the authorization to operate in a Restricted Zone, please contact flysafe@dji.com or request for Online Unlocking.

Altitude Zones

Altitude Zones: Altitude zones will appear in gray on the map. When flying in these areas, users receive warnings in DJI app, or flight altitude is limited. (Example: zone in gray near an airport)

Authorization Zones

Authorization Zones: In these zones, which appear in blue on the map, users will be prompted with a warning and flight is limited by default. Authorization Zones may be unlocked by authorized users using a DJI verified account.

Warning Zones

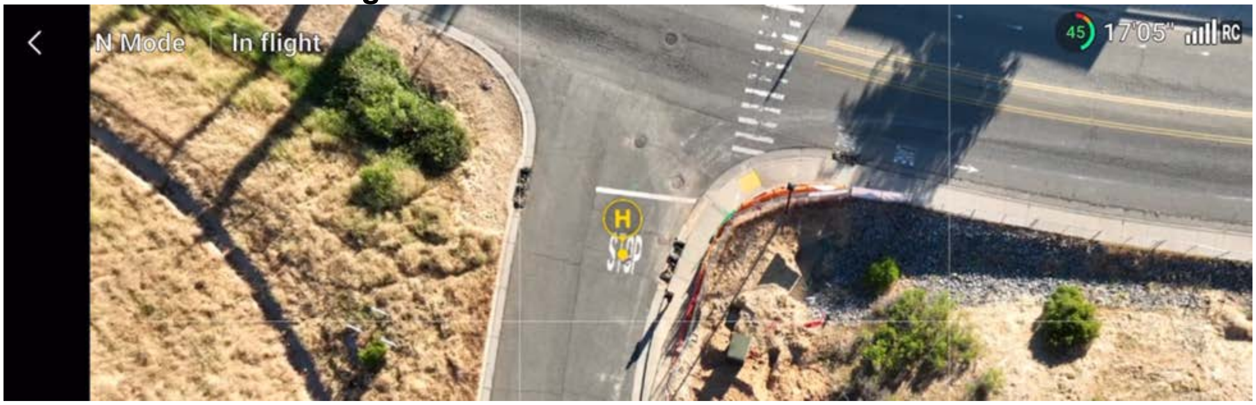
Warning Zones: In these zones, which may not necessarily appear on the map, users will be prompted with a warning message. (Example: Class E airspace)

Enhanced Warning Zones

Enhanced Warning Zones: In these zones, you will be prompted by GEO at the time of flight to unlock the zone using the same steps as in an Authorization Zone, but you do not require a verified account or an internet

ELEVATION MEASUREMENTS by Drone Elevation Readings

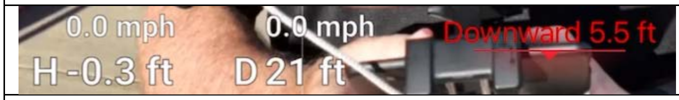
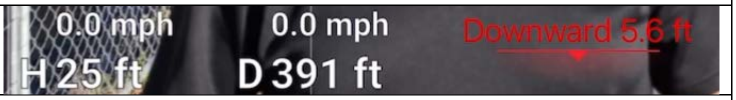
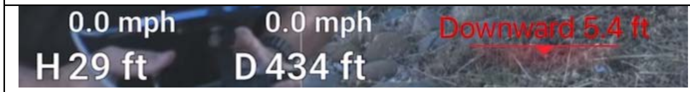
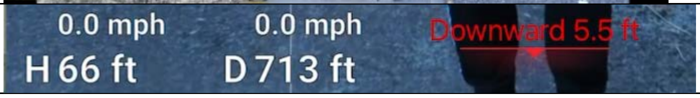
Home Point on STOP legend



STEP 1: First point 21 feet from stop legend center and at the SW corner of Pintail/Macintosh where the first elevation will be measured in next slide, showing height at approximately 0 feet, but aircraft is 5.5 feet above the ground. This establishes a "ZERO" point at the "X" location shown below, just to the right of the manhole cover in the street at the SW corner of the EB Mcintosh approach (when the drone aircraft is 5.5 feet above the ground surface).

Moving the drone down to a screen elevation reading of "Height=0 ft" this was established at the "ZERO" height point to get the differential when measuring other locations. This height also established a screen reading that detected the asphalt below was 5.5 feet from current position to the ground surface below. To be consistent in all other readings, the drone would be lowered until the position to the ground would also read 5.5 feet. Then the difference in height (H) is the change in elevation from the original point. In the next photo screen shot of the drone control app, the "Downward 5.5 ft" distance of 5.5 feet in red lettering is shown, meaning that the drone is exactly positioned 5.5 feet above the ground surface. This is the first location or "station" in measuring elevations which are then used to measure the slope and grade of the road on various segments where speed and sight distance is a concern. This includes the immediate Mallard Lane segment to the south of Drake Ct.

(up the steep grade to the power lines crossing), and the Mallard Lane segment to the north of Drake Ct. (up to its intersection with Pintail Ln.).

	
Station 1: Height Measurement at SW corner of Mallard at Mcintosh is approximately **0 feet** *(reads -0.3 ft on screen)*	**Station 2:** Next measurement was taken at end of the sidewalk across from Drake Ct., a **25-foot rise** and 391 feet away (straight line) from **Station 1** location.
	
	
Station 3: Measurement taken next at NE corner of Drake Ct., on the top of the sidewalk surface, a **29-foot rise** (*4 feet higher than the other side of the street*) and 434 feet away from **Station 1**.	**Station 4:** Measurement on Electric Service Ground Box slab surface, which is flush with sidewalk, 713 feet (straight line) away from **Station 1**, and a **66-foot rise** from **Station 1**.

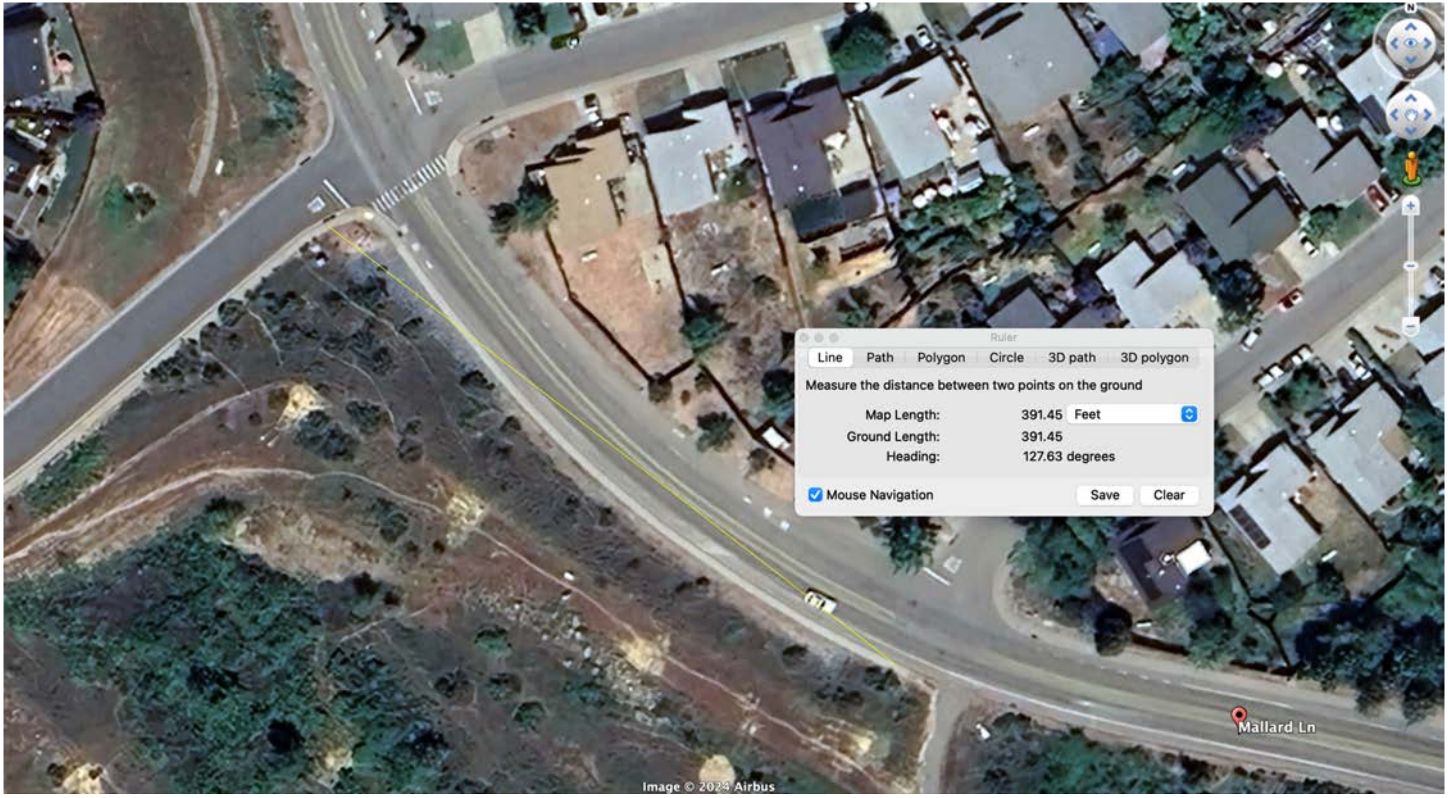
Slope and Grade Calculations

These elevation values shown previously were used to calculate the slope or the grade of the roadway, Mallard Lane in SPEED ZONE 1 and SPEED ZONE 2, as follows:

Station 1 to Station 2 Straight Line Distance is 391 feet and Elevation Rise is 25 feet.

GRADE = 100 * SLOPE = 100 * (Rise / Run) = 100 * (25 feet / 391 feet = 100 * 0.06 = **6% Grade (average).**

Cross checking and validating drone satellite distances with Google Earth distance features, typical:



Measure the distance between two points on the ground

Map Length: 391.45 Feet

Ground Length: 391.45

Heading: 127.63 degrees

☑ Mouse Navigation

Speeds were measured for NB Mallard (coming down hill). There is a 30-mph speed limit sign posted for the road.

Station 3 to Station 4 *(in SPEED ZONE 1)* Straight Line Distance is 285 feet and Elevation Rise is 66 - 29 = 37 feet.

GRADE = 100 * SLOPE = 100 * (Rise / Run) = 100 * (37 feet / 285 feet = 100 * 0.13 = **13% Grade** *(average).*

Note: In the actual speed calculations in our speed survey spreadsheet and graph/chart, the **distance** used for **timing** the cars traveling a fixed distance to determine their speeds in SPEED ZONE 1 was **300 feet** as measured from center of the Drake Court intersection to the Electric Service Ground Box slab area. For SPEED ZONE 2 the distance measured was also from the center of Drake Court intersection to the edge of the zebra style crosswalk at Pintail Lane on Mallard Lane, or approximately **400 feet**.