

MEMORANDUM

Date: August 7, 2017

Project #: 20616

To: Andrew Bielak
MidPen Housing

From: Mike Alston, Aaron Elias, P.E., Damian Stefanakis
Project: Cypress Point Preliminary Traffic Assessment
Subject: Alternatives for Carlos Street and Highway 1 (Version 2)

This memorandum by Kittelson and Associates, Inc. (KAI) presents an initial evaluation of the traffic impacts of an affordable housing proposal in Moss Beach, California and an assessment of the nearby Highway 1/Carlos Street intersection. MidPen Housing is proposing to build Cypress Point, a 71-unit affordable housing development in Moss Beach, an unincorporated community in San Mateo County, California (Project). Based on initial data collected, KAI has found that the Project will not significantly impact the adjacent Highway 1/Carlos Street intersection and the existing two-way stop control provides sufficient operational capacity with the Project. However, in order to respond to existing questions or concerns at a local level regarding the Highway 1/Carlos Street intersection, KAI has analyzed current conditions and potential improvements to the intersection.

The Project site will be accessible via Carlos Street, which connects to California Highway 1 (the Cabrillo Highway) at an unsignalized intersection just north of the site. To the South, Carlos Street runs parallel to the highway through Moss Beach. The County of San Mateo has expressed interest in improving circulation and safety at the Highway 1/Carlos Street and the nearby Highway 1/16th Street intersection.

Under current conditions and with project traffic added, the Highway 1/Carlos Street intersection has sufficient operational capacity as a two-way stop control intersection. However, two main conditions at the intersection may warrant consideration for improvement:

- Drivers on Carlos Street lack sufficient sight distance to the South given the operating speeds along Highway 1;
- There are overlapping and conflicting left turns using the same two-way left turn lane for drivers entering Carlos Street and those accessing the Point Montara Lighthouse.

A number of background studies propose crosswalks and/or trail crossings near the intersection, which would contribute to the development of a regional coastside trail. The current conditions, which include a 50 mile-per-hour posted speed limit and uncontrolled through traffic on Highway 1, would need to be modified to accommodate a pedestrian crossing.

Given the low traffic volumes at this intersection today, there is no warrant for or obvious benefit to signalization at this intersection. Therefore, the existing stop-control or a roundabout (i.e. yield control) intersection could be appropriate for alternative solutions. For either stop-controlled or roundabout solutions, there are grading and topographic considerations that are currently unknown in scale, difficulty, and cost. Maintaining stop-control at the intersection likely should include some access realignment or other modifications to enhance sight distance and access. A roundabout would entail geometric design on the Highway 1 approaches to achieve slower operating speeds. Lastly, there are grading concerns: Highway 1 itself curves both vertically and horizontally through Moss Beach, and there is a berm on the eastern side of the road that affects sight distance and makes earthwork more challenging.

This memorandum presents a summary of background studies pertaining to this intersection, existing conditions at the intersection, project conditions, and alternatives to improve the Highway 1/Carlos Street intersection.

BACKGROUND

The Project site is located on the corner of Carlos Street and Sierra Street in Moss Beach and its proposed access is on Carlos Street. Carlos Street forms a “T” intersection with Highway 1, as there is no access on the West side of the highway. Approximately 150 feet north of Carlos Street is the four-way intersection of Highway 1 and 16th Street. This intersection (“Point Montara intersection”) features access to the Point Montara Lighthouse and its parking lot on the west side of Highway 1. The Point Montara intersection has been discussed in a number of reports, mostly with a focus on multimodal access for visitors of the lighthouse, the beach, and through- trail users. The following section provides a summary of prior studies.

Highway 1 Safety and Mobility Improvement Study: Phase 2

In November 2012 the San Mateo County Board of Supervisors accepted the *Highway 1 Safety and Mobility Study*, a report focused on multimodal safety and mobility solutions along Highway 1 through a 5.5-mile study area that included Moss Beach. The study identified the Point Montara intersection as a location of high pedestrian crossing demand and recommended two crossing alternatives, shown in Exhibit 1. In both scenarios, left turns from Carlos Street onto Highway 1 are eliminated, and the conflicting left turns on Highway 1 are addressed with back-to-back left turn bays into Carlos Street and 16th Street.

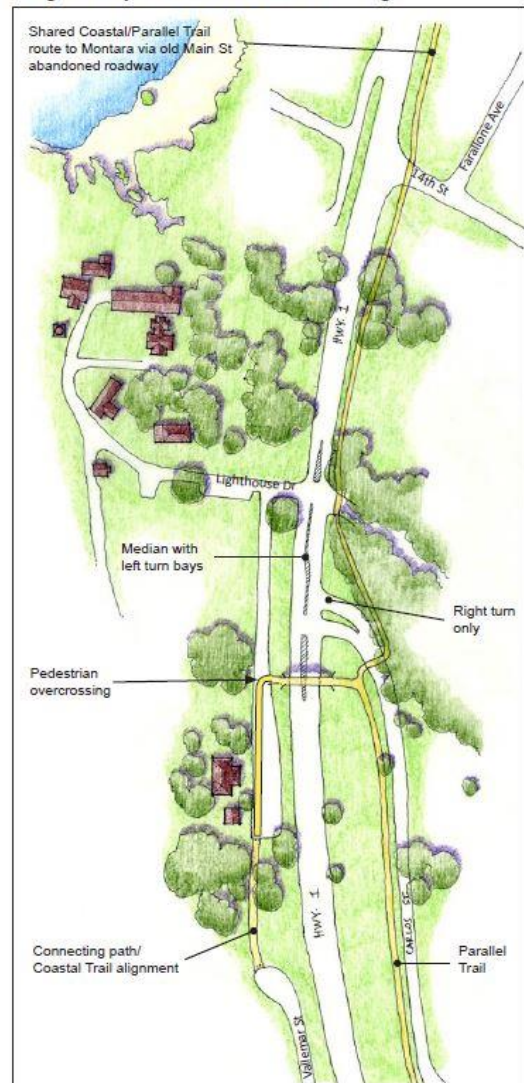
The study also suggests “naturally reducing” vehicle speeds with features like medians, gateway and edge treatments into and out of identified community zones. Its “recommended target speed” through the Point Montara area is 40 miles per hour, compared to an existing speed limit of 50 miles per hour. The study acknowledges that speed limits cannot be changed arbitrarily but prevailing speeds can be influenced through roadway design.

Exhibit 1: Proposed Trail Crossings at Point Montara Intersection in the Preliminary Planning Report for Highway 1 Congestion & Safety Improvement Project

Short Term Option: Pedestrian Crossing at Grade



Long-Term Option: Pedestrian Overcrossing



Source: Highway 1 Safety and Mobility Improvement Study: Phase 2, 2012.

Preliminary Planning Report for Highway 1 Congestion & Safety Improvement Project

In August 2015 the San Mateo County Transportation Authority released its *Preliminary Planning Study for the Highway 1 Congestion & Safety Improvement Project*. The Point Montara and Highway 1/Carlos Street intersections are discussed in this report with respect to pedestrian crossing opportunities.

The report offers two crossing alternatives, included here as Attachment B. Alternative 1 includes advanced yield markings, painted medians on both Highway 1 approaches, and a crosswalk with push-button rectangular rapid flashing beacons (RRFBs) across the northern leg of the Point Montara intersection. The second alternative includes raised medians on both Highway 1 approaches, a crosswalk with RRFBs, and a mid-block pedestrian refuge on the northern leg of the intersection. This alternative would require widening the roadway and constructing a retaining wall along the western side of Highway 1. The report ultimately recommends Alternative 1 at the 16th Street intersection as a cost effective solution. The study also points out a lack of traffic calming features or any signaling to drivers of changing context zones along Highway 1, citing the proposed pedestrian crossing with rectangular rapid flashing beacons as recommended traffic-calming improvements.

Connect the Coastside

In March 2016 San Mateo County released a draft report of the *Connect the Coastside* study. The study identifies transportation improvements consistent with the Midcoast Update to San Mateo County's Local Coastal Program to show land use and transportation infrastructure that can support future development scenarios.

The draft study recommended a median with back-to-back left-turn bays at the Point Montara intersection and Carlos Street to improve circulation and to assist pedestrians crossing Highway 1, with the median serving as a crossing refuge. The study also recommended signage to restrict left turns at Carlos Street and traffic calming measures along Carlos street south of the project site. These recommendations are expected to remain consistent in the next version of the report.

The study also addressed operational deficiencies further south in Moss Beach at Highway 1/California Avenue and at Highway 1/Cypress Avenue, suggesting a roundabout in each case but ultimately recommending signalization. The study added that the roundabout option at Highway 1/California Avenue would require "significant study and a large footprint." At Highway 1/Cypress Avenue, a signal showed capacity improvements but a roundabout did not. However, the County is further exploring these alternatives for the next version of the report.

An updated draft of the study is due in the summer of 2017.

SUMMARY OF BACKGROUND STUDIES

The three studies focus on the Point Montara intersection as a pedestrian crossing. As two of the studies highlight, lower travel speeds would help support and enhance crossing opportunities and

promote overall safety through the Point Montara and Highway 1/Carlos Street intersections. Two of the studies recommend restricting movements into and/or out of Carlos Street, but do not provide extensive explanation for these recommendations. There is no discussion of a change in control type.

EXISTING CONDITIONS

This section discusses existing conditions at the Highway 1/Carlos Street intersection and the Point Montara intersection based on field observation, multimodal turning movement counts, and traffic operations analysis conducted from April through June 2017.

Traffic Operations Analysis

Both the Highway 1/Carlos Street intersection and the Point Montara intersection are two-way stop-controlled intersections, with the through vehicular movements on Highway 1 operating uncontrolled. The Highway 1/Carlos intersection operates with minimal control delay and within the San Mateo County guidelines for acceptable operations¹. Traffic counts conducted in April 2017 show the following numbers of drivers turning onto Highway 1 from Carlos Street: 23 drivers in the weekday AM peak hour, five drivers in the weekday PM peak hour, and 11 drivers in the Saturday midday peak hour. Given the low volumes, the intersection operates at a level of service (LOS) B or better for all movements under existing conditions. See Attachment C for preliminary traffic operations findings.

The Project is expected to add 37 trips during a typical weekday AM peak hour, 45 trips during a typical weekday PM peak hour, and 37 trips during a typical Saturday midday peak hour. Preliminary operational analysis shows that, with the additional trips from the Project, the intersection will operate at LOS C or better, which is acceptable based on the LOS C standard (with no individual movements below LOS D) in the San Mateo County Guidelines.² Refer to Attachment C for preliminary traffic operations findings.

Based on this data, the Project does not demonstrate a substantial impact on the operations of the Highway 1/Carlos Street intersection. The existing two-way stop control provides sufficient operational capacity with the Project.

¹ *Traffic Impact Study Requirements*, County of San Mateo, December 9, 2014

² *Traffic Impact Study Requirements*, County of San Mateo, December 9, 2014

Geometric Conditions

KAI performed a field visit on Wednesday, May 10, 2017. Based on this field visit and a review, KAI identified two notable geometric conditions:

Overlapping Turn Lanes

Carlos Street and 16th Street are roughly 150 feet apart, and both consist of stop-controlled access to Highway 1. This close proximity creates some interaction between the two intersections that has been addressed in previous studies. Notably, northbound drivers turning left into the Point Montara Lighthouse parking lot and southbound drivers turning left onto Carlos Street must share a two-way left turn lane that is approximately 125 feet in length. This storage length creates some challenges for turns by putting opposing movements in conflict and providing limited deceleration length.

Intersection Sight Distance

The speed limit on this portion of Highway 1 is 50 miles per hour. The Caltrans *Highway Design Manual* lists required corner sight distance at a two-way stop-controlled intersection based on the design speed of the primary (i.e., uncontrolled) street. Adequate corner sight distance refers to the following:

Adequate time must be provided for the waiting user to either cross all lanes of through traffic, cross the near lanes and turn left, or turn right, without requiring through traffic to radically alter their speed.

Based on an assumed design speed of 55 miles per hour (conservatively 5 miles per hour greater than the posted speed), the Caltrans *Highway Design Manual* standard for corner sight distance is 605 feet. This distance provides 7-1/2 seconds for side-street drivers to turn either left or right onto Highway 1 and accelerate to the appropriate speed. This distance should be provided in both directions, per Table 405.1A in the Caltrans *Highway Design Manual*.

KAI conducted field measurements of corner sight distance at the Highway 1/Carlos Street intersection and found that the sight distance to the South was 305 feet (see Figure 1) or about 300 feet less than Caltrans' required corner sight distance. The lack of visibility beyond 305 feet is attributable the road's horizontal curvature, its vertical curvature, and trees and berm on the eastern roadside. While the Design Manual requirements would apply to the design of any new intersections, they also identify whether an existing intersection does not meet the current standard. Therefore, any modifications to an existing intersection would need to address current Caltrans standards.



Date: 5.17.2017

Scale in Feet



Moss Beach Housing TIA / Carlos Street and Highway 1
Corner Sight Distance

FIGURE 1

INTERSECTION CONTROL

There are three primary control alternatives that can be considered in determining changes to the intersection to correct geometric deficiencies. These include:

1. Stop control
2. Roundabout
3. Signal control

Each control option has benefits and drawbacks, and all options would require additional improvements to address pedestrian access across Highway 1. Additionally, all options would require coordination and approval from Caltrans as the managing agency of Highway 1.

1. Stop Control

The Highway 1/Carlos Street intersection currently operates under two-way stop control. As previously discussed, stop control on Carlos Street provides sufficient intersection capacity. However, if stop control is maintained, there are three primary areas that should be examined to address the existing challenges with the intersection – the insufficient corner sight distance, overlapping left turns with the 16th Street intersection, and lack of pedestrian access.

Overlapping Left Turns

One option to eliminate the overlapping left turns (northbound left onto 16th Street and southbound left onto Carlos Street) is to combine the Carlos Street and 16th Street access to Highway 1. A single access point would eliminate the left turn at the existing Carlos Street alignment, making the existing two-way left turn lane operate as a single northbound left turn pocket. This realignment would remove the overlap and conflict between the two turning movements. The feasibility of this option depends in large part on the size of the Caltrans right of way and will require more detailed survey/topographic information.

Sight Distance

With existing operating speeds, earthwork or tree clearing would be necessary to clear sight distance to the South at Carlos Street. This would include cutting back trees and re-grading the berm between Highway 1 and Carlos Street. While clearing the land would provide adequate sight distance for the horizontal curvature of the road (see Figure 1), there is also a vertical curve due to elevation changes that may obstruct sight distance. Because Highway 1 crests south of the Carlos Street intersection, a driver may not be able to see vehicles on the other side of the crest of the curve. A detailed topographic map would be needed to determine if the vertical curve provides adequate sight distance.

Restrict Movements at Carlos Street

Another option to maintain a stop controlled intersection at Carlos Street is to restrict outbound movements from Carlos Street onto Highway 1. This would convert Carlos Street into a one way (inbound) street. Drivers in the neighborhood could access Highway 1 via Etheldore Street approximately 2,000 feet south. This alternative removes the corner sight distance requirement.

Along with the movement restriction, a conversion of the two-way left turn lanes to back-to-back left turn bays would eliminate the overlap in left-turn movements. A similar treatment is shown in Exhibit 1, proposed in the *Highway 1 Safety and Mobility Study*. This treatment would provide room for left-turn storage but not enough for full deceleration. Therefore, vehicles would have to decelerate on Highway 1 before entering the turn lane.

This alternative would have the advantage of requiring no construction and no change to Highway 1 other than restriping the two-way left turn lane, but would represent an increase in activity at the Etheldore/Highway 1 and/or California/Highway 1 intersections for existing and future trips that would otherwise access Highway 1 at Carlos Street.

Either stop-control scenario would need additional improvements if crosswalk or trail crossing were planned, as proposed in the background studies. A transition zone with lower speeds, as mentioned in the *Highway 1 Safety and Mobility Study*, would be appropriate to promote a crossing at this location. The two-stage crossing with a median, proposed in the *Preliminary Planning Report*, also has merit and would pair with lower operating speeds. A lower operating speed would relax the corner sight distance requirements at intersections, as well.

2. Roundabout

A change of control from stop control to a roundabout would convert all approaches to yield control, eliminating the applicability of the corner sight distance standard. Drivers on Carlos Street, Highway 1, and 16th Street (if it is brought into a roundabout alignment) would all be required to yield to drivers inside the roundabout making conflicting movements. A roundabout would also require reducing vehicle speeds and would eliminate the overlapping left turn lanes for 16th Street and Carlos Street if the two intersections could be combined into a single roundabout. The reduced speeds would better provide for controlled pedestrian crossing locations consistent with the needs identified in background studies.

*Roundabouts: An Informational Guide*³ explains that roundabouts are an ideal option for supporting speed reductions “within small communities along an extended highway,” through the use of geometric design features like horizontal curves on the highway approaches. Creating such features at this location would present challenges based on topographic constraints, including limited right-of-

³ NCHRP Report 672. *Roundabouts: An Informational Guide*, 2nd Edition, 2010.

way, grade changes, and existing horizontal curvature of the roadway. These constraints may require additional right-of-way clearance, cutting into terrain and trimming back foliage.

3. Signal Control

A first step to determine whether a signal is an appropriate solution at an intersection is to determine if the intersection meets the signal warrants provided in the *California Manual on Uniform Traffic Control Devices (MUTCD)*. The MUTCD lists several criteria (warrants) under which the need for a traffic signal can be established. The Highway 1/Carlos Street Intersection was analyzed to determine if it meets the peak hour signal warrant as described in Chapter 4C of the California MUTCD⁴. The volumes and side street delay were insufficient to meet the peak hour signal warrant.

The Caltrans *Highway Design Manual* says corner sight distance values should be maintained even at signalized intersections due to “unanticipated conflicts . . . due to violation of signal, right turns on red, malfunction of the signal, or use of the flashing red/yellow mode.” The combination of not meeting the signal warrant and the implications of unanticipated conflicts makes signalization of this intersection a less desirable option than the two control types previously described.

SUMMARY

The Project proposes access along Carlos Street, which would route most trips to and from the site through the Highway 1/Carlos Street intersection. The intersection provides sufficient capacity with the existing two-way stop control under existing conditions and if the Project were built.

Based on current conditions at the intersection, there are other considerations at this location that could warrant improvement. This memo has explored options to address conflicting left turns, limited corner sight distance, and compatibility with proposed pedestrian crossings. Based on the initial research, there are two options that could be explored further: maintaining the existing two-way stop control with access modifications, or implementing a roundabout, with a roundabout likely to involve significantly more cost and design challenges. The third option of adding a traffic signal was found to not address sight distance and would not be need for traffic operations.

In order to facilitate pedestrian crossings as identified in background studies, either for the two-way stop control or roundabout intersection, additional traffic-calming measures and transition zones would need to be established prior to the intersection to slow the operating speeds through the area. These improvements would improve the feasibility of constructing a crosswalk across Highway 1.

⁴ KAI analyzed the signal warrants using multimodal turning movement counts collected for this project.

NEXT STEPS

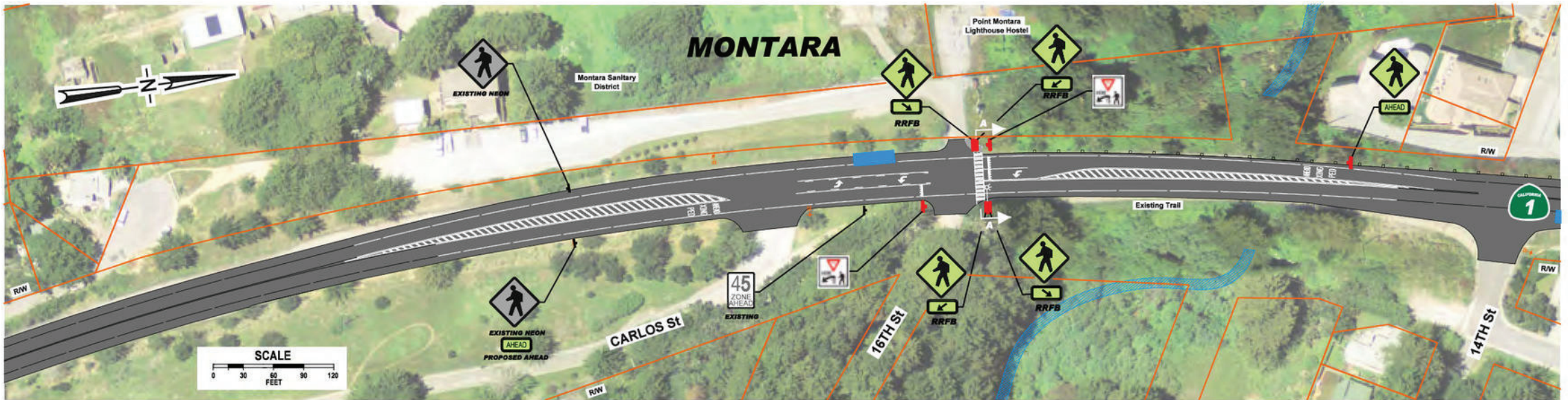
As a next step, KAI would recommend further coordination with all relevant parties regarding potential options for the intersection. A more detailed traffic study and Intersection Control Evaluation (ICE) could then be completed as required for Caltrans approval. Once an option is approved, a proposed transportation improvement could move into final engineering design and construction.

Attachment A: Project Site



Attachment B: Highway 1 Preliminary Planning Study Proposed 16th Street Crossings

DESIGNATED PEDESTRIAN CROSSING 16TH STREET - ALTERNATIVE 1



RECTANGULAR RAPID FLASHING BEACON WITH PAINTED MEDIAN

SECTION A-A
NO SCALE

HIGH VISIBILITY PAINTED MEDIAN

Painted median helps to provide traffic calming.

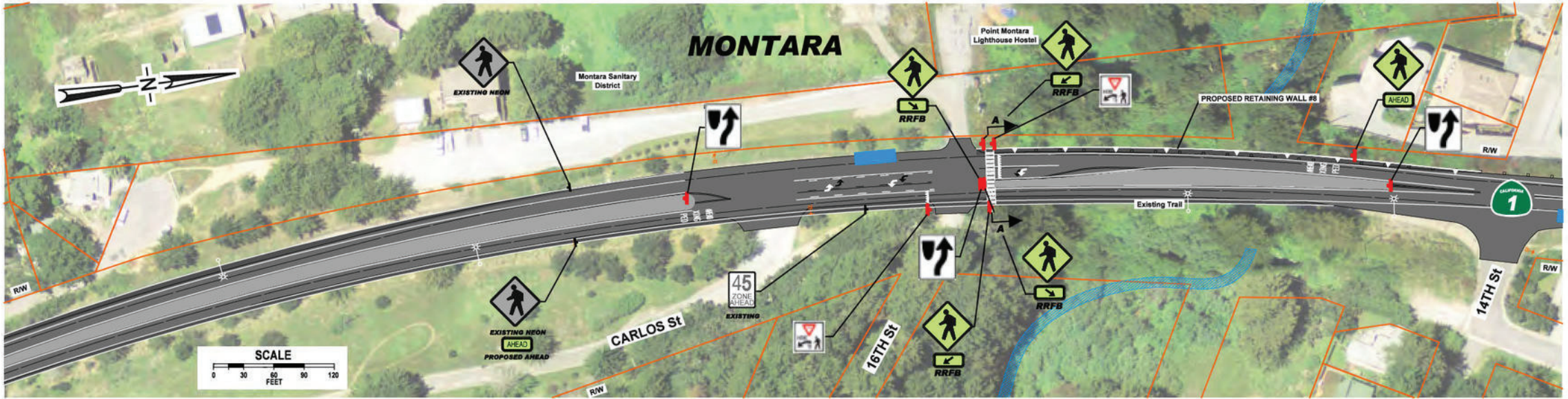
RECTANGULAR RAPID FLASHING BEACON

Push button activated rectangular rapid flashing beacons use an irregular flash pattern that is similar to emergency flashers and police vehicles to alert vehicular traffic.

LEGEND:

- | | | |
|-------------------|-------------------|------------------|
| EXISTING STRIPING | PROPOSED STRIPING | EXISTING SIGNAGE |
| EXISTING ROADWAY | EXISTING BUS STOP | PROPOSED SIGNAGE |

DESIGNATED PEDESTRIAN CROSSING 16TH STREET - ALTERNATIVE 2



RAISED MEDIAN WITH TYPE D CURB AND RAPID RECTANGULAR FLASHING BEACONS



LEGEND:

- PROPOSED WIDENING
- EXISTING ROADWAY
- PROPOSED STRIPING
- EXISTING STRIPING
- PROPOSED RAISED MEDIAN
- PROPOSED SIGNAGE
- EXISTING BUS STOP
- EXISTING SIGNAGE

Attachment C: Preliminary Traffic Operations Findings

Level-of-service (LOS) analyses described in this memo were performed in accordance with the procedures stated in the 2000 *Highway Capacity Manual*⁵ (HCM). The LOS methodology is a qualitative description of the performance of an intersection based on average delay per vehicle. For signalized intersections and all-way stop control intersections, the LOS is based on the volume weighted average of the delay for each approach. For two-way stop control intersections, the average delay and LOS for the worst stop-controlled approach at the intersection is presented. The intersection LOS was calculated using Synchro 9 software package.

Intersection level-of-service ranges from LOS A, which indicates free flow or excellent conditions with short delays, to LOS F, which indicates congested or overloaded conditions with extremely long delays. LOS definitions for signalized and unsignalized intersections are described in Table 1. Per the San Mateo County Traffic Impact Study Guidelines, the minimum acceptable level of service (LOS) is C at intersections overall, with no individual movement operating below D.⁶

Table 1: Level of Service Criteria for Intersections

Level of Service	Description	Average Delay (seconds / vehicles)	
		Signalized Intersections	Unsignalized Intersections
A	Light or no delay	≤ 10.0	≤ 10.0
B	Short traffic delay	> 10.0 and ≤ 20.0	> 10.0 and ≤ 15.0
C	Average traffic delay	> 20.0 and ≤ 35.0	> 15.0 and ≤ 25.0
D	Long traffic delay	> 35.0 and ≤ 55.0	> 25.0 and ≤ 35.0
E	Very long traffic delay	> 55.0 and ≤ 80.0	> 35.0 and ≤ 50.0
F	Extreme traffic delay	> 80.0	> 50.0

The Carlos Street/Highway 1 intersection currently operates at LOS B in all three study periods—the weekday AM peak, the weekday PM peak, and Saturday midday periods. As shown in Table 2, project-generated trips are expected to degrade LOS from B to C in the weekday PM and Saturday midday periods. The intersection retains a B level of service in the weekday AM period.

⁵ Highway Capacity Manual, Transportation Research Board (TRB), Washington, D.C., 2000

⁶ On occasion, the County may consider LOS D acceptable in dense urban conditions.

Table 2: Traffic Operations at Carlos Street/Highway 1

Scenario	Weekday AM		Weekday PM		Saturday Midday	
	LOS	Delay	LOS	Delay	LOS	Delay
Existing Conditions	B	13.3	B	13.2	B	14.0
Existing Plus Project	B	14.4	C	15.5	C	15.9