West Street Road Diet Project Evaluation

Oakland Department of Transportation | Safe Streets Division | Bicycle & Pedestrian Program

Before

After

January 2025

OakDOT
Oakland Department of Transportation

Introduction

In 2021-2022, the West Street Road Diet Project reconfigured West Street (from San Pablo Avenue to 52nd Street) with the goals of reducing traffic collisions and speeding, making the street safer for residents, and more comfortable for pedestrians and bicyclists. The project was part of a citywide street repaving contract, with additional funding provided by the City's 2017-2019 Capital Improvement Program. The project paved the street, upgraded curb ramps to meet accessibility standards, and adjusted the lane configuration, replacing the existing two-way center turn lane with a six-foot wide striped median, reallocating roadway space to add buffers to the existing bike lanes and pedestrian refuge space at key crossing points.[1] Other features of the recently completed project included:

- High-visibility crosswalks;
- Raised pedestrian safety islands at six crosswalks;
- Raised corner islands (also known as protected intersections) to slow turning vehicles and shorten bicyclist and pedestrian crossings at two signalized intersections with other bikeways;
- A median refuge area for northbound bicyclists crossing San Pablo Avenue, created by removing the northbound left turn pocket at the intersection of San Pablo Ave and Isabella St;
- One speed hump and six speed cushions (speed humps with emergency vehicle pass-throughs);
- Two raised intersections (flat, raised areas covering the entire internal area of an intersection, with ramps on all approaches); and
- Resurfacing and refresh of the existing conventional bike lanes on one block of West Street between San Pablo Avenue and West Grand Avenue.

Illustrative images of each feature type and a map of project feature locations are presented in Figures 1 &2.

Project design and construction were preceded by a road diet feasibility study and project-specific community outreach. The study, completed in July 2020, found the road diet to be feasible and recommended the project be advanced with upcoming resurfacing as a cost-effective means of addressing speeding, safety, and access for all road users. The key findings behind the study's recommendation were:

- There were 76 injury crashes and 157 total crashes during the five-year study period (2012-2016), including seven pedestrian-involved and 24 bicyclist-involved crashes;
- Approximately 32% of motorists exceeded the speed limit in the pre-project condition;
- One travel lane per direction was determined to be sufficient to accommodate the existing motor vehicle traffic;
- The proposed project would improve pedestrian safety and access with new high-visibility crosswalks, pedestrian safety islands, and one less lane to cross; and
- The proposed project had the potential to make West Street suitable for bicycling by most adults if successful in reducing prevailing motor vehicle speeds from 33 mph (existing) down to 30 mph, whereas the street was only suitable for experienced commuter bicyclists in the pre-project condition.

During project outreach, community members shared concerns about speeding, motorists disregarding stop signs, motorists using the center turn lane to pass other vehicles illegally, and other reckless driving. These concerns appeared to grow during the onset of the COVID-19 pandemic in 2020. While the project proposals

[1] To put the project road diet in historical context, an earlier road diet (first installed between Sycamore St and W MacArthur Blvd in 1997, then extended north to 52nd St in 2007) reduced West St from a four-lane configuration (two lanes in each direction) to one lane in each direction, adding the center turn-lane and bicycle lanes. The 1997 project created the second known bicycle lanes in Oakland.

received broad support, stakeholders recommended doing more to prevent vehicles from traveling at high speeds through stop-controlled intersections. Based on this feedback, speed cushions and raised intersections were added to the design. Furthermore, city staff arranged to complete a before/after evaluation of the project's impact on traffic speed and volume.

Evaluation Summary

This project evaluation focuses on the issues identified in the project feasibility study and community outreach: motorist speeds and volumes, pedestrian safety at roadway crossings, and suitability of the street as a bicycling corridor. Driver behavior at speed cushions (a new feature on the corridor) is also evaluated. The key outcomes observed in this project evaluation include:

- Motor vehicle traffic volumes on the corridor went down slightly after the project, however, because the project was built during the COVID-19 pandemic, it is difficult to separate project related effects on traffic volume from the larger regional effects on travel associated with the pandemic;
- Prevailing motor vehicle speeds went down, and high-end speeding (motorists traveling over 40 miles per hour) was dramatically reduced after project completion. This was a reversal of trends showing increased speeding as the COVID-19 pandemic progressed;
- Compliance with speed cushions was high, with only 14% of motorists deviating slightly to use one emergency vehicle pass-through, and 1% of motorists deviating from the travel lane enough to use both emergency vehicle pass-throughs;
- The road diet improved safety and comfort for pedestrians at roadway crossings by creating space for six concrete pedestrian safety islands, shortening crossing distances and increasing the likelihood that drivers will yield, eliminating uncontrolled multi-threat crosswalks, and making standard upgrades such as high-visibility crosswalks and red curb to daylight intersections; and
- The road diet improved the suitability of West St as a bicycling corridor by creating space to add striped buffers to the existing bike lanes, installing two protected intersections, and reducing the number of lanes intersecting bikeways cross. Furthermore, the reductions in traffic speed and volume made West St a more comfortable bikeway, with buffered bike lanes representing a preferred bikeway type for a wider range of cyclists.

Figure 1 – Project Features

Three to Two Lane Road Diet

(Before)

(After)

Pedestrian Safety Island

Protected Intersection

Speed Cushion

Raised Intersection

Figure 2 – Project Map

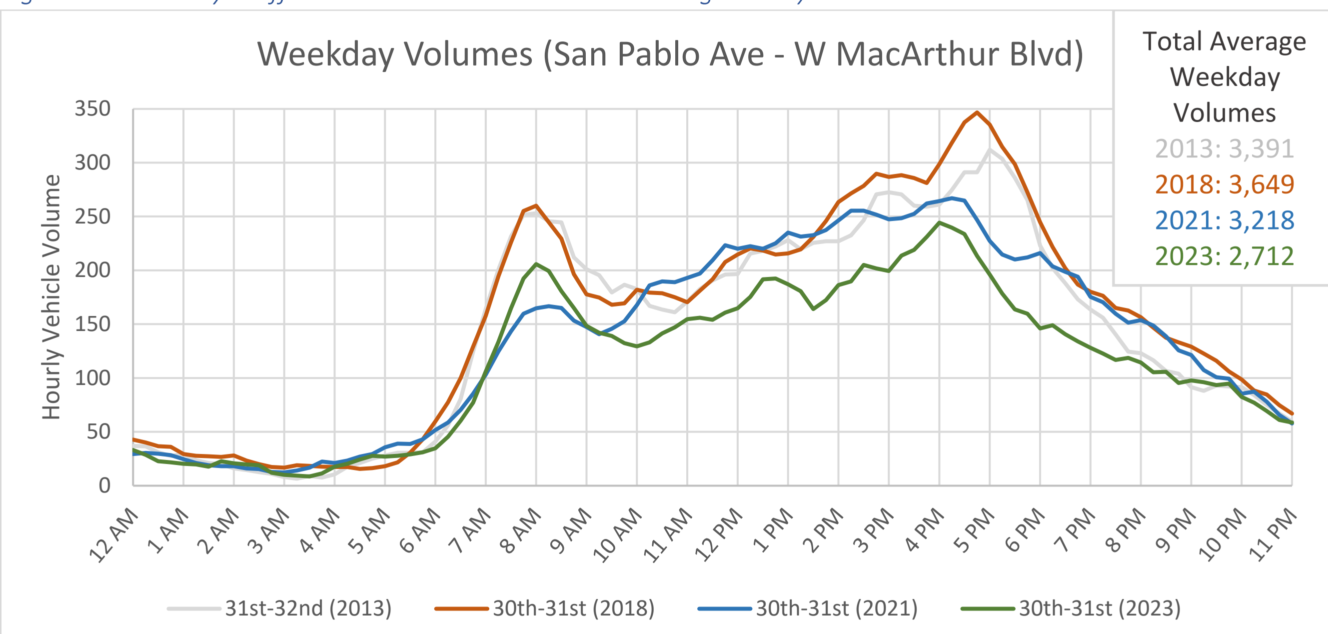
Observations

Traffic Volume

The COVID-19 pandemic changed driving behavior dramatically. Beginning in 2020, traffic volumes decreased significantly, and AM and PM peaks became less pronounced as many people began working from home, lost their jobs, or had more flexible schedules. Traffic volumes have been rising steadily since 2020. Given this dramatic change in driving behaviors, the impact of which is likely larger than that of the project, it's difficult if not impossible to separate the impact of the pandemic from the project on traffic volumes. The traffic volume observations presented below should be considered with this in mind.

In 2018, when preparing the West Street Road Diet Feasibility Study, the City collected a three-day mid-week pneumatic tube count between 30th St and 31st St to assess the volume and speed of traffic using the corridor. Then in 2021, two months before roadway construction, the City collected pre-project tube counts on the same block, as well as the block between 43rd St and 44th St. Finally, in 2023 the City collected post-project tube counts on the same two blocks. The City also gathered historic reports from two pneumatic tube counts collected in 2013 (one on the block between 31st St and 32nd St, and another on the block between 46th St and 47th St). Figures 3 and 4 below show the average weekday traffic volumes reported on West St in each of these counts:

Figure 3 –Weekday Traffic Volumes on Southern Corridor Segment by Year

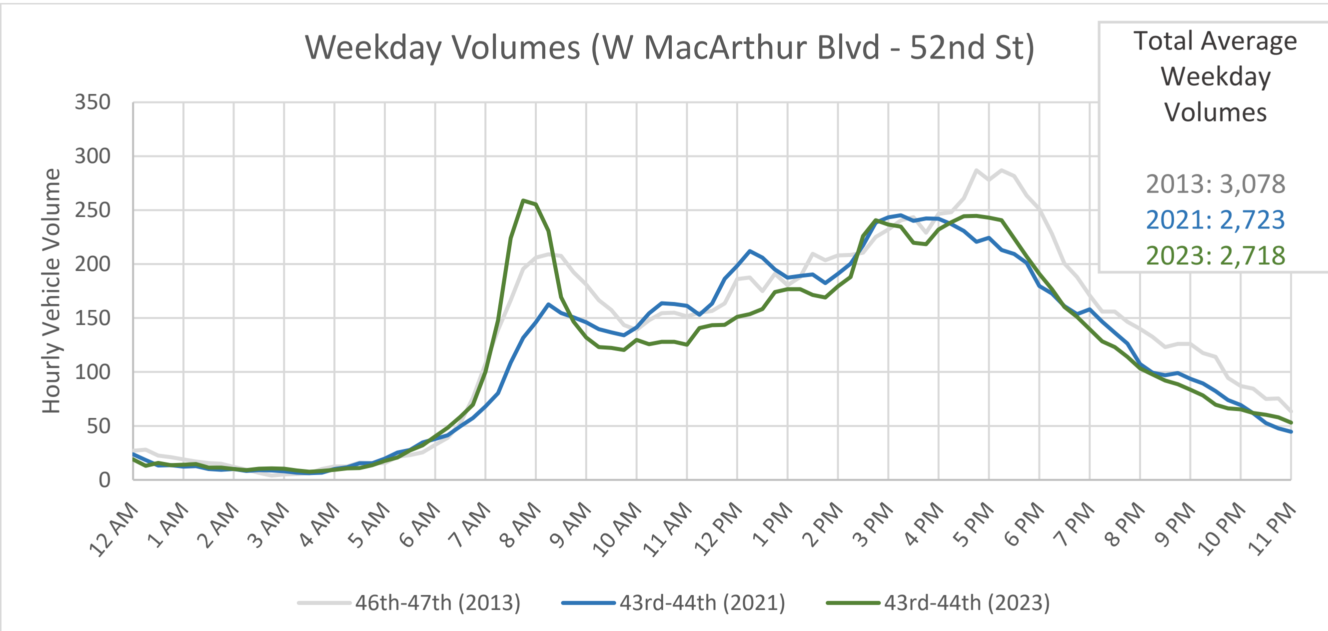


Between 30th St and 31st St, which is representative of West St to the south of W MacArthur Blvd (see Figure 3):

- From 2018 (pre-pandemic) to 2021 (pre-project), the total average weekday traffic volume decreased by about 430 cars per day (12%). From 2021 to 2023 (post-project), traffic volume decreased again by about 500 cars per day (16%).
- *A 2013 count from one block to the north is provided for historic reference, showing that average daily traffic volumes on this segment increased by about 250 vehicles (or 8%) from 2013 to 2018, with the increased volume spread mainly throughout the afternoon and evening.*
- AM peak hourly volumes decreased by approximately 100 vehicles per hour (v/h) hour from 2018 to 2021, then increased by approximately 50 v/h from 2021 to 2023.

- Midday volumes were effectively unchanged from 2018 to 2021 but decreased by approximately 50 v/h from 2021 to 2023.
- PM peak volumes decreased by approximately 80 v/h from 2018 to 2021 and decreased another 20 v/h from 2021 to 2023. Because the volume decreases were observed mainly at the later end of the peak, the timing of the PM peak shifted, with evening traffic beginning to subside earlier (4:45 PM in 2018, 4:15 PM in 2021, and 4:00 PM in 2023).
- The absolute peak hourly volume observed throughout the day has gone down from 347 v/h (during the PM peak in 2018) to 244 v/h (during the PM peak in 2023).

Figure 4 –Weekday Traffic Volumes on Northern Corridor Segment by Year



Between 43rd St and 44th St, which is representative of West St to the north of W MacArthur Blvd (see Figure 4):

- From 2021 (pre-project) to 2023 (post-project), total average weekday traffic volumes were effectively unchanged. *Both recent year counts report approximately 350 fewer vehicles per day than the 2013 historic reference count from three blocks to the north.*
- AM peak hourly volumes decreased by approximately 50 vehicles per hour (v/h) hour from 2013 to 2021, then increased by approximately 100 v/h from 2021 to 2023. In 2021, the AM peak was diminished enough to blend into a steady increase of hourly volume throughout the morning and midday. In 2023 the AM peak returned, more pronounced than in 2013.
- Midday volumes were effectively unchanged from 2013 to 2021 but decreased by approximately 10-50 v/h from 2021 to 2023.
- PM peak volumes decreased by approximately 50 v/h from 2013 to 2021 and were effectively unchanged from 2021 to 2023. Overall, the PM peak was less pronounced and spread over a longer period in 2021 and 2023 than in 2013. PM peak timing shifted, with evening traffic beginning to subside earlier in 2021 than in 2013 or 2023 (5:15 PM in 2013, 3:45 PM in 2021, and 4:45 in 2023).

Traffic Speed

In addition to traffic volume, the project pneumatic tube counts recorded the speed at which traffic was traveling along the corridor in the pre-pandemic (2018, for the southern corridor segment only), pre-project (2021), and post-project (2023) evaluation periods. This data is summarized in Table 1, Figure 5, and Figure 6 below. The table and figures compare the mean speed and 85th percentile speed, as well as the percentage of vehicles traveling over 30 miles per hour (the posted speed limit) and the percentage and absolute number of vehicles traveling over 40 miles per hour (significantly above the posted speed limit).

Table 1 – Pre and Post Project Speed Data

Location	Year	Mean Speed	85th Percentile Speed	% Over 30 MPH	% Over 40 MPH	# Over 40 MPH
Between 43rd St & 44th St	2021	28	33	30.3%	1.5%	116
	2023	25	30	14.7%	0.6%	46
Between 30th St & 31st St	2018	26	33	32.1%	1.5%	169
	2021	26	33	25.4%	2.1%	193
	2023	21	28	6.1%	0.4%	34

Figure 5 – Pre- and Post-Project Speed Data on Northern Corridor Segment

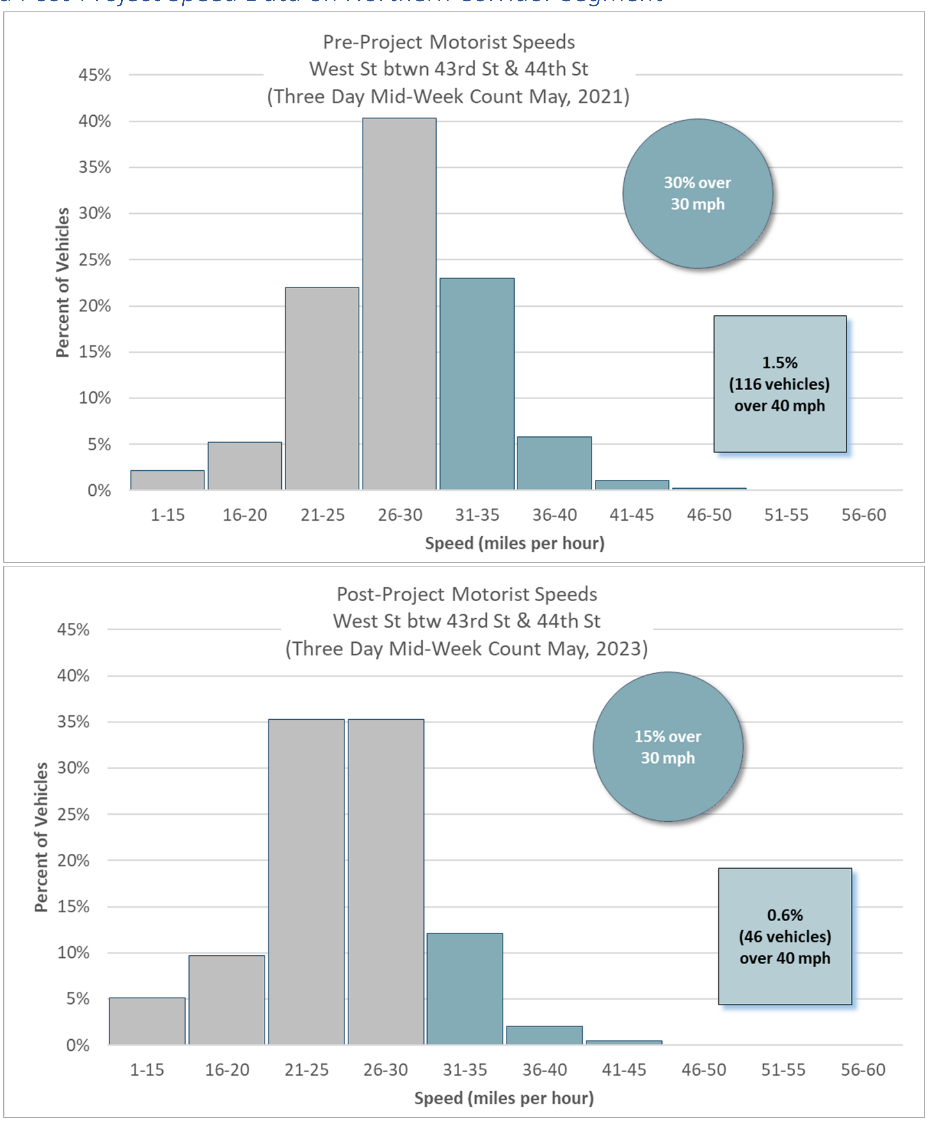
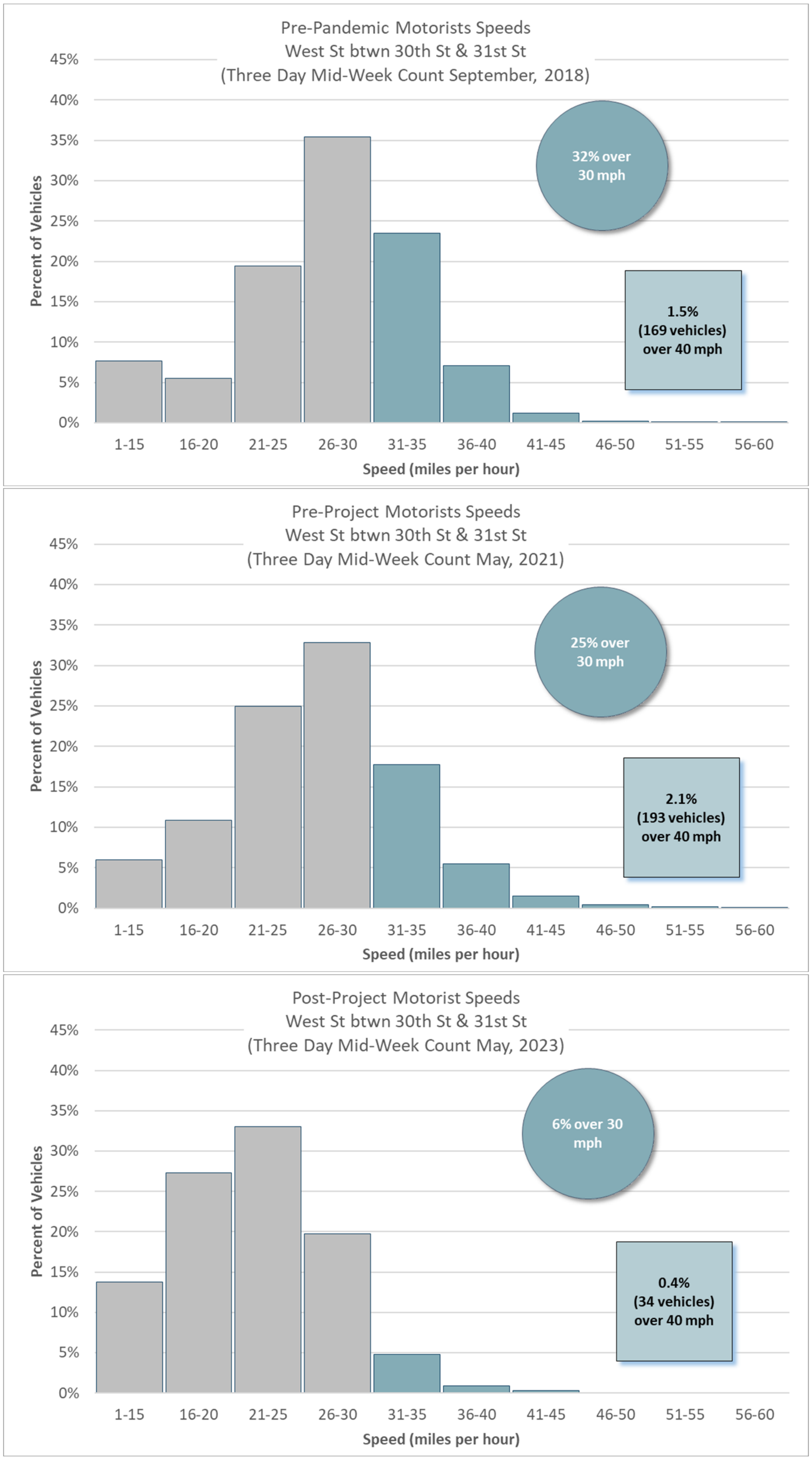


Figure 6 – Pre- and Post-Project Speed Data on Southern Corridor Segment



In the northern corridor segment, represented by the traffic counts between 43rd St and 44th St, all reported speed metrics decreased from 2021 (pre-project) to 2023 (post-project). 85th percentile speed (also known as prevailing speed) decreased from 33 MPH to 30 MPH (the posted speed limit) and the percentage of traffic traveling over the posted speed limit decreased from 30% to 15%. The percentage of vehicles traveling above 40 MPH (i.e. significantly over the speed limit) fell from 1.5% (116 vehicles over a three-day count period) to 0.6% (46 vehicles over a three-day count period). There is no pre-pandemic tube count for this segment, however, the mid-morning portions of these 2021 and 2023 tube counts are compared to a 2013 radar speed survey in Table 2 below.

In the southern corridor segment, represented by the traffic counts between 30th St and 31st St, all reported speed metrics decreased from 2021 to 2023, however, more dramatically than in the northern corridor segment. 85th percentile speed decreased from 33 MPH to 28 MPH and the percentage of traffic travelling over the posted speed limit went from 25% to 6%. The number of vehicles traveling above 40 MPH fell from 2.1% (193 vehicles over a three-day count period) in 2021 to 0.4% (34 vehicles over a three-day count period) in 2023.

Speed data from the 2018 pneumatic tube count (before the project and before the pandemic) is available for the southern corridor segment. From 2018 to 2021, the 85th percentile speed remained the same (33 MPH), the percentage of traffic traveling over the posted speed limit decreased from 32% to 25%, and the percentage of vehicles traveling above 40 MPH increased from 1.5% to 2.1%. In other words, while the prevailing traffic speeds remained steady from 2018 to 2021 and speeding decreased overall, the distribution of traffic speed became more dispersed, and an increase in traffic traveling significantly over the speed limit was observed. The observed increase in high-end speeding parallels trends observed across the region with the onset of the pandemic, however, the trend was reversed on West St in 2023 (after the project), when traffic was observed to travel at lower, more consistent speeds.

Mid-Morning Traffic Speed

As stated above, pre-pandemic tube count speed data is not available for the norther corridor segment, however, radar speed survey data from 2013 is available for both corridor segments. The 2013 radar speed surveys were conducted at the mid-morning periods and nearby locations listed in Table 2 below. See Table 2 and the discussion below it for a comparison of the just the mid-morning portions of the project tube counts to the 2013 radar speed surveys.

Table 2 – Comparison of Mid-Morning Speed Data from Project Traffic Counts to Historic 2013 Speed Surveys

Location	Year	Mean Speed	85th Percentile Speed	% Over 30 MPH	% Over 40 MPH	# Over 40 MPH
Between 46th St & 47th St (9:00-10:30AM)	2013	26	30	14%	0.0%	0
Between 43rd St & 44th St (9:00-10:30AM)	2021	28	34	34%	2.4%	11
	2023	25	30	14%	0.7%	4
Between 31st St & 32nd St (9:24-10:50AM)	2013	27	31	21%	0.0%	0
Between 30th St & 31st St (9:30-11:00AM)	2018	27	34	34%	0.9%	7
	2021	26	33	26%	2.4%	12
	2023	21	27	4%	0.2%	1

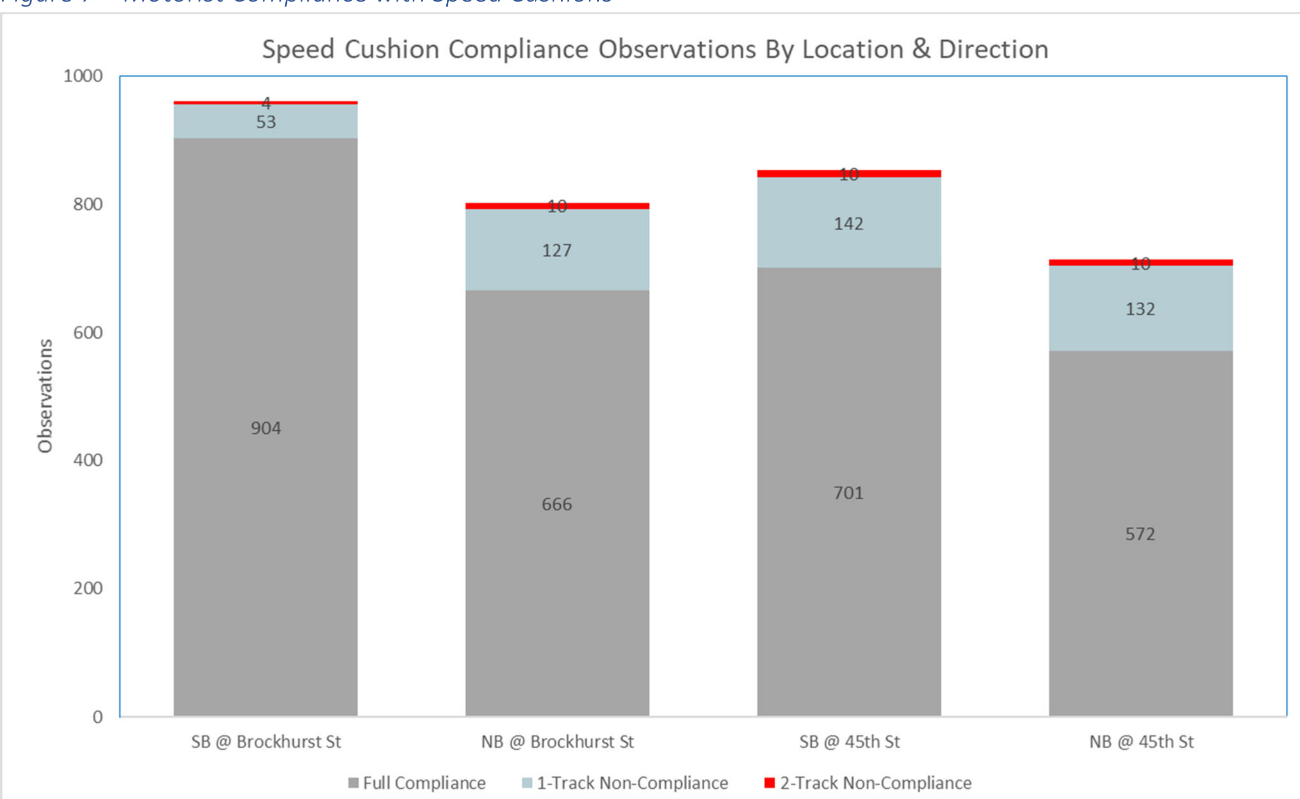
Two nearby speed surveys were conducted in 2013, each approximately one and a half hours in duration during the mid-morning. Because the three-day (72-hour) project traffic counts report traffic data in 15-minute intervals, it is possible to compare them to the radar speed surveys by looking at roughly the same time of day. These comparisons (presented in Table 2) provide some general historic context to the project traffic data, however, some caution should be used when comparing these data sources in detail. Beyond the differences in duration, the counts differ in methodology, one employing a human observer pointing a Doppler radar unit at specific vehicles in the traffic stream, the other automatically recording data from vehicles as they traverse pneumatic tubes affixed to the roadway surface. In general, comparing the project traffic count speed data to the 2013 radar speed surveys reinforces the trends observed in the previous section, where over time and before the project, traffic speeds were becoming more dispersed, with more vehicles observed travelling significantly over the speed limit. These trends were then reversed in the 2023 data, where speeds were lower and less dispersed after the project.

Compliance with Speed Cushions

The project installed six new speed cushions (undulations in the roadway, like speed humps with two lengthwise gaps for emergency vehicles) along the corridor. The gaps in the speed cushions were spaced to allow the left and right wheels of an emergency vehicle to pass with minimal vertical deflection. The gaps were also centered within the 6' wide striped centerline, a location where emergency vehicles in either direction could access them, but outside of the travel lanes where passenger cars are expected to operate.

While not a main concern of the feasibility study or outreach process, the project evaluation presented an opportunity to investigate how drivers would react to the new speed cushions. Data was collected on whether private vehicles passed both sets of wheels over the speed cushions as intended (full compliance), deviated slightly out of the travel lane to pass one set of wheels through a gap (1-track non-compliance), or deviated completely out of the travel lane attempting to pass both sets of wheels through the gaps (2-track non-compliance). Traffic was observed in each direction at two of the six speed cushions, one north of 45th St (within the northern corridor segment) and one north of Brockhurst St (within the southern corridor segment). These observations are summarized in Figure 7 below:

Figure 7 – Motorist Compliance with Speed Cushions



Overall, 85% of cars fully complied with the speed cushion, 14% of cars deviated slightly to pass one set of wheels through a gap, and 1% attempted to fully bypass the hump by using both gaps. A higher rate of compliance was observed at the speed cushion north of Brockhurst St (89% Compliance in both directions) than the one north of 45th St (81%), but the compliance difference was most pronounced in the southbound direction (82% SB @ 45th St vs. 94% SB @ Brockhurst St). These directional differences in compliance rate could be examined further as more data becomes available or as comparable locations are built. Physical differences between the two locations, which may play a role in compliance include:

- The speed cushion north of Brockhurst St is centered 66' north of the intersection, whereas the cushion north of 45th St is centered 97' north of the intersection;
- The speed cushion north of Brockhurst St fronts a school and bikeshare station on one side (residences on the other), whereas the cushion north of 45th St fronts residences on both sides;
- The speed cushion north of Brockhurst St is coupled with a speed cushion on the south side of Brockhurst 161' to the south, as well as a ped safety island at the northern end of the block 125' to the feet north; whereas
- The speed cushion north of 45th St is coupled with a speed cushion on the south side of 45th St, 170' to the south. the nearest calming feature to the north is another speed cushion two blocks away, 586' to the north.

Because speed cushions are a relatively new roadway feature in Oakland, and other speed cushions in Oakland have tended to be installed on much higher volume roadways than West St (e.g. 35th Ave or High St) these observations cannot be compared to similar speed cushion installations in the city. However, the observed corridor-wide speed reductions, and high rate of speed cushion compliance, suggest that speed cushions were an effective part of achieving the project goals on West St.

Discussion

The main goals of the West Street Road Diet Project included improving overall traffic safety, improving pedestrian safety and comfort at roadway crossings, and improving the suitability of the street as a bicycling corridor. The discussion below evaluates progress on these goals based the physical infrastructure the project built and the observations above. Limitations of the project evaluation are also discussed.

Overall Traffic Safety

Modest reductions in average daily and peak hour motor vehicle traffic were observed on West St after the project was built. However, the project was built against a backdrop of evolving regional traffic patterns, where travel drastically reduced during the COVID-19 pandemic related lockdowns leading up to project construction. Traffic volumes are subsequently returning to near-pre-pandemic daily volumes, except with lower peaks spread out over longer timeframes (Bhagat-Conway MW, Zhang S., 2023). Thus, it is difficult to say whether the project had any durable effect on volume beyond the effects of the pandemic. Still, there are fewer cars on West St currently, which has been shown to increase traffic safety for everyone (drivers, passengers, pedestrians, cyclists, etc.) through reduced exposure to the risks associated with driving (Høye & Hesjevoll, 2020) (Litman, 2024).

The project has appeared to have a significant effect on traffic speed, particularly high-end speeding. Before the project, traffic speeds were becoming more dispersed, with more vehicles observed travelling significantly over the speed limit. These trends were reported by residents on the corridor during pre-project outreach and across the country, possibly linked to reductions in peak hour volume (Wang & Cicchino, 2023) and these risky driving behaviors have persisted nationally, even as traffic volumes have begun to return to pre-pandemic levels (TRIP, 2024). After the project was built on West St, however, prevailing traffic speeds and speeding were reduced to pre-pandemic or lower levels. Traffic speed plays a large role in traffic safety through three main mechanisms: Vehicles traveling at higher speeds require longer distances to react to changes in condition and come to a stop, travelling at higher speeds narrows a driver's field of vision making it more difficult to see and react to changes in condition (Solowczuk, 2021) (Bartmann, Spijkers & Hess, 1991), and increases in vehicle speeds increase the risk that a crash will result in severe injury and death for vulnerable road users such as pedestrians (Tefft, 2011). The lower traffic speeds on West St are expected to increase safety for all roadway users.

Overall, the traffic calming features and road diet the project installed have improved traffic safety by increasing buffer space between traffic streams and placing vehicles into a single lane in each direction, encouraging slower, more predicable traffic flow. The road diet and physical calming features work together to achieve this result for all roadway users, however, specific elements are geared toward improving the roadway for pedestrians and cyclists, as discussed below.

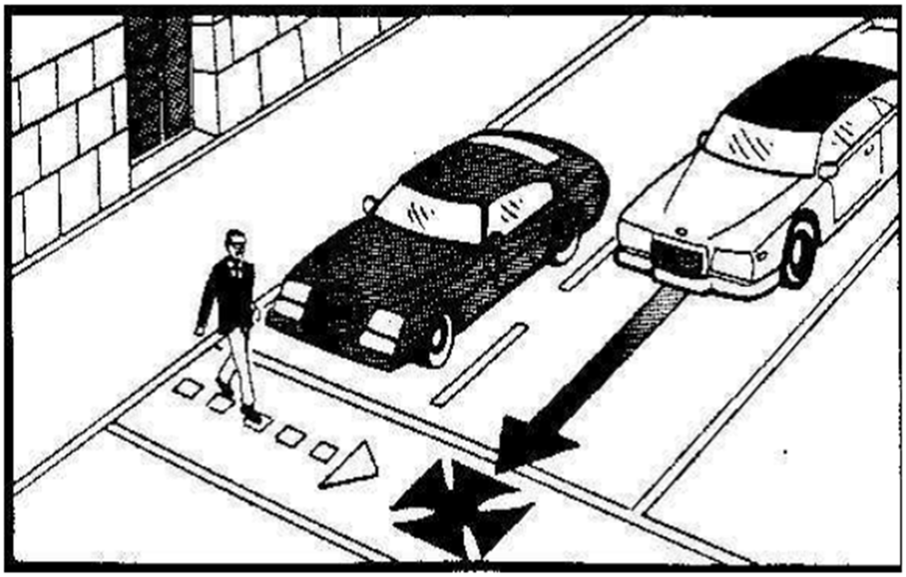
Improving Pedestrian Safety and Comfort at Roadway Crossings

The original West St road diet (implemented in 1997 and extended in 2007), which converted the roadway from four lanes to three (one in each direction with a center turn lane), significantly improved pedestrian crossing conditions in its own right. 'Four-to-three' road diets like this earlier project improve conditions for pedestrians by reducing the number of lanes a pedestrian must cross and by increasing drivers' likelihood of recognizing and yielding to crossing pedestrians thanks to fewer other conflicts demanding their attention (turning across one oncoming lane instead of two when making a left turn, for example). If traffic volumes and speeds are relatively high, center left turn lanes can provide further benefit by allowing left-turning drivers a dedicated space (away from the 'pressure' of through moving traffic) to focus on oncoming traffic and crossing pedestrians before turning. However, these potential benefits must be weighed against the fact that left turn lanes are an additional lane for pedestrians to cross and the potential that center turn lanes present an opportunity for speeding drivers to pass slower moving vehicles illegally, increasing risks for other roadway users. Furthermore, at uncontrolled crosswalks, two adjacent motor vehicle lanes in the same direction (including a left turn lane adjacent to a through lane) create a 'multi-threat' crossing, where a car yielding in one lane may obstruct the sightline between a crossing pedestrian and a vehicle traveling in the adjacent lane (see Figure 8 below).

While the four-to-three lane road diet on West St created many benefits for pedestrians over the previous lane configuration, the recently completed project improved upon this by reassessing the need for a continuous center turn lane. Instead of providing a center turn lane along the entire corridor, the new roadway configuration provides left turn pockets at the locations where they would provide a net benefit to all users (based on actual turning traffic volumes analyzed in the feasibility study). Left turn pockets were only maintained at three signal-controlled locations.

Thus, the project road diet (a three-to-two lane road diet) improved pedestrian safety and comfort at roadway crossings by eliminating all uncontrolled 'multi-threat' crosswalks within the project corridor. Furthermore, removing lanes at uncontrolled crossings improved pedestrian comfort by reducing the distance that pedestrians are exposed to vehicles when crossing, making it easier to judge when it is safe to cross. The reduction in lanes and the reduction in prevailing speeds associated with the road diet increases the likelihood that drivers will yield, and thus decreases the time pedestrians must wait to cross the street.

Figure 8 – Illustration of a multiple-threat pedestrian crash (reproduction of fig. 21 from Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations, Zeeger et al, 2005)



The project lane reconfiguration also made room for six concrete pedestrian safety islands, which increase pedestrian safety and comfort by providing a protected refuge area in the middle of the crossing, allowing pedestrians to cross each 'leg' of a crossing independently. At uncontrolled crossings, this reduces pedestrian delay because pedestrians are no longer required to find a simultaneous gap in both traffic directions. Pedestrian safety islands further improve safety and comfort by calming traffic turning left around the nose of the island and by discouraging high speed drivers from crossing the centerline to pass vehicles traveling at or around the speed limit. The project focused on building ped safety islands at six key locations (the four existing uncontrolled school crosswalks on the corridor and two signalized crosswalks at the I-580 ramp terminals). Additionally, the project lane configuration provided striped refuge space between lanes in each direction throughout the corridor, into which future projects could build additional islands.

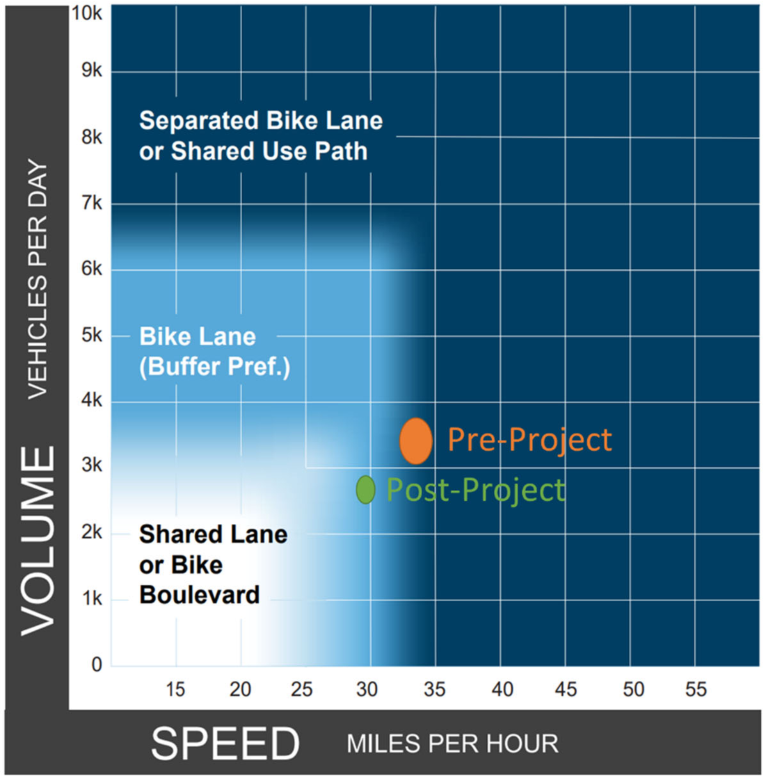
Finally, the project upgraded either unmarked or basic crosswalks to high-visibility crosswalk markings and signage, installed advanced yield lines or advanced limit lines, and refreshed or expanded red curb daylighting throughout the project corridor. Curb ramps were also upgraded to current accessibility standards.

Improving the Suitability of the Street as a Bicycling Corridor

The project road diet also made room for bikeway improvements, including adding buffers to the existing class II bike lanes and installing two protected intersections. West St was already a well-used bicycle corridor before the project. The project improvements have brought the roadway context further in-line with the importance of this bikeway connection.

Figure 9 below overlays the pre-project and post-project traffic speed and volume data onto figure 9 from FHWA's Bikeway Selection Guide (Schultheiss, Goodman, Blackburn, Wood, Reed, Elbech, 2019). The figure specifies a preferred bikeway type based on the prevailing traffic speed and average daily traffic volume. As shown, the reduced speeds and volumes observed after the West St project are within the region where a buffered bike lane (the facility the project built) is considered a preferred facility. Buffered bike lanes are preferred over conventional bike lanes based on the lateral separation they provide from moving traffic. Furthermore, buffered bike lanes improve cyclist comfort by allowing cyclists to position themselves further away from parked car doors and improving cyclists' ability to ride side-by-side.

Figure 9 – Preferred Bikeway Type for Urban, Urban Core, Suburban and Rural Town Contexts (reproduction of fig. 9 from FHWA Bikeway Selection Guide)



The project improved conditions for cyclists crossing West St on intersecting bikeways by reducing traffic speeds and reducing the number of lanes to cross. At two major signalized intersections with intersecting bikeways (27th St and W MacArthur Blvd), the project installed protected intersections, which reduce pedestrian and cyclist crossing distances, improve visibility by providing vulnerable roadway users with a head start on crossings, calm vehicular turning movements, and give cyclists a protected space to queue for two-stage left turns without merging across adjacent moving vehicle lanes. Protected intersections have been shown to increase the rate at which drivers yield to pedestrians and cyclists, reduce right turning vehicle speeds, and reduce the likelihood that cyclists will choose to ride on the sidewalk rather than in the bike lane (Fitzpatrick, Shirinzad, Whitacre, 2023).

Finally, while more observation of speed cushions is likely needed, some insights related to speed cushions on streets with bike lanes can be gained from the West St Project. While overall compliance with speed cushions on West St was good (with only 15% of vehicles deviating out of their lane to access one or two gaps in the cushion), the deviation that was observed suggests designers should carefully consider where to place the gaps when using speed cushions on roadways with bike lanes. The West St project design placed speed cushion gaps near the center of the roadway, so if drivers deviate out of their lane, they move away from the bike lane. Some guides suggest locating speed cushion gaps within bike lanes to improve cyclist comfort by allowing them to bypass the hump. If cars continued to deviate to access gaps under an arrangement like this, they would encroach into the bike lane, degrading the safety and comfort of the bike facility. This suggests the project design approach, to locate speed cushion gaps outside of bike lanes is preferred. Oakland addresses cyclist comfort riding over speed humps and speed cushions by specifying a sinusoidal undulation profile and building humps with compaction keyways to ensure smooth conforms at the leading and trailing edges of undulations.

These measures have been shown to increase cyclist comfort without negatively impacting undulation performance (Sayer, Nicholls, and Layfield, 1999).

Limitations of This Evaluation

This project evaluation is limited by data availability and analysis resources and does not represent a controlled study. Available data include basic geometrics such as roadway width and allocation of space, as well as traffic data collected at discrete locations and times on West St before and after project construction. The following specific limitations emerged through the preparation of this report.

Many evaluations of traffic safety rely on a review of crash records reported through the Statewide Integrated Traffic Record System (SWITRS) database managed by the California Highway Patrol. For example, the pre-project road diet feasibility analysis reviewed SWITRS crash records on the corridor over a five-year period from 2012 to 2016, finding that out of 157 total crashes, there were 6 injury crashes involving vehicles & pedestrians, 21 injury crashes involving vehicles & bicyclists, and 49 injury crashes involving motor vehicles only. This project evaluation is unable to compare these observations to post-project SWITRS data for two reasons. First, it can take two years or more for local and state law enforcement agencies to finalize all crash reports and upload them to the SWITRS database (at the time of writing, SWITRS data after 2022 is still considered incomplete, provisional, and subject to change). Second, because crashes are random and relatively unlikely events, it is customary to review several years of crash data to make reliable observations. Considering these factors, five years of post-project crash records (to compare to the five-year period reviewed in the pre-project study) may not be available until 2029.

Furthermore, studies have shown that police crash records tend to underrepresent the number of crashes that occur, particularly for vulnerable road users (Soltani S, Schwarcz L, Morris D, Plevin R, Dicker R, Juillard C, Nwabuo A, Wier M, 2022). Reviewing hospital and EMS crash data could help overcome some of these limitations, and a review of post-project crash data on the project corridor could be worthwhile in the future. This evaluation uses the available pre- and post-project traffic data to assess traffic safety in the meantime.

While the traffic speed reductions observed in this evaluation indicate the improvements the project installed are working together as a system to calm traffic along the corridor, a more controlled study with more locations would be required to determine if a specific measure was more effective than another. For example, the project installed speed cushions and raised intersections along the corridor. Since both deflection types were relatively new for Oakland at the time, staff advanced a mix of these measures to compare their effectiveness over time. Based on the limited data available, it is not yet clear if one treatment is more effective than the other.

Since improving compliance with the four stop signs along the West St project corridor was a goal identified during project outreach, raised intersections were installed at two stop-controlled intersections, while the other two stop-controlled intersections had speed cushions placed nearby on the West St approaches to the intersection. The City ordered counts to assess pre/post-project stop sign compliance at these four intersections. The scope for these counts was to record video footage of each intersection throughout one mid-weekday before the project and again after the project, then review each video to record the number of vehicles that stop outside of the crosswalk (full compliance), stop but encroach into the crosswalk, slow down but ultimately perform a 'rolling stop', or pass through the stop control without slowing. Upon review of the preliminary results and videos for these stop compliance assessments, several limitations became clear. First, the video resolution and framerate were good enough to count vehicles, but not adequate to determine how each driver behaved according to the four subjective categories above. Second, the video quality varies significantly between the pre-project and post-project recordings, which could lead to differences in observer perception of recorded behavior. Third, since a single camera angle was captured at each intersection, the field of view in each recording reveals very little space upstream of some approaches, making it difficult to see if a driver stopped or slowed on the intersection approach. Finally, because the pre-project and post-project recordings were collected over a year apart, there was a significant amount of time between when each video was reviewed and reduced. Even if the same consultant staff person reviewed the pre- and post-project video, the time between reviews could lead to discrepancies in how the four subjective compliance categories were applied. While the stop compliance data collection effort didn't yield reliable results for this project evaluation, it did yield important lessons learned:

- Stop compliance assessments should either be performed by live observers in the field, or higher resolution cameras should be employed than those used in a typical turning movement count;
- Camera angle and field of view should be reviewed in detail before collecting video stop compliance counts, to make sure an adequate length of each approach being studied is captured. Each recording should either focus on fewer intersection approaches, or cameras should be adjusted to capture a wider field of view;
- More precise and objective category descriptions should be developed to help increase consistency of observations, and the same observer should review pre- and post-project recordings without a significant time gap between each review.

Acknowledgements

This project evaluation report was prepared by David Pené (Transportation Engineer, West Street Road Diet Project Manager), Noel Pond-Danchik (Transportation Planner), and Jason Patton (Senior Transportation Planner, Program Supervisor) of the OakDOT, Safe Streets Division, Bicycle & Pedestrian Program.

The West Street Road Diet Project was completed thanks to the contributions of: Pablo Miras (Complete Streets Paving Project Manager), Joshua Ekstedt (conceptual design), Jennifer Stanley (road diet feasibility study, communications), Wei Xie (resident engineer), Marielle Cuison (pavement design and estimating), the Hoover-Foster Resident Action Council, The Hoover-Durant (6X) Neighborhood Council, the Longfellow Community Association, the Friends of Helen MacGregor Plaza, and other community partners who's input helped shape the project.

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