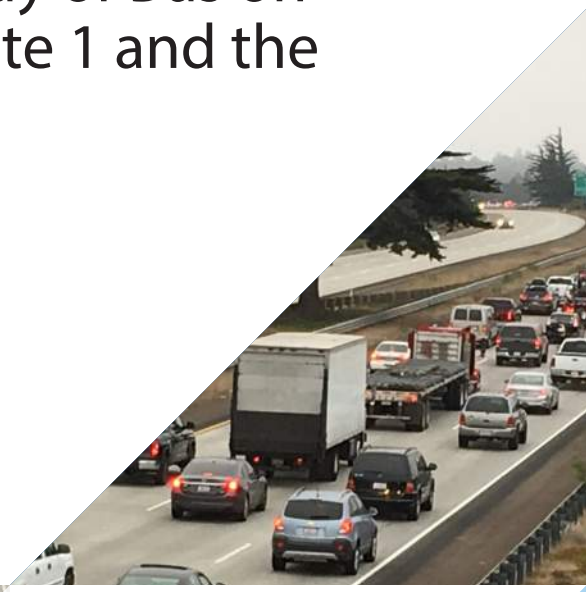
Final Project Report

Monterey Bay Area Feasibility Study of Bus on Shoulder Operations on State Route 1 and the Monterey Branch Line



Monterey-Salinas Transit

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CDM Smith

Acknowledgements

Project Partners

Monterey-Salinas Transit (MST)

Transportation Agency for Monterey County (TAMC)

Association of Monterey Bay Area Governments (AMBAG)

California Department of Transportation (Caltrans)

Santa Cruz Metropolitan Transit District (METRO)

California Highway Patrol (CHP)

Santa Cruz County Regional Transportation Commission (SCCRTC)

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California Highway Patrol (CHP) Divisions 720 & 730

Association of Monterey Bay Area Governments (AMBAG)

City of Marina

City of Sand City

City of Seaside

City of Monterey

Fort Ord Reuse Authority (FORA)

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Chapter 1
Introduction and Summary

As the Monterey Bay area continues to grow, congestion and delay on State Route 1 (SR 1) in both Monterey and Santa Cruz Counties is becoming more severe. This is being further exacerbated by the strong Northern California economy. Monterey-Salinas Transit (MST) and Santa Cruz METRO (METRO) buses using SR 1 contend with this congestion every day, diminishing the service quality and reliability offered to riders and increasing costs of operation. Physical improvements to the highway are difficult and can take many years due to lack of funding, environmental issues, and freeway design complexities, as well as geographic constraints.

In response to these issues, MST, in partnership with the Transportation Agency for Monterey County (TAMC), Association of Monterey Bay Area Governments (AMBAG), Caltrans, Santa Cruz METRO, the California Highway Patrol (CHP), and the Santa Cruz County Regional Transportation Commission (SCCRTC), is conducting this study to explore the potential for implementing bus-on-shoulder operations on SR 1 in the areas that are found to be best suited to bus-on-shoulder treatments. Under the right conditions, bus-on-shoulder treatments offer a relatively low-cost, immediate means of providing buses with the ability to bypass freeway and highway congestion. While not the ideal transportation solution, they have been proven to operate effectively and safely when applied appropriately. In addition, this study explores the possibility of using the Monterey Branch Line rail corridor for bus rapid transit (BRT) operations (see Error! Reference source not found.). The study corridor extends from the Reservation Road/ Del Monte Boulevard intersection in Marina to the intersection of Del Monte Avenue and English Avenue in Monterey, a distance of 8.0 miles.

Background – Legislation

California Assembly Bill No. 946 which was passed in 2013 authorizes the Monterey-Salinas Transit District and the Santa Cruz Metropolitan Transit District to conduct a transit bus-only program using the shoulders of certain state highways as transit bus-only traffic corridors, subject to approval by the department (Caltrans) and the Department of the California Highway Patrol.

California Assembly Bill No. 1746, which is currently under consideration, states that Monterey-Salinas Transit, the Santa Cruz Metropolitan Transit District and a number of other transit operators:

> … may conduct a transit bus-only program using the shoulders of certain highways in the state highway system within the areas served by the transit services of each entity, with the approval of the department and the Department of the California Highway Patrol. The department, the Department of the California Highway Patrol, and each participating transit entity shall jointly determine the segments of each highway where it is appropriate to designate the shoulders as transit bus-only traffic corridors, based upon factors that shall include, but are not limited to, right-of-way availability and capacity,

peak congestion hours, and the most heavily congested areas. Under the program, the participating transit entities shall actively work with the department and the Department of the California Highway Patrol to develop guidelines that ensure driver and vehicle safety and the integrity of the infrastructure.

Figure 1-1: Monterey County Study Area

With the support of this legislation, MST and METRO embarked on this study to examine the feasibility of bus-on-shoulder on SR 1.

Plans and Policies – Monterey County

The Metropolitan Transportation Plan (MTP) and its Sustainable Communities Strategy (SCS) will be released by the Association of Monterey Bay Area Governments in 2018. It identifies Bus Rapid Transit in the SR 1 corridor as part of the year 2040 transit network plan, it also references this bus-on-shoulder and branch line study as an ongoing effort. This plan will replace the current Metropolitan Transportation Plan (MTP) and its Sustainable Communities Strategy (SCS) which was adopted in 2014.

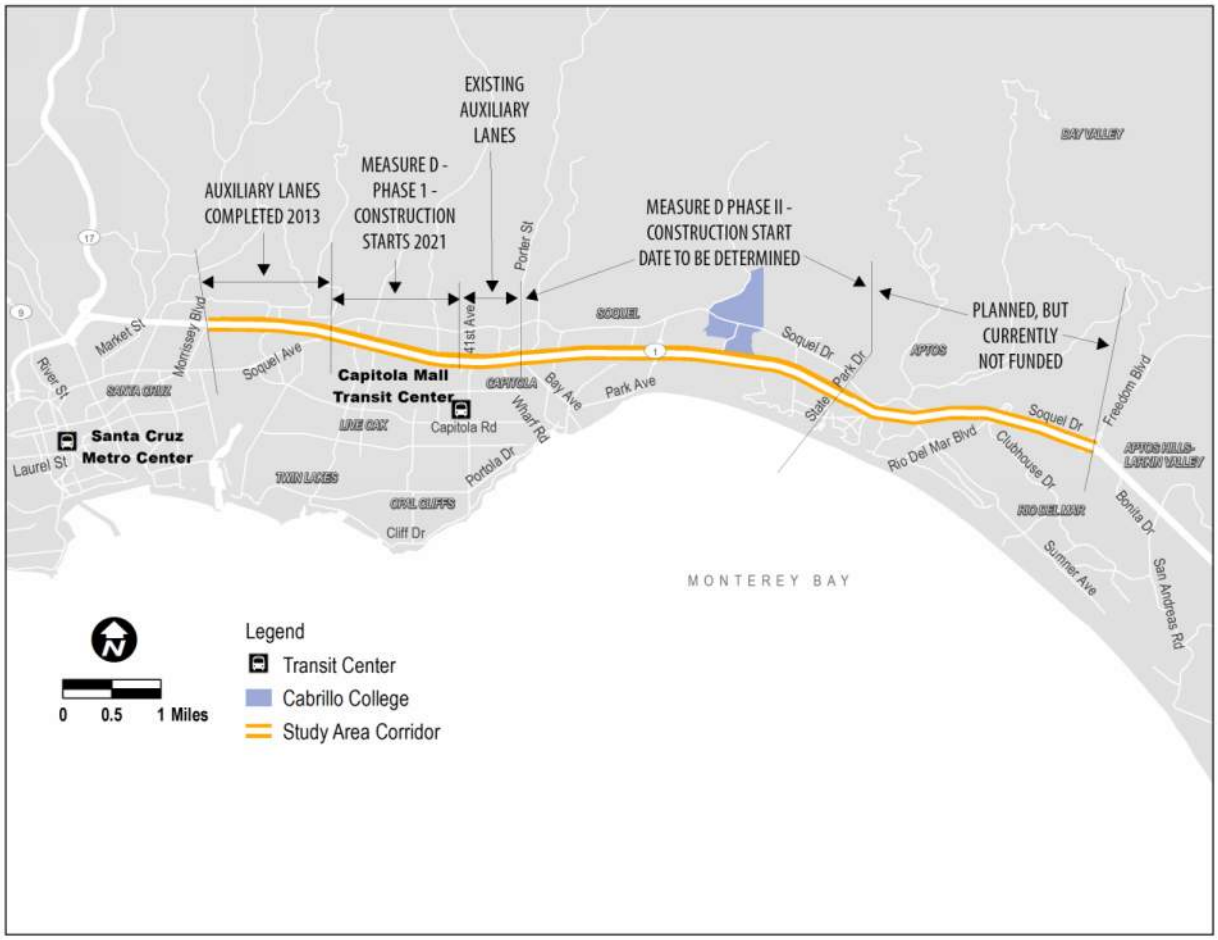
The Transportation Agency for Monterey County's Measure X expenditure program includes the Highway 1 Traffic Relief – Busway project which is described as follows: "Create a new rapid bus corridor along Highway 1 between Monterey and Marina, with possible extensions to Castroville,

utilizing the shoulder of the highway and/or portions of the parallel rail right-of-way, to provide a way for buses to travel more rapidly than cars so that commuters spend less time in traffic."

Plans and Policies – Santa Cruz County

The SR 1 study corridor in Santa Cruz County extends from Morrissey Boulevard in the north to Freedom Boulevard in the south, a distance of 7.5 miles. The planned SR 1 Auxiliary Lanes are being implemented by the Santa Cruz County Regional Transportation Commission as part of the Measure D funding program (see **Figure 1-2**). There are existing auxiliary lanes between the Morrissey Boulevard and Soquel Avenue interchanges and between the 41st Avenue and Porter Street interchanges.

Figure 1-2: Santa Cruz County Study Area and Planned Auxiliary Lane Improvements

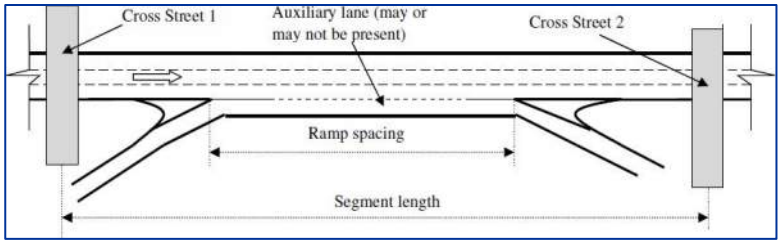


Auxiliary lanes as shown conceptually in **Figure 1-3** are short lane segments which extend along the right side of the freeway between the on and off-ramps. They are very effective at increasing the efficiency of the traffic weaving that occurs between ramps.

The first phase of the Measure D project will close the gap between the Soquel Avenue and 41st Avenue interchanges. Further phases will extend the auxiliary lanes south to the State Park Drive interchange. Ultimately the lanes will extend throughout the corridor to Freedom Boulevard, but

currently planned or completed projects will provide auxiliary lanes all the way south to State Park Drive.

Figure 1-3: Auxiliary Lane Concept



The Association of Monterey Bay Area Governments' Metropolitan Transportation Plan (MTP) and its Sustainable Communities Strategy (SCS) will be released in 2018 and identifies Bus Rapid Transit in the SR 1 corridor as part of the year 2040 transit network plan, it also references this bus-on-shoulder and branch line study as an ongoing effort. This plan will replace the current Metropolitan Transportation Plan (MTP) and its Sustainable Communities Strategy (SCS) which was adopted in 2014.

The Santa Cruz County Regional Transportation Commission is conducting the *Unified Corridor Investment Study.* The *Unified Corridor Investment Study* will examine which transportation improvements work together to make the most effective use of the community's north/south transportation corridor including three parallel routes: SR 1, Soquel/Freedom, and the Santa Cruz Branch Rail Line right-of-way. The study includes both HOV lanes and bus-on-shoulder alternatives for the SR 1 corridor.

Santa Cruz METRO has indicated that it would consider providing a significant increase in bus services using the SR 1 corridor between Santa Cruz and Watsonville if either bus-on-shoulder or HOV lanes were implemented. The extent of the current congestion and delay on this section of SR 1 is such that METRO purposely avoids using the freeway because of the low speeds and uncertain conditions that are prevalent during long periods of the day.

Purpose of the Study

The purpose of this study is to explore on a preliminary basis the concept of using bus-on-shoulder operations on SR 1 in both Monterey and Santa Cruz Counties to enhance the operations of MST and METRO buses during the periods of significant traffic congestion. The time savings and improved transit reliability offered by the use of the shoulder should improve the transit rider experience and attract new riders to transit, as well as reducing transit operating costs by increasing speeds and improving reliability. The time savings will reduce the costs of providing existing transit services and allow additional new services to be provided at a cost which is less than that which would occur under current traffic conditions. In Monterey County, the option also exists to provide a busway facility on the Monterey Branch Line rail right-of-way, which is owned by the Transportation Agency for Monterey County. This study considers the use of the rail right-of-way as one option for enhancing transit.

The Bus-on-Shoulder Concept

Figure 1-4: Bus-on-shoulder Operation in Minneapolis

Bus-on-shoulder refers to the practice of allowing buses to use the paved shoulder areas of freeways to bypass areas of severe traffic congestion. While the notion of bus-on-shoulder conjures a vision of buses flying by stalled traffic on a narrow shoulder lane, the reality is that bus-on-shoulder involves operation of buses under carefully defined and controlled conditions. First, the shoulder area has to meet certain criteria in terms of its width, clearance, and pavement strength. Second, the transit operators must receive training in how and when to properly operate the bus on the freeway shoulder. Third, there are guidelines/rules as to what traffic conditions/speeds must exist for a bus to be allowed to use the shoulder and how much faster than the general freeway traffic the bus is allowed to operate. The bus-on-shoulder concept is not new, it originated in this country in 1991 in Minnesota and has been implemented in a number of locations since then, including San Diego, California. As a result, there is substantial experience and research on bus-on-shoulder that can be used to inform the consideration of bus-on-shoulder operations on SR 1 in Monterey and Santa Cruz counties.

1. The basic requirements for successful bus-on-shoulder operations include:
    - *Presence of buses – usually at least four buses per hour.*
    - *Congested freeways – speeds of less than 35 miles per hour for right side shoulder use.*
    - *Minimum 10-foot continuous shoulder of sufficient strength to support buses. Ideally, the shoulder should be at least 12 feet wide to better protect protruding bus mirrors.*
    - *Avoidance of multi-lane entrance and exit ramps and ramps with very high traffic volumes (more than 1,000 vehicles per hour).*
    - *Bus operators receive special training in how to operate on the shoulder and buses are typically limited to a speed no more than 10 miles per hour faster than the general freeway traffic.*
    - *Special signage and driver education programs to inform motorists of the bus-on-shoulder presence.*

Monterey Branch Rail Line

The concept of creating a bus facility on a railroad right-of-way is not new either, but it is not a widely-used practice. Typically, a two-lane roadway designed exclusively for buses would be developed within the right-of-way. Stations or stops would also be in the right-of-way, often

located near streets which cross the right-of-way. Where the right-of-way crosses an existing street, a traffic signal would be used to allow buses to cross safely or a grade separation of the busway and the cross-street would be constructed. The crossings are the most challenging part of developing a busway in a railroad right-of-way, particularly where there are nearby streets running parallel to the railroad right-of-way.

The Los Angeles Orange Line Busway is a good example of a busway on an abandoned railroad right-of-way. The Los Angeles Metropolitan Transportation Authority converted an 18-mile former Southern Pacific Railroad right-of-way to a busway in 2006. The project cost was $327 million. The project was an instant success, with ridership well exceeding the projections. The line has 18 stations and serves about 22,000 daily riders. Crossings of public streets are signalized and at-grade.

Figure 1-5: Orange Line Station

Study Partners/Outreach

The partner agencies for this project are:

- Transportation Agency for Monterey County
- Association of Monterey Bay Area Governments
- Caltrans
- Santa Cruz METRO
- California Highway Patrol, and
- Santa Cruz County Regional Transportation Commission

These project partners participated in a Technical Advisory Committee that also included the cities of Marina, Sand City, Seaside and Monterey, as well as the Fort Ord Reuse Authority. This group met several times during the course of the study to review and provide input for the study as it progressed.

During the course of study, in-person meetings were held with the Fort Ord Reuse Authority and with the Cities of Monterey, Sand City, Seaside and Marina. In each case, it was determined that the bus-on-shoulder concept or use of the Monterey Branch Line for a busway was compatible with their existing plans and policies, and in general would be supportive of their sustainability goals in terms of transportation and the environment. The City of Monterey has studied the feasibility of a bus rapid transit alignment paralleling Del Monte Avenue which would provide for an extension of this project into the heart of Monterey. In Santa Cruz County meetings were held with representatives of the Santa Cruz County Regional Transportation Commission.

Summary

A summary of the alternatives considered, and the results of the analysis and evaluation of the alternatives is presented here with additional detail provided in Chapters 4 and 5.

Monterey County Alternatives

Seven different alternatives were studied for the SR 1 Corridor in Monterey County including a No-Build Alternative and an HOV Lane Alternative.

1. **Southbound Bus–on-Shoulder** – This alternative would provide bus-on-shoulder operations on SR 1 between Del Monte Boulevard in Marina and Del Monte Avenue in Monterey. Currently, congestion on this section of SR 1 occurs southbound in the morning peak period, so the bus-on-shoulder operation would be southbound only. The current shoulders in this segment are not the minimum 10 feet width needed for bus-on-shoulder operations, they are typically in the 6-to-8-foot range. Thus, this project would require shoulder widening. There are also four bridges that would either have to be widened or the buses would need to leave the shoulder to bypass them. The estimates of costs and time savings assume that there would not be any widening of structures, as this type of construction would dramatically increase the costs of the project, with only small improvements in travel time. There is also no connection to the planned Intermodal Center at 8th Street in Fort Ord. The Intermodal Center would be the western terminus of the planned Marina-Salinas Multimodal Corridor to Salinas.

Figure 1-6 - Depiction of Bus-on-Shoulder on SR-1 Southbound

2. **Southbound Bus-on-Shoulder Plus Branch Line** – This alternative involves southbound AM peak period bus-on-shoulder operations between Del Monte Boulevard in Marina and the Monterey Road, California Avenue, Fremont Boulevard intersection in Sand City. From the Monterey Road, California Avenue, Fremont Boulevard intersection

to Contra Costa Street in Sand City, a single lane, bi-directional busway (southbound in the morning and northbound in the afternoon) would be developed in the Monterey Branch Line right-of-way. Beyond Contra Costa Street the buses would operate on Del Monte Boulevard all the way to Monterey. The busway would underpass the Monterey Road, California Avenue, Fremont Boulevard intersection to avoid conflicts with traffic at this complex set of intersections. The City of Seaside is currently studying alternative solutions to this intersection, which could be a less costly approach as compared with the cut-an-cover underpass, which would cost about $2.1 million. There would be traffic signals or roundabouts at the three other street crossings in this area. There is also no connection to the planned Intermodal Center at Fort Ord with this alternative.

3. **Branch Line** – The Branch Line Alternative uses the rail right-of-way from Reservation Avenue in Marina all the way to Contra Costa Street in Sand City, and then uses Del Monte Boulevard to Monterey. The busway would be a single lane, bi-directional facility which would operate southbound in the morning and northbound in the afternoon, consistent with peak traffic flow directions. This alternative also provides an underpass of the Monterey Road, California Avenue, Fremont Boulevard intersection and it provides a connection to the Intermodal Center in Fort Ord via an existing underpass of SR 1 that was a rail spur. This would allow a direct connection to the future Marina-Salinas Multimodal Corridor.

Figure 1-7 – Depiction of Bus on the Monterey Branch Line

4. **Pedestrian/Bike Trail Plus Branch Line** – This alternative is very similar to Alternative 3 except that instead of using the rail right-of-way between Marina and Sand City it uses the alignment of the Monterey Peninsula Recreational Trail. This is the trail closest to SR 1 and there is another existing parallel recreational trail immediately adjacent to the west. This alternative also provides an underpass of the Monterey Road, California Avenue, Fremont Boulevard intersection and it provides a connection to the Intermodal Center in Fort Ord.

Figure 1-8 - Depiction of Bus on the Caltrans Pedestrian/Bike Trail

5. **Northbound Bus-on-Shoulder** – This alternative serves a different purpose from the others in that it is focused strictly on bus-on-shoulder operations on SR 1 in the northbound direction between Casa Verde Avenue in Monterey and Fremont Boulevard in the northern part of Sand City. The shoulder would need to be widened in several areas and there are three structures that the buses would need to bypass by leaving the shoulder and using the right traffic lanes.

6. **No-Build** – This alternative represents current conditions as a baseline for comparison with the build alternatives. It is assumed that there will be some increases in bus service in the corridor by year 2025 and that the Intermodal Center and Marina-Salinas Multimodal Corridor would be in operation.

7. **HOV Lanes** – This alternative is hypothetical, as it is not included in any regional or local plans. It was included for the purposes of providing a comparison of costs and impacts. It would involve adding a new lane to SR 1 in each direction between Marina and Monterey. The new lanes would accommodate buses, carpools, and other exempt vehicles per the California motor vehicle code. It would involve extensive new

construction in the freeway corridor including widening or lengthening of eight structures at costs averaging from $25-$35 million for each bridge. There would not be a connection to the Intermodal Center.

Table 1-1 presents a summary of the alternatives and their evaluation results. Some of the key findings are:

- In general, the alternatives involving bus-on-shoulder (Alternatives 1, 2, and 5) do not perform well compared to the others. Because the shoulders are not wide enough and would have to be widened in most areas to accommodate the buses, the construction costs are relatively high. The fact that buses would need to leave the shoulder to bypass structures along the route somewhat defeats the purpose of trying to use the shoulder to bypass traffic. Also, traffic conditions today are often not congested to the point where speeds drop below 35 miles per hour, so bus-on-shoulder operations would not occur every weekday. By year 2025, however, congestion is expected to be more severe and would support bus-on-shoulder operations.

- The HOV Lane alternative also does not perform well primarily due to its high cost and significant environmental impacts. A major concern would be the ability of buses to safely and efficiently make the weaving movement to and from the freeway ramps, across the general purpose traffic lanes and into the HOV lane.

- Compared to other alternatives, the Branch Line Alternative would be a strong performer. Its cost is similar to the Bus-on-Shoulder Alternative, but it provides service in both directions and has connections to the Intermodal Center and Marina-Salinas Multimodal Corridor. It would have environmental impacts which would need to be addressed, particularly in the areas of habitat preservation and biological resources. It also displaces the parking and storage facilities for some existing businesses in Sand City, although they are only leasing the use of the land on a temporary basis.

- Alternative 4, which displaces the Monterey Peninsula Recreational Trail, performs well and is very similar to Alternative 3, the Branch Line Alternative. Displacing the trail may prove to be a very difficult task even though there is an alternative parallel trail that appears to be more heavily used.

Table 1-1: Evaluation Summary – Monterey County

	Alternatives	Evaluation Results											
		Constructability Issues	Average 2025 Transit Time Savings (minutes)*	Annual Transit Operating Cost Savings (percent of existing service costs)	2025 Annual Operating Costs Compared to No-Build (millions)*	Buses Required (increase over No-Build)*	2025 Annual Rider-ship*	Connection to Intermodal Center?	Vehicle Miles of Travel Reduction*	Environmental Issues**	Total Capital Costs*	Benefit/ Cost Ratio	Overall Assessment
1	Southbound Bus-on-Shoulder	Medium	7.1	3.1%	$5.8	8	112,400	No	613,100	2	$35.0	0.18	+
2	Southbound Bus-on-Shoulder Plus Branch Line	Medium	10.1	4.3%	$5.5	8	304,900	No	1,663,100	7	$32.1	0.25	++
3	Branch Line	Medium	15.9	6.8%	$5.0	8	449,400	Yes	2,451,200	9	$33.4	0.66	+++
4	Pedestrian/Bike Trail Plus Branch Line	Medium	15.9	6.8%	$5.0	8	449,400	Yes	2,451,200	10	$32.6	0.67	++
5	Northbound Bus-on-Shoulder	Low	4.8	2.1%	$5.2	8	240,800	N/A	1,313,400	3	$10.5	0.26	+
6	No-Build	NA	0.0	0.0%	$0.0	0	0	No	0	4	$0.0	N/A	N/A
7	HOV Lanes	High	14.2	6.1%	$25.7	8	465,400	No	2,538,500	11	$449.7	0.07	+

Notes: ** - Results are incremental to the No-Build Alternative, all costs are in 2017 dollars.*

*** - Score calculated the sum for all impact categories, using for each category: 2 points for significant, 1 point for possibly significant and 0 points for not significant (see Table 5-11).*

Santa Cruz County Alternatives

There are four build alternatives identified for Santa Cruz County, as well as a no-build alternative. These alternatives are very much related to the planned implementation of auxiliary lanes on SR 1 as part of the Measure D funding program. More detail and schematic maps are provided in Chapter 4.

1. **Interim Southbound Bus-on-Shoulder** – Between Soquel Avenue and State Park Drive the southbound right shoulder is generally wide enough to allow bus-on-shoulder operations. In the northbound direction the right shoulders are consistently too narrow to allow bus-on-shoulder operations. Southbound, there would be a gap from the 41st Avenue interchange to the Capitola Avenue overcrossing where buses would need to merge back into the rightmost freeway lane in order to avoid narrow, 6 to 8 foot wide shoulders under or over existing structures. In this section the Bay Ave overcrossing has shoulders that are wide enough, but both the Wharf Rd undercrossing and the Capitola Avenue overcrossing have narrow shoulders. The next segment of bus-on-shoulder operations would extend from south of the Capitola Avenue overcrossing to the State Park Drive interchange. The final segment would be between the south railroad bridge and the Freedom Boulevard interchange. Overall, the bus-on-shoulder alternative includes about 4.2 miles on shoulders in a 7.5 mile distance. The gaps between these segments are long enough so that buses could merge back into the right traffic lane to bypass the gap area and then return to the shoulder after the structure or other obstacle has been passed. Some widening of shoulder areas would be needed in portions of the corridor to support bus-on-shoulder operations This alternative is called "interim" because it was envisioned that it could be implemented prior to the first phase of the auxiliary lanes project, although bus-on-shoulder operations could continue on the portions of the freeway south of where the auxiliary lanes end, until the time when the auxiliary lanes are funded and constructed.

2. **Bus-on-Right-Shoulder with Auxiliary Lanes** – There are two variations to this alternative, both of which would extend from Morrissey Boulevard to State Park Drive and would be implemented after or with the construction of each phase of the auxiliary lanes project. As part of the Highway 1 Corridor Investment Program, southbound and northbound auxiliary lanes will be constructed at the following locations:

    - *Auxiliary Lane 1: Between Soquel Avenue and 41st Avenue interchanges*
    - *Auxiliary Lane 2: Between Porter Street and Park Avenue interchanges*
    - *Auxiliary Lane 3: Between Park Avenue and State Park Drive interchanges*
    - *Auxiliary Lane 4: Between State Park Drive and Rio Del Mar Boulevard interchanges*
    - *Auxiliary Lane 5: Between Rio Del Mar Boulevard and Freedom Boulevard interchanges*

    It is important to note that the Auxiliary Lane 4 and 5 phases are considered more as long-range improvements. They are not currently funded by Measure D and they

require significant mainline reconstruction and railroad bridge replacements. The estimated cost of these phases is $124.6 million. This amount would have to be raised before bus-on-shoulder operations could occur south of the State Park Drive interchange.

Auxiliary Lane 1 will be starting construction by year 2021, Auxiliary Lanes 2 and 3 will begin construction by year 2023-24, but this is contingent upon the availability of funds. The construction timeframe for Auxiliary Lanes 4 and 5 is currently unavailable, but it is definitely beyond the year 2025 time frame. The interim bus-on-shoulder alternative was developed to provide improved transit operations in the southbound direction prior to the implementation of the auxiliary lanes.

As part of the auxiliary lane project, the right shoulders in either direction will be improved and widened and should be 10 feet wide in most areas which will be wide enough for bus-on-shoulder operation. Some improvements may be necessary to clear roadside obstacles and assure adequate width in all areas, to allow safe bus-on-shoulder operations. The two options are:

Option A: Hybrid-Auxiliary Lanes – Auxiliary lanes are essentially short freeway lane segments between on- and off-ramps. They reduce congestion and improve operations by facilitating traffic movements to and from the ramps. The speeds in auxiliary lanes tend to be slightly higher than those in the regular freeway lanes. The Hybrid-Auxiliary Lanes Alternative involves the buses using the auxiliary lanes between interchanges and then transitioning to the shoulder through the interchange area. These short shoulder areas would need to be specially marked and signed to advise motorists that they are for use by buses (and emergency stopping) only. Sufficient right-of-way is typically available at the interchanges, once the auxiliary lane project is complete, except at the overcrossings of 41st Avenue and State Park Drive. However, widening of shoulder pavement and pavement structure enhancement may be required at a few locations.

Option B: Bus-on-Shoulder – As each stage of the auxiliary lane project is constructed, a new shoulder will be provided on the right side of the freeway. As currently planned, this shoulder width will be 10 feet in width in most areas which is adequate for bus-on-shoulder operations. There may be locations where roadside obstacles or other constraints require additional construction to accommodate bus-on shoulder operations.

3. **HOV Lane Project** – Because Santa Cruz METRO's planned primary use of SR 1 is to operate express buses, non-stop, on SR 1 between Watsonville and Santa Cruz, their preference was for left-side bus-on-shoulder operations to avoid conflicts with on and off-ramps. However, the left-side shoulder on SR 1 was found to be too narrow to provide the minimum 12 feet of width needed to support bus-on-shoulder operations next to the freeway median. The most direct way to create this width would be to use the space available on the right shoulder to shift the freeway lanes to the right and thereby create the space needed for a wider median shoulder. This however, proved to be impractical as it would eliminate the right shoulder in conflict with Caltrans' design

standards, requiring exceptions to the Caltrans design standards outlined in the Highway Design Manual (HDM). As the right shoulder is essential for safety as a vehicle refuge area. it is highly unlikely that these design exceptions would be acceptable. In addition, in areas where structures limit the shoulder width, the buses would need to weave into the left traffic lane from the left shoulder, which is a far more dangerous maneuver than weaving in from the right shoulder. To address the desire for left side bus operations, this HOV Lane Project Alternative was developed. It is an adaption of the HOV Lane Alternative that was studied as part of the Measure D Program (see the Tier I and Tier II Draft Environmental Impact Report/Environmental Assessment https://sccrtc.org/external/hwy1corridorEnvDocs/01_Hwy_1_HOV_cover_pages_Oct_2015_JA-TML_LP_GMG.pdf).

The project has been shortened to avoid some of the most costly and difficult obstacles, but still requires widening of five freeway structures. This alternative would involve adding a new HOV lane to SR 1 in each direction between Soquel Avenue and State Park Drive. The new lane would accommodate buses, carpools and other exempt vehicles per the California motor vehicle code.

3. **No-Build Alternative** – This alternative represents the existing conditions plus the implementation of the Measure D auxiliary lanes project. No increase in bus transit service on SR 1was assumed as METRO currently runs a limited number of routes on the freeway due to the congestion and unreliable traffic conditions. Currently, the auxiliary lanes project is programmed for the segment from Morrissey Boulevard to State Park Drive. The segment from State Park Drive to Freedom Boulevard is not funded and will not be completed by the year 2025. Because the alternatives that are dependent on the completion of the auxiliary lanes would not be constructed prior to each phase of the auxiliary lane project, the No-Build Alternative is assumed to terminate at State Park Drive. An additional $124.6 million would be required to extend the auxiliary lanes from State Park Drive to Freedom Boulevard, making this a very long-term project.

Table 1-2 provides a summary of the evaluation of these alternatives. Key conclusions include:

- **Traffic Congestion –** Congestion on this segment of SR 1 between Soquel Avenue and Freedom Boulevard is quite severe in the northbound direction during the morning peak period and the southbound direction in the afternoon peak period, which would justify bus-on-shoulder operations.

- **Alternative 1: Interim Southbound Bus-on-Shoulder** – For the most part, the right and left-side shoulders on this segment of SR 1 are not wide enough to support bus-on-shoulder operations. The exception is the southbound shoulder where many areas do provide the required 10-foot minimum. Alternative 1: Interim Southbound Bus-on-Shoulder option, takes advantage of this opportunity. It performs well compared to the other alternatives. The main question is one of phasing – does it make sense to pursue this project prior to the implementation of the auxiliary lane project? This is a matter of timing and also whether funds spent on the interim project could be expended in a way that benefits the upcoming auxiliary lane project, which may be unlikely. Realistically, this alternative probably only makes sense in the segment of southbound SR 1 between State Park Drive and Freedom

Boulevard because the auxiliary lanes in the segments to the north will be completed too soon for interim bus-on-shoulder to have benefit.

- **Alternative 2 Option A: Hybrid-Auxiliary Lanes** bus on right shoulder option offers a relatively low-cost approach to providing bus-on-shoulder in both travel directions, as long as the implementation of the bus-on-shoulder operations occurs in coordination with each phase of the auxiliary lane project. The buses would use the new auxiliary lanes in the areas between interchanges and would use the shoulders in the areas between the off-ramps and on-ramps of the interchanges. This limits the need for shoulder improvements and does not require the bus to use the shoulders between interchanges. This is a new concept – a variation of the bus-on-shoulder practice – and it would have to be vetted fully with Caltrans and the California Highway Patrol. It would be feasible to test the concept on an existing section of the freeway with auxiliary lanes. The costs would mostly be for signage and pavement markings. In some locations the shoulder areas on bridges or under structures may not be wide enough for bus operations and the buses would have to merge back into the general purpose lanes to bypass these obstacles. This is a standard bus-on-shoulder operating practice. This option involves less weaving movements by the buses as compared with Option B.

- **Alternative 2 Option B: Bus-on-shoulder Alternative** is a version of Alternative 2A which makes use of the new 10-foot wide right shoulder that comes as part of the auxiliary lane project both between interchanges and in the areas between the off-ramps and on-ramps of the interchanges. The costs would mostly be for signage and pavement markings. It is possible that the costs could be reduced if the shoulder improvements needed were designed and implemented at the same time as the auxiliary lane project. This would essentially create an integrated auxiliary lane/bus-on-shoulder project. In some locations the shoulder areas on bridges or under structures may not be wide enough for bus operations and the buses would have to merge back into the general purpose lanes to bypass these obstacles. This is a standard bus-on-shoulder operating practice.

Table 1-2: Evaluation Summary – Santa Cruz County

Alternatives		Evaluation Results										
		Constructability Issues	Average 2025 Transit Time Savings (minutes)*	Annual Transit Operating Cost Savings (percent of existing service costs)	2025 Annual Operating Costs Compared to No-Build (millions)*	Buses Required (increase over No-Build)*	2025 Annual Ridership*	Vehicle Miles of Travel Reduction*	Environmental Issues**	Total Capital Costs (millions)*	Benefit/ Cost Ratio	Overall Assessment
1. Interim Bus-on-Shoulder Southbound	Soquel Avenue to State Park Drive	Low	8.8	10.0%	$2.7	12	555,000	3,531,800	8	$14.1	0.20	+
2. Bus on Right Shoulder with Auxiliary Lanes	A. Hybrid-Auxiliary Lanes - Morrissey Blvd. to Freedom Blvd.	Low	16.5	6.0%	$2.5	12	1,365,000	8,686,400	0	$7.9	1.38	+++
	B. Bus-on-shoulder - Morrissey Blvd. to Freedom Blvd.	Medium	18.0	20.0%	$2.4	12	1,372,500	8,734,100	0	$8.1	1.69	+++
3. HOV Lane Project	Soquel Avenue to State Park Drive	High	12.7	22.0%	$19.1	27	1,965,000	12,504,600	18	$364.1	0.06	+
4. No-Build Project	Existing Highway with Auxiliary Lanes - Morrissey Blvd. to State Park Drive	N/A	8.4	9.0%	$0	0	0	0	9	$0	N/A	N/A

Notes: * - *Results are incremental to the No-Build Alternative, all costs are in 2017 dollars.*

** - *Score calculated the sum for all impact categories, using for each category: as 2 points for significant, 1 point for possibly significant and 0 points for not significant (see Table 5-22)*

- **Alternative 3 – HOV Lanes** is a substantial construction project requiring widening or lengthening of five structures and acquisition of new right-of-way. It was identified as having the potential for significant environmental impacts, including visual impacts, reduction of sensitive habitat, and displacement of businesses and residential units. It was not very cost effective in terms of transit use as compared to the other alternatives.

Project Implementation and Next Steps

The above findings suggest several additional elements of consideration that could lead to successful implementation of bus-on-shoulder or bus rapid transit improvements in both counties. Additional steps are suggested to help support project implementation.

Monterey County

- **Inadequate Shoulders –** Unfortunately, the right-side shoulders on SR 1 in the study corridor are not consistently wide enough to support bus-on-shoulder. Traffic demand and congestion has become an issue, southbound, on weekday mornings, but the problem is not as severe northbound in the afternoon peak period. Costly shoulder widening would be required. As a result, the bus-on-shoulder alternatives had a poor benefit-cost ratio. Segment I -Option A – the southbound bus-on-shoulder operation between Del Monte Boulevard/SR 1 interchange in Marina and Fremont Boulevard/SR 1 interchange in Sand City would be the most cost-effective location for an initial bus-on-shoulder project, yet its benefit cost ratio would still be well below 1.0.

- **Use of the Monterey Branch Line** – The analysis suggests that using the branch line for a bi-directional busway could be cost-effective as compared to a bus-on-shoulder project on SR 1 in Monterey County. Environmental impacts are a concern, but many of these same impact types would occur with widening the freeway shoulder. Since the Transportation Agency for Monterey County owns the branch line's right-of-way, this project is much more straightforward than either widening the shoulder of SR 1 or displacing the Monterey Peninsula Recreational Trail between Marina and Sand City. Still with a cost-benefit ratio of less than one, the project is not fully cost-effective. One way to address this would be to consider a phased project. The first segment from Reservation Road in Marina to the intersection of Monterey Road/California Avenue/Fremont Boulevard in Sand City is more cost-effective than the alternative as a whole, with about a 0.82 benefit-to-cost ratio as compared to 0.66 for the whole project. It is possible with further study and refinement that the benefit-to-cost ratio could be improved further.

- **Widening of SR 1** – A widening of SR 1 in the study area would involve significant environmental impacts and related costs. If a widening involving additional lanes were to occur, environmental considerations would likely dictate that it be in the form of HOV Lanes. This analysis showed HOV lanes not to be a very effective approach to improving transit in the corridor.

Santa Cruz County

- **Inadequate Shoulders** - Unfortunately, the right-side and left-side shoulders on SR 1 in the study corridor are not consistently wide enough to support bus-on-shoulder. Also, they may not have the structural depth and configuration to support long term bus operations. Traffic demand and congestion has become severe in the peak travel directions. Costly shoulder widening would be required. As a result, even though the ridership demand estimates were strong, the bus-on-shoulder alternatives had a poor benefit-cost ratio.

- **Coordination with the Auxiliary Lane Project –** The auxiliary lane project represents a great opportunity to implement bus-on-shoulder as each phase of the project is completed, it will provide shoulders that are suitable for bus-on-shoulder operations. Implementation of bus-on-shoulder improvements in Santa Cruz County should be tied to the implementation of the auxiliary lanes. Coordination of the two projects to allow an integrated roll out of the auxiliary lanes that were designated to accommodate bus-on-shoulder would be a cost-effective strategy. Both the auxiliary lane and bus-on-shoulder improvements could occur as a single project, with phases for each segment of the freeway moving south from Santa Cruz. Making this happen could prove beneficial in the long run. In order for this to happen, the bus-on-shoulder improvement would have to go through its own environmental clearance process separate from the Tier II 41st/Soquel Avenue auxiliary lanes project. The first phase is scheduled to begin construction in 2021, so coordination of bus-on-shoulder improvements should begin soon it order to integrate the two projects.

- **Hybrid-Auxiliary Lanes –** The bus on right shoulder Alterative 2- Option A, which involves buses using the auxiliary lanes between interchanges instead of the shoulder is superior in terms of operations to Alternative 2 – Option B, which involves continuous use of the new shoulders provided by the auxiliary lane project. This is because bus operations and conflicts with traffic are simplified, with buses operating in the auxiliary lanes rather than on the shoulder for most of the distance in Option A. Whereas in Option B buses must weave out of the shoulder into the auxiliary lane before each interchange.

- **HOV Lanes –** Implementing HOV lanes on SR 1 is a long-term goal of the Santa Cruz County Regional Transportation Commission and it supports METRO's objectives for improved transit service in the corridor. Unlike in Monterey County, the longer distance METRO buses will travel on the freeway will mitigate the concerns about buses having to weave across the freeway lanes to get in or out of the HOV lanes. However, because of the high cost of this project and the current lack of funding, it would be appropriate to pursue in the near-term the Alternative 2- Option A – Hybrid-Auxiliary Lanes, which can be implemented with relatively little cost once the auxiliary lanes are in place.

Next Steps

- **Monterey County** – This analysis suggests that MST should pursue Alternative 3 – the bi-directional busway on the Monterey Branch line. This is the most cost-effective alternative. It is also supported by funding from the Measure X program administered by the Transportation Agency for Monterey County. The first step would be to get acceptance of this study from the partner agencies. Then, the next step would be to initiate the

preliminary engineering and environmental studies. The Technical Advisory Committee set up for this project could continue to function for this next phase.

- **Santa Cruz County** – METRO should coordinate closely with the Santa Cruz County Regional Transportation Commission to further explore planning the auxiliary lane program to include bus-on-shoulder operations. The would allow bus-on-shoulder operations to commence as each phase of the auxiliary lane program is constructed. METRO should began work to get Caltrans and California Highway Patrol acceptance of the bus-on-shoulder proposal consistence with the prevailing legislation that is in place.

- **Advanced Technology –** Two developing technologies should be considered in the development of either bus-on-shoulder or busway projects. The first is ***vehicle-to-infrastructure technology***. One of the major concerns with bus-on-shoulder operations is conflicts with vehicles using on- and off-ramps. Ramp metering combined with vehicle-to-infrastructure communications between the buses and the ramp metering controllers would allow on-ramp traffic to be stopped as a bus crosses the point where the on-ramp merges with freeway. Note that to date, this technology has not been used with bus-on-shoulder applications as there is no record of actual safety problems related to on-ramp traffic accidents involving buses using the shoulder. An alternative to ramp-metering would be a signal on the on-ramp which would only be activated when a bus is approaching on the shoulder, stopping on-ramp traffic momentarily. This would not require the major ramp modifications often involved with ramp metering. However, actual bus-on-shoulder operating experience around the country has shown no ramp controls are needed to assure safe operations. With a busway operation, traffic signals at crossing locations can be activated by on-board technology in the buses, limiting the impact to traffic at the nearby intersections. Ramp metering is not currently planned or funded in either County.

  The second innovation is ***autonomous buses***. The development of these buses is occurring at a rapid pace and demonstrations of smaller shuttle buses with various levels of autonomous operational capabilities are occurring in a number of locations, including one in the Bishop Ranch business park in San Ramon, California. A controlled environment such as a busway would be ideal for an autonomous bus operation. Use of these buses in a bus-on-shoulder application would be more complex, but not infeasible. Autonomous buses would reduce labor requirements, allowing more buses to be operated with the same number of personnel. This would result in a more cost-effective transit service. Ridership is highly dependent on service frequency and with autonomous buses, METRO and/or MST could offer higher frequencies without the cost penalty associated with traditional bus operations. In the timeframe in which a busway project could be implemented it is highly likely that revenue service tested autonomous buses would be available. There may also be special federal or state funding for this type of innovative technology application.

Chapter 2

Literature Review

This chapter is a summary of the current literature and case studies regarding both the practices of bus-on-shoulder operations and bus use of railroad rights-of-way.

Bus-on-Shoulder

Bus-on-shoulder refers to the practice of allowing buses to use the paved shoulder areas of freeways to bypass areas of severe traffic congestion. While the notion of bus-on-shoulder conjures a vision of buses flying by stalled traffic on a narrow shoulder lane, the reality is that bus-on-shoulder involves operation of buses under carefully defined and controlled conditions. First, the shoulder area has to meet certain criteria in terms of its width, clearance and pavement strength. Secondly, the transit operators must receive training in how and when to properly operate the bus on the freeway shoulder. Finally, there are guidelines/rules as to what traffic conditions/speeds must exist in order for the bus to be allowed to use the shoulder and how much faster than the traffic the bus is allowed to operate. The bus-on-shoulder concept is not new, it originated in this country in 1991 in Minnesota and has been implemented in a number of locations since then including San Diego, California. As a result, there is substantial experience and research on bus-on-shoulder that can be used to inform the consideration of bus-on-shoulder operations on Highway 1 in Monterey and Santa Cruz counties.

There are four national studies and three state-sponsored studies of bus-on-shoulders of relevance to this MST study.

National Studies

- Transit Cooperative Research Program Report 151 – *A Guide for Implementing Bus-on-Shoulder Systems* (the most comprehensive of the studies)
- Transit Cooperative Research Program Synthesis Report 64 – *A Synthesis of Transit Practice*
- FHWA's *Use of Freeway Shoulders for Travel – A Guide for Planning, Evaluating and Designing Part-time Shoulder use as a Traffic Management Strategy*
- American Association of State Highway and Transportation Officials – *Guide for Geometric Design of Transit Facilities on Highways and Streets*

Figure 2-1: Bus-on-Shoulder in Minnesota

State-Sponsored Studies

- Minnesota Department of Transportation *Bus Only Shoulder Guidelines*
- Caltrans Transit Lane Demonstration Pilot Report (San Diego)
- I-55 Bus-on-Shoulder Demonstration – In the Spirit of Time (Chicago)

The Minnesota guidelines are often the basis for agencies to tailor their own guidelines as Minnesota has the largest and one of the oldest bus-on-shoulder operations as well as the most time proven. The Caltrans report describes the only California bus-on-shoulder application in San Diego, and the Chicago I-55 report describes a left-side shoulder bus-on-shoulder project.

TCRP Report 151 – A Guide for Implementing Bus-on-Shoulder (BOS) Systems

Transit Cooperative Research Program Report 151 – *A Guide for Implementing Bus-on-Shoulder (BOS) Systems* provides the most comprehensive reference for bus-on-shoulder implementation. It was published in 2012 and describes:

- Current North American practice;
- Common shoulder operations issues;
- Guidelines for operations based on experience and surveys of both drivers and passengers;
- Design considerations;
- Traffic operations guidelines; and
- A general framework for decision-making.

The Transit Cooperative Research Program is part of the National Academy of Sciences Transportation Research Board whose research is largely funded by state DOTs. Report 151 included case studies of bus-on-shoulder projects in Minneapolis-St. Paul Twin Cities Area; Miami; San Diego; New Jersey; Ottawa; Columbus, Ohio; and Atlanta, Georgia. This report preceded implementation of bus-on-shoulder projects in Raleigh, North Carolina (Research Triangle), Kansas City, Chicago, and Colorado. The TCRP team, however, provided inputs to these new projects being planned, with the exceptions of the very recent bus-on-shoulder project in Denver. All the bus-on-shoulder projects were for the right-side shoulders, except for the Cincinnati and Chicago projects which both used the left-side shoulders.

A collaborative approach to the planning, design, and operations involving all stakeholders was found to be very important to the successful implementation of bus-on-shoulder projects. Each project tended to involve different traffic, transit, physical highway features, climate, geology, and agency operating practices, and the collaborative approach helped to recognize these features. It is one of the reasons a "one-size fits all" rigid template for design and operations was not recommended by this research.

Bus-on-shoulder projects have proven to be popular with bus passengers and the communities that have implemented them, and the bus drivers that operate on the shoulders feel that they are

good projects. Typically, they are not the ideal bus priority or corridor capacity enhancement option, but because they utilize current right-of-way they are low-cost, low-impact, and relatively easy to implement. The Transit Cooperative Research Program Report 151 found many conclusions can be drawn from current bus-on-shoulder operations:

1. Bus priority treatments on freeways and arterials have operated successfully for about 50 years. They have increased the person-capacity of highway corridors and saved bus passengers time without adversely affecting vehicle flow.

2. The concept of bus-on-shoulder has emerged in the past two decades. It has been applied where bus volumes are too low to justify new bus lanes and/or roadway geometry does not permit dedicated bus lanes.

3. With bus-on-shoulder, authorized buses can use the roadway shoulders (typically the right-side shoulder) during peak hours only when the main freeway lanes are congested.

4. Bus-on-shoulder has proven successful in many communities including metropolitan regions of Minneapolis-St. Paul, San Diego, Miami, Cleveland, Columbus, Cincinnati, Washington DC, Seattle, Atlanta, New Jersey, Wilmington, Ottawa, and Toronto.

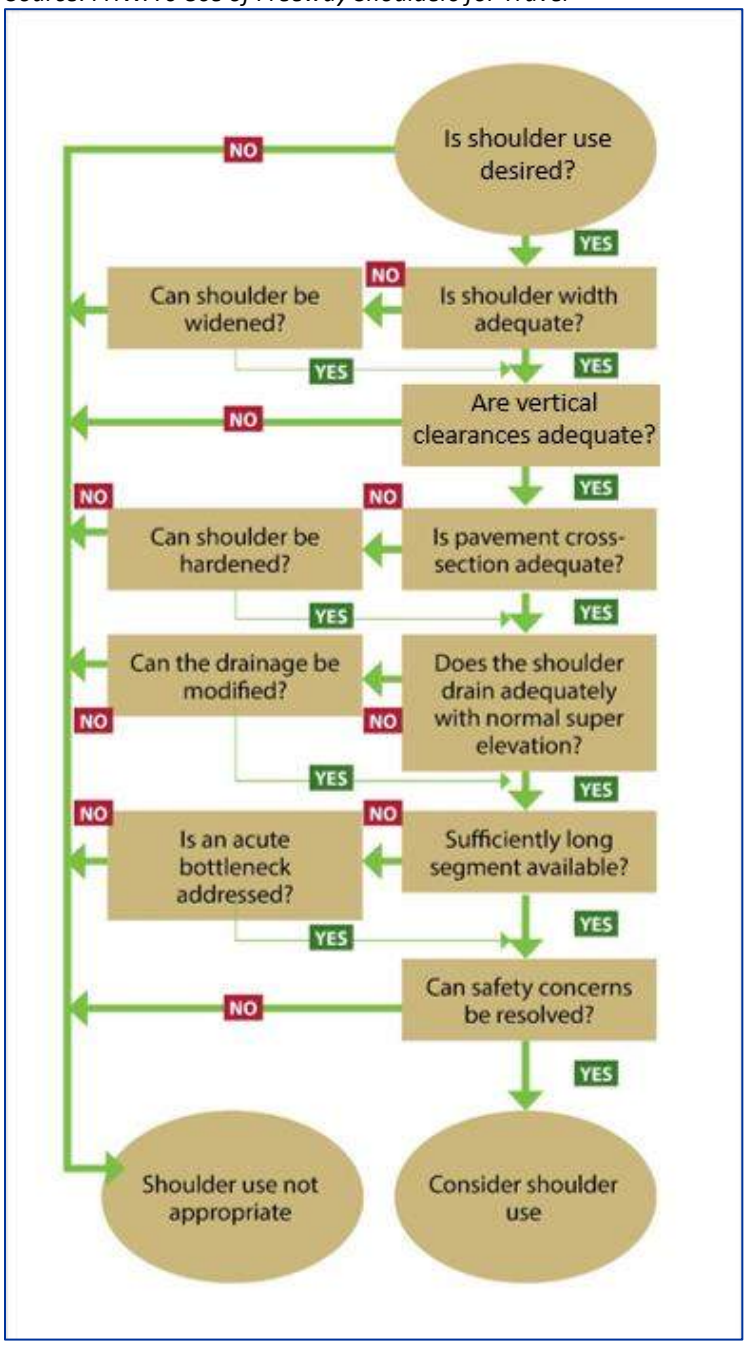
5. Bus passengers save time while highway service levels remain unchanged.

6. Safety experience has been excellent even running on narrow 10-foot-wide shoulders.

7. The basic requirements for a successful bus-on-shoulder include:

    - *Presence of buses – usually at least four buses per hour.*
    - *Congested freeways – speeds of less than 35 miles per hour for right side shoulders.*
    - *Minimum 10-foot continuous shoulder of sufficient strength to support buses. Ideally, the shoulder should be at least 12 feet to better protect protruding bus mirrors.*
    - *Avoidance of multi-lane entrance and exit ramps and ramps with very high traffic volumes (more than 1,000 vehicles per hour).*
    - *Willingness of transit and roadway agencies (along with the MPO) to work together.*
    - *Ability to obtain needed "design exceptions" from the Federal Highway Administration.*

Figure 2-2: Shoulder Suitability Review Process
Source: FHWA's Use of Freeway Shoulders for Travel



Bus-on-shoulder operations should be installed only after a careful analysis of physical and operational feasibility. Buses should be able to safely enter and leave the lanes. Shoulders should be wide and strong; there should be no nearby obstacles or protrusions. Complementary corridor improvements like park-and-ride lots are desirable. Bus-on-shoulder operations tend to be safer than high-occupancy vehicle (HOV) and general traffic use of shoulders as bus operators are professionals and receive special training as well as monitoring. There are also far fewer buses than HOVs and general traffic vehicles which reduces risks and potential blockages of the shoulder.

Report 151 summarized the findings of passenger surveys conducted for bus-on-shoulder projects in the Twin Cities, San Diego, Miami, and Cincinnati. Passengers generally felt safe and liked the shoulder operations for travel time benefits. Often passengers would encourage drivers to use the shoulders when traffic speeds slowed.

Report 151 also surveyed bus drivers to understand their feelings and concerns regarding bus-on-shoulder. Drivers in the Twin Cities, New Jersey, San Diego and Miami were surveyed. Most felt that bus-on-shoulder operations were safe, shoulder widths generally adequate, signage and markings were adequate, training was adequate, and that bus-on-shoulder was a good concept. Bus driver input generally is sought particularly regarding speed protocols.

The national research found relatively little documentation of benefits, costs, and safety impacts. Interestingly, the apparent reason for the absence of performance data is that no problems have arisen, and the bus-on-shoulder concept appears intuitively beneficial. Passengers love it and bus drivers think it is a good concept. Quantification of the benefits is also complicated by the widely

fluctuating traffic conditions in congested corridors and by difficulty isolating bus-on-shoulder benefits from the numerous other factors that influence patronage (e.g., service and fare changes).

TCRP Synthesis 64 Bus Use of Shoulders – A Synthesis of Transit Practice

Synthesis Report 64 was a precursor to Report 151 and focused on identifying where bus-on-shoulder operations had been implemented and the resultant experience. Published in 2006, it identified bus-on-shoulder operations in the Twin Cities area; Falls Church, Virginia; Burtonsville, Maryland; Bethesda, Maryland; Seattle; Mountainside, New Jersey; Old Bridge, New Jersey; Alpharetta, Georgia; Wilmington, Delaware; Miami; Toronto; Ottawa; Dublin; Wellington, New Zealand; and San Diego, California, and provides brief overviews of these projects. The project entailed a web survey of transit agencies, metropolitan planning organizations (MPOs), departments of transportation (DOTs) and other transportation agencies with 71 responses received to the survey (did not include enforcement agencies). The survey sought to identify bus-on-shoulder projects, experience to date, and key concerns including seeking to identify loss of shoulder functions, traffic safety issues and experience, physical design practice, legal issues, and costs.

In general, the findings indicated that while bus-on-shoulder was not the ideal solution, it was low cost, low impact and relatively easy and quick to implement. Safety experience was found to be good and none of the bus-on-shoulder projects had been abandoned due to problems.

FHWA's Use of Freeway Shoulders for Travel – A Guide for Planning, Evaluating, and Designing Part Time Shoulder Use as a Traffic Management Strategy

Published in early 2016, this guide covers planning, design, implementation and day-to-day operations of the full array of shoulder uses including bus, HOVs, and general traffic use of freeway shoulders. It describes different forms of shoulder use, decision-making and preliminary engineering issues, benefits assessments, safety analyses, environmental analyses, cost analyses design considerations, implementation process, and day to day operations management. The Guide also describes case study applications for ten cities, most of which are bus-on-shoulder operations. The guide suggests a minimum 10-foot-wide shoulder is needed with 12 feet being desired. The primary relevance of this report is that it provides comprehensive descriptions of shoulder use design issues and day to day operations discussions.

AASHTO Guide for Geometric Design of Transit Facilities on Highways and Streets

Published in 2014, this guide for geometric design describes the practice recommended by the American Association of State Highway and Transportation Officials. It does not define minimum standards, but instead it is intended as a guide. The American Association of State Highway and Transportation Officials recognizes the potential travel time and reliability benefits that bus-on-shoulder operations can provide. It suggests a 12-foot desired shoulder width.

Minnesota Department of Transportation Bus Only Shoulder Guidelines

In partnership with the Minnesota Department of Transportation, Metro Transit began allowing buses to use shoulders to bypass congestion in 1991. They currently allow more than 250 miles of shoulders to be used by buses to bypass congestion. Their experience has been used by many newer bus-on-shoulder project agencies as a template for proven practice. The Twin Cities established operating protocols, signage and marking guidelines, and minimum design guides. Their operation is entirely right-side shoulders. **Table 2-1** summarizes some of their key design guidelines set in 1997. Use of shoulders is restricted to only drivers that have received special training.

Table 2-1: Shoulder Use by Buses: Geometric Design Criteria

Type of Highway: Urban Multi-Lane Freeway and Expressways; Buses on Right Shoulder		
Controlling Geometric Design Criteria	**Mn/DOT Std.**	**Notes**
Design Speed, mph	35 mph	Maximum speed for buses traveling on shoulder, as per operational policy
Shoulder Width (feet)	10 12	Minimum Desirable for pavement longevity and added safety
Bridge Width (feet)	11.5	11.5’ wide shoulder is needed on bridges
Grades, maximum percent	nc	no change (nc) match existing roadway
Inslopes	1:6	If inslopes are not steeper than 1:6, inslopes may be steepened to 1:6. If inslopes are steeper than 1:6, match existing, except in the following cases; if fill slope is steeper than 1:3 and higher than 2 feet, provide guardrail, unless there is 18 feet between the edge of shoulder and the point where the fill slope becomes steeper than 1:3.5.
Structural Capacity	HS25	For new bridges, for existing bridges to allow shoulder use the shoulder must be structurally adequate (capable of carrying legal loads and does not appear on the inventory of inadequate bridges).
Horizontal Alignment, radius (feet)	nc	no change (nc) match existing roadway
Vertical Alignment minimum K value (ft./deg.)	nc	no change (nc) match existing roadway
Stopping Sight Distance (feet)	250’	Stopping Sight Distance based on 35 mph design speed
Cross Slope, (feet/feet)	.02-.05	Mn/DOT Road Design Manual: Tbl. 4-4.03A, p. 4-4.0(3)
Superelevation max Max. negative (feet/feet)	.06-.04	for curves less than or equal to 8 degrees Mn/DOT Road Design Manual; p. 3-2.0 (2A)
Vertical Clearance	14’	AASHTO 1990 Policy on Geometric Design of Highways & Streets; p. 526 Tallest design vehicle is 10’-9”
Horizontal Clearance	0’	AASHTO 1990 Policy on Geometric Design of Highways & Streets; p. 586 2’ beyond edge of shoulder is preferable, as a minimum, place at the edge of shoulder

Transit Lane Demonstration Pilot Report – San Diego

California allows Caltrans Districts to participate in pilot projects and in 2005, Caltrans District 11, along with the San Diego Association of Governments and San Diego Metropolitan Transit System, established bus-on-shoulder operations on SR-52 and I-805 near University Town Centre. This was a right-shoulder project. The shoulder width was typically 10 feet, but slightly narrower in some areas. Buses were allowed to use the shoulder only when general traffic speeds were 35 mph or less, and then they were limited to a speed no more than 10 mph faster than the traffic in the general-purpose lanes. The two-year long pilot project required a one-year evaluation report. Caltrans evaluated the safety, freeway operations, and travel time/reliability aspects of the project and concluded that safety and freeway operations impacts were negligible and that shoulder operations provided some limited benefits to transit. The limited benefits were primarily due to the 15-minute bus service that was provided on the pilot segment. As California's Vehicle Code does not allow for shoulder operations, the shoulder was technically redefined to be a transit-only lane for the purposes of the pilot. The cost of implementing the 8-mile bus-on-shoulder project was about $100,000. As much as a five-minute time savings was reported under the most severe traffic conditions.

Figure 2-3: SANDAG Bus-on-Shoulder Demonstration

I-55 Bus-on-Shoulder Demonstration – In the Spirit of Time

A technical paper was developed by the Chicago Regional Transportation Authority and AECOM describing the implementation of a left-side shoulder project on Interstate 55 (also known as the Stevenson Expressway) for the Transport Chicago 2011 Conference. The left-side shoulders are 12 feet or wider and Pace operates the bus services. Buses can only use the left shoulder when speeds drop below 35 mph and are not permitted to run faster than 35 mph when using the shoulder. Overhead gantry mounted signs designate the shoulder use. The bus-on-shoulder project has been very successful and is currently being expanded, and more bus services are being added.

I-71 Cincinnati Left Shoulder Bus-on-Shoulder

Figure 2-4: I-71 Left Shoulder Bus-on-Shoulder

Cincinnati also operates left-side shoulder bus operations. Metro and the Ohio DOT moved forward with the implementation of the nation's first left shoulder bus-on-shoulder project. This new bus-on-shoulder project began operation in July 2007. It is about a 10-mile segment of I-71 in the northeastern part of the metropolitan area. The left-side shoulders are generally 12-feet wide with a rumble strip running down their centers. This rumble strip was retained during the first year when the service was operated as a pilot program. Buses can use the left shoulder when traffic slows to 30 mph and are allowed to run 15 mph faster than traffic in the general lanes. Signage is very minimal.

Bus on Railroad Rights-of-Way

The concept of creating a bus facility on a railroad right-of-way is not new either, but it is not a widely-used practice. Typically, a two-lane roadway designed exclusively for buses would be developed within the right-of-way. Stations or stops would also be in the right-of-way, often located near streets which cross the right-of-way. Where the right-of-way crosses an existing street, a traffic signal would be used to allow buses to cross safely, or a grade separation of the busway and the cross-street would be constructed. The crossings are the most challenging part of developing a busway in a railroad right-of-way, particularly where there are nearby streets running parallel to the railroad right-of-way.

TCRP Report 117 *Design, Operation and Safety of At-Grade Crossings of Exclusive Busways* provides guidelines on safe design and operation of at-grade crossings, which are one of the major challenges for buses operating on railroad rights of way. The practice in Los Angeles for their Orange Line and for Miami's South Dade Busway are both described.

Los Angeles Orange Line Busway

Figure 2-5: Orange Line Station

The Los Angeles Metropolitan Transportation Authority converted an 18-mile former Southern Pacific Railroad right-of-way to a busway in 2006. The project cost was $327 million. The project was an instant success, with ridership well exceeding the projections. The line has 18 stations and serves about 22,000 daily riders. Crossings of public streets are signalized and at-grade. During the first year of operation there were problems

with grade crossing accidents, but these diminished with improved signage and markings. Motorists also had to adapt to the new situation. The project has specially designed buses with doors on both sides to allow stops at median stations as shown in the photo. The project has been so successful that Metro is considering expansion options and a possible conversion to light rail.

South Dade Busway

Figure 2-6: South Dade Busway Station

Opened in 1997, this busway utilizes a former Florida East Coast Railroad right-of-way. It is one lane in each direction with at-grade crossings of local streets. A bike path is located adjacent to the busway in the busway right-of-way. Crossings are signalized. The initial phase of the busway, which consists of 8.3 miles, opened in 1997. The first segment of the extension to Florida City, opened in 2005, and extended the busway five miles to Naranja. The second and final segment of the extension, which opened on December 16, 2007, extends the busway another 6.5 miles south to Florida City, Miami-Dade County's southernmost municipality. There are 56 busway stations all of them right-side loading. A 10 percent time savings was reported as compared to when the buses operated on the parallel US-1. Ridership increased dramatically when the project opened and has continued to grow as this is a high growth region of the county. There was a major increase in bus frequency which helped to encourage new ridership. Accidents at intersections has proved to be a problem and modification to traffic signals and signage was necessary. Originally the signal system was designed to allow the buses to travel through the intersections at 45 mph without stopping. To reduce the number and severity of accidents the approach speed of the buses has been reduced to 15 mph.

Figure 2-7: Dade Busway showing traffic signals at a street crossing

Hartford-New Britain Busway

Subsequent to the Transit Cooperative Research Program Report 117, the Hartford-New Britain Busway opened in 2015; this busway shares a portion of the right-of-way with Amtrak and freight traffic. Much of it is elevated, but there are three at-grade crossings. A bikeway is also accommodated. It is about ten miles in length with 10 stations and serves about 19,500 daily riders. Most stations have passing lanes and are side-platform designed. Five local and four express routes operate along the busway. When opened, the costs of operating the project were much higher than expected and ridership was below the projections. However, since then ridership has increased and there is now discussion of an extension.

Figure 2-8: Hartford-New Britain Busway Station

Chapter 3
Existing Conditions

Background

As the Monterey Bay area continues to grow, congestion and delay on SR 1 in both Monterey and Santa Cruz Counties is becoming more severe. This is further exacerbated by the strong Northern California economy. MST and METRO buses that use SR 1 must contend with this congestion nearly every day, diminishing the service quality and reliability that they can offer their riders and increasing their costs of operation. Physical improvements to the highway are difficult and can take many years due to lack of funding, environmental issues, and geometric as well as geographic constraints.

This chapter provides an overview of the existing transportation conditions in the study corridor for both Monterey and Santa Cruz Counties. It addresses the current and projected future traffic conditions, transit operations and ridership, and highway geometrics. For those interested in a more comprehensive presentation and analysis should refer to a separate document entitled *Preliminary Analysis Report* which was prepared as part of this study.

Study Area

The study area of this project includes the portion of SR 1 located between the Cities of Monterey and Santa Cruz. The northern limit of the study area is the Ocean Street interchange in the City of Santa Cruz and the southern limit is the Carpenter Street intersection near the City of Carmel. However, currently, the majority of MST and METRO bus lines running along SR 1 are operating near the southern terminus of the study area (in Monterey County between Fremont Street and SR 156 interchanges) and northern terminus (in Santa Cruz County between Main Street and Ocean Street interchanges) of the study corridor, but not in the central portion of the corridor, where only two MST bus lines operate providing limited service on weekdays. Therefore, for the bus-on-shoulder concept, this study will focus on areas located near the northern and southern termini of the study corridor. These focus areas of study of the bus-on-shoulder concept are shown in **Figure 3-1** and **Figure 3-2**. Additionally, this study focuses on providing the bus-on-shoulder concept during weekday peak period conditions on typical weekday peak period conditions, rather than weekends or holidays, since this is the time period when buses are most likely to perceive maximum and regular benefits from shoulder operations. In Monterey County, the study will also examine the potential for a bus only facility on the Monterey Branch Rail Line which parallels SR 1 from SR 156 all the way to the City of Monterey.

Figure 3-1: Bus-on-Shoulder Concept Focus Area – Santa Cruz County

Figure 3-2: Bus-on-Shoulder Concept Focus Area – Monterey County

Existing Traffic Conditions

Existing traffic conditions along the SR 1 study corridor are described in this section, including lane configurations, traffic volumes, travel times, and operational issues. Currently documented traffic forecasts are also discussed.

Highway Configuration

SR 1, in the study area, includes sections classified as freeway, expressway, and conventional highway. A summary of the study corridor attributes is included in **Table 3-1**, while the distribution of number of lanes along the study corridor near the northern and southern termini are illustrated in **Figure 3-3** and **Figure 3-4**. The focus areas for bus-on-shoulder operations in Monterey and Santa Cruz Counties are classified as freeway. Freeway sections in Santa Cruz County are primarily four-lane segments, with a short six-lane section south of the SR 17 interchange. Similarly, freeway sections in Monterey County are primarily four-lane segments (two lanes in each direction), with a six-lane segment between the north side of Seaside and the south side of Marina. There are also highway sections (two to three miles long) north of Watsonville that have a third lane in one of the travel directions.

Traffic Volumes

Average annual daily traffic values along the study corridor are provided in **Table 3-2**. Highway segments with the highest daily volumes are located in Santa Cruz County between Freedom Boulevard and SR 17. There are also high-volume segments in Monterey County between Aguajito Road and SR-68, and between Seaside and Marina.

Table 3-1: State Route 1 Road Attributes

County	Limits of SR 1 Segment		Facility Type	Number of Lanes	Auxiliary Lanes
	Southern	Northern			
Monterey	North of Carpenter Street, Carmel (PM 74.932)	Fremont Boulevard, Seaside (PM 80.679)	Freeway	2 in each direction	Munras Avenue – SR-68/Holman Highway (SB) Fremont Street – SR 68/Salinas Highway (2 NB and SB lanes) SR-68/Salinas Highway – Casa Verde Way (NB and SB) Del Monte Avenue – Canyon Del Rey Boulevard (NB and SB)
Monterey	Fremont Boulevard, Seaside (PM 80.679)	Del Monte Boulevard, Marina (PM 85.135)	Freeway	3 in each direction	-
Monterey	Del Monte Boulevard, Marina (PM 85.135)	SR 156, Castroville (PM 91.019)	Freeway	2 in each direction	Molera Road/Nashua Road – SR 156 (NB and SB)
Monterey	SR 156, Castroville (PM 91.019)	SR 183, Castroville (PM 92.288)	Expressway	1 in each direction	-
Monterey	SR 183, Castroville (PM 92.288)	Salinas Road (PM 101.443)	Conventional Highway	1 in each direction	-
Monterey	Salinas Road (PM 101.443)	Santa Cruz County Line (PM 102.031)	Freeway	2 in each direction	-
Santa Cruz	Monterey County Line (PM 0.000)	Airport Boulevard, Watsonville (PM R3.181)	Freeway	2 in each direction	-
Santa Cruz	Airport Boulevard, Watsonville (PM R3.181)	Between Buena Vista Drive and Mar Monte Avenue	Freeway	NB 3 lanes SB 2 lanes	-
Santa Cruz	Between Buena Vista Drive and Mar Monte Avenue	Larkin Valley Road (PM R7.663)	Freeway	NB 2 lanes SB 3 lanes	-
Santa Cruz	Larkin Valley Road (PM R7.663)	Morrissey Boulevard (PM 15.822)	Freeway	2 in each direction	Bay Avenue – 41st Avenue (NB and SB) Soquel Drive – Morrissey Boulevard (NB and SB)
Santa Cruz	Morrissey Boulevard (PM 15.822)	SR 17 (PM 16.821)	Freeway	3 in each direction	-
Santa Cruz	SR 17 (PM 16.821)	South of SR-9/River Street (PM 17.456)	Freeway	2 in each direction	-

Notes:
PM – Caltrans Postmile
NB – Northbound, SB – Southbound

Figure 3-3: State Route 1 Facility Type and Lanes in Each Direction – Santa Cruz County

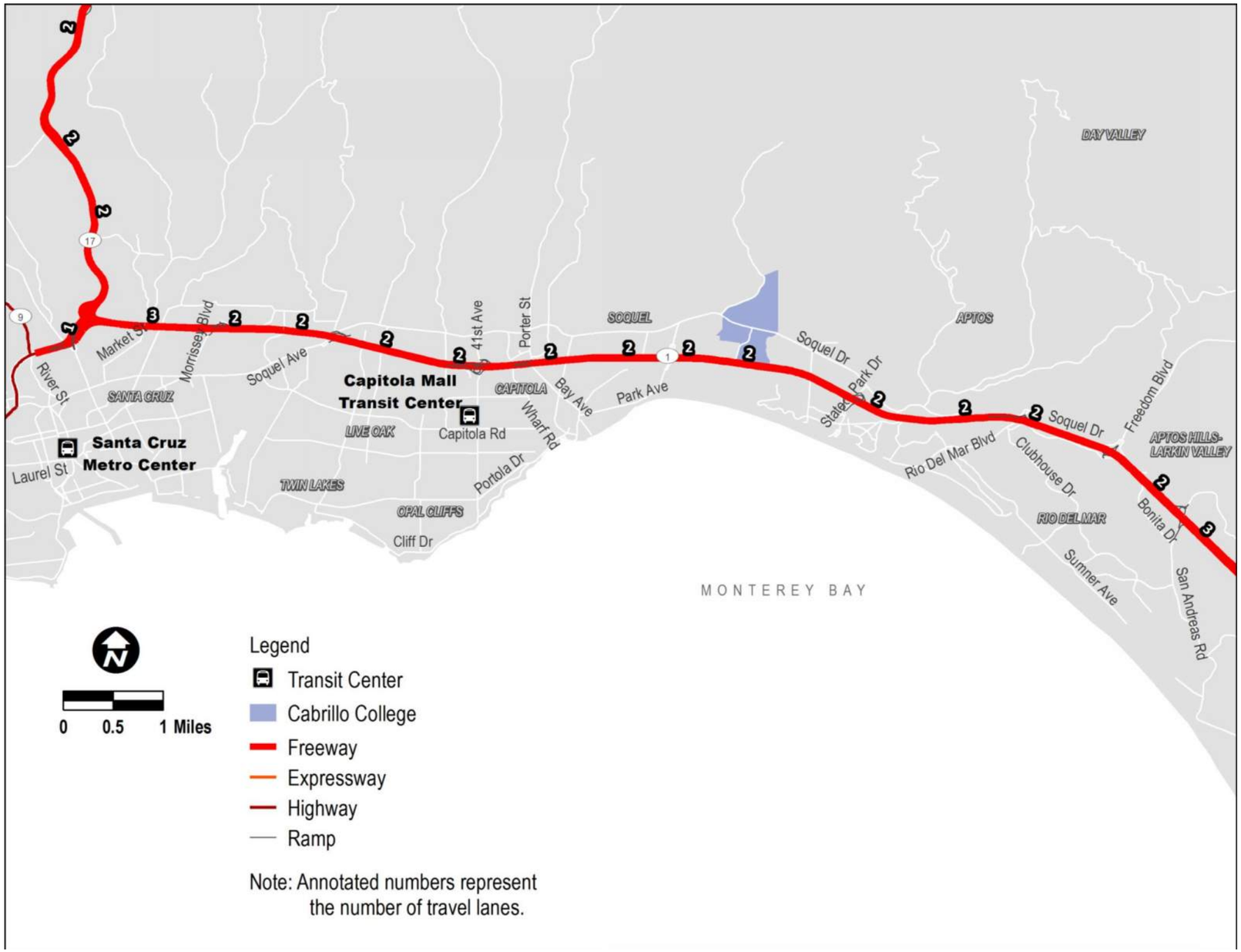


Figure 3-4: State Route 1 Facility Type and Lanes in Each Direction – Monterey County

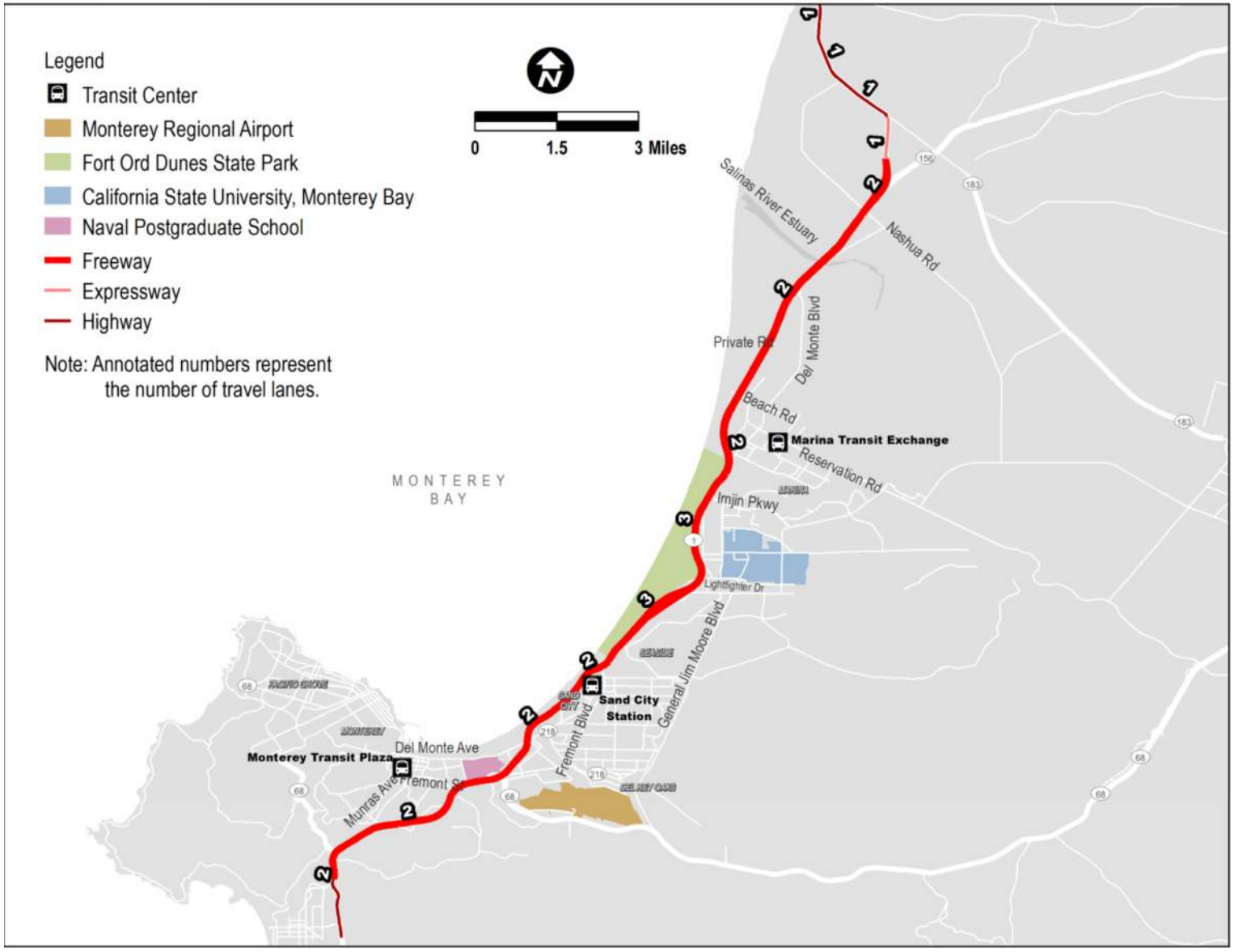


Table 3-2: Study Corridor Daily Traffic Volumes

County	Limits of SR 1 Segment		Average Annual Daily Traffic (2015)
	Southern Limit	Northern Limit	
Monterey	Ocean Avenue, Carmel	SR-68/Holman Highway	46,100
Monterey	SR-68/Holman Highway	Aguajito Road	52,000
Monterey	Aguajito Road	SR-68/Salinas Highway	77,000
Monterey	SR-68/Salinas Highway	Del Monte Avenue, Monterey	58,000
Monterey	Del Monte Avenue, Monterey	Fremont Boulevard, Seaside	72,000
Monterey	Fremont Boulevard, Seaside	Imjin Parkway	83,000
Monterey	Imjin Parkway	Del Monte Boulevard, Marina	64,900
Monterey	Del Monte Boulevard, Marina	SR 156	47,000
Monterey	SR 156	SR 183	17,700
Monterey	SR 183	Santa Cruz/Monterey County Line	37,000
Santa Cruz	Santa Cruz/Monterey County Line	SR 129	37,000
Santa Cruz	SR 129	SR 152	40,000
Santa Cruz	SR 152	Larkin Valley Road	60,000
Santa Cruz	Larkin Valley Road	Freedom Boulevard	68,000
Santa Cruz	Freedom Boulevard	Bay Avenue	88,000
Santa Cruz	Bay Avenue	41st Avenue	97,000
Santa Cruz	41st Avenue	Soquel Avenue	88,000
Santa Cruz	Soquel Avenue	Morrissey Boulevard	94,000
Santa Cruz	Morrissey Boulevard	SR 17	86,000
Santa Cruz	SR 17	SR-9/River Street	61,000
Santa Cruz	SR-9/River Street	Mission Street	47,000

Source: Caltrans, 2015 Traffic Volumes on California State Highways. (http://www.dot.ca.gov/trafficops/census/)

Travel Times and Speeds

Travel speeds under weekday peak period conditions were evaluated all along the study corridor. Even though data were compiled for the entire study area, the primary focus of operations analysis, as mentioned above, was on the two focus areas located near the northern and southern termini of the study corridor.

Speed Data

Travel time and speed analysis is based on data obtained from INRIX database for all midweek days (Tuesday through Thursday) in year 2016. The INRIX data represent anonymous tracking of trajectories based on signals from a sample of mobile devices (mobile phones and global positioning system/GPS units). Speed data were obtained from the INRIX database for all 12 months (from January 1 to December 31) in year 2016. The raw speed data included every day of

the year, every segment between freeway interchanges or major cross streets, and is split into designated time periods.

The initial analysis was based on five-minute intervals (12 speeds reported for each hour of the day for each segment). The five-minute analysis was too variable to provide meaningful results along the study corridor. Therefore, a second version of the data set was obtained with speeds reported by 15-minute intervals (four speeds reported for each hour of the day for each segment).

Speed Data Analysis

Traffic and congestion on SR 1 varies depending on the time of year and day of the week. This analysis was focused on typical weekday peak period conditions, rather than weekends or holidays, since this is the time period when buses are most likely to perceive maximum and regular benefits from shoulder operations. Therefore, data were extracted for the midweek days (Tuesday, Wednesday, and Thursday).

The INRIX data were separated into sections by county. The Monterey County section covers approximately 28 miles between SR 68 in Monterey and Riverside Drive (SR 129) in Watsonville, with primary focus on the southern area between SR 68 and SR 156. The Santa Cruz County section is approximately 17 miles between Riverside Drive in Watsonville and River Street in Santa Cruz. These two sections were further subdivided by direction and evaluated for the morning (5 AM – 10 AM) and evening (3 PM – 7 PM) peak periods.

Determination of Representative Weekday Conditions

The total end-to-end corridor travel times for each county segment were calculated for each of the approximately 156 midweek days and compared. Travel times along the study corridor at various percentiles are reported in **Table 3-3** and **Figure 3-5** and **Figure 3-6.**

Table 3-3: Study Corridor Travel Times

Percentile of Days	Travel Times (minutes)			
	Northbound AM (5 AM – 10 AM)	Northbound PM (3 PM – 7 PM)	Southbound AM (5 AM – 10 AM)	Southbound PM (3 PM – 7 PM)
Monterey County – between SR 68 in Monterey and SR-156 in Castroville				
50th (median)	27.8	35.1	42.5	34.8
85th	28.4	41.8	49.9	45.8
90th	28.5	43.5	51.0	48.0
95th	28.7	47.0	55.8	53.3
99th	35.3	58.1	80.7	69.5
Santa Cruz County - between Riverside Drive in Watsonville and River Street in Santa Cruz				
50th (median)	37.6	19.7	17.5	45.2
85th	47.5	22.0	19.2	55.4
90th	49.5	22.8	19.8	60.1
95th	54.5	24.5	22.1	65.6
99th	85.1	55.8	33.0	80.8

Source: Kittelson & Associates based on INRIX data for all midweek days (Tuesday-Thursday) in 2016.

Figure 3-5: State Route 1 Travel Times for 2016 Weekdays – Monterey County

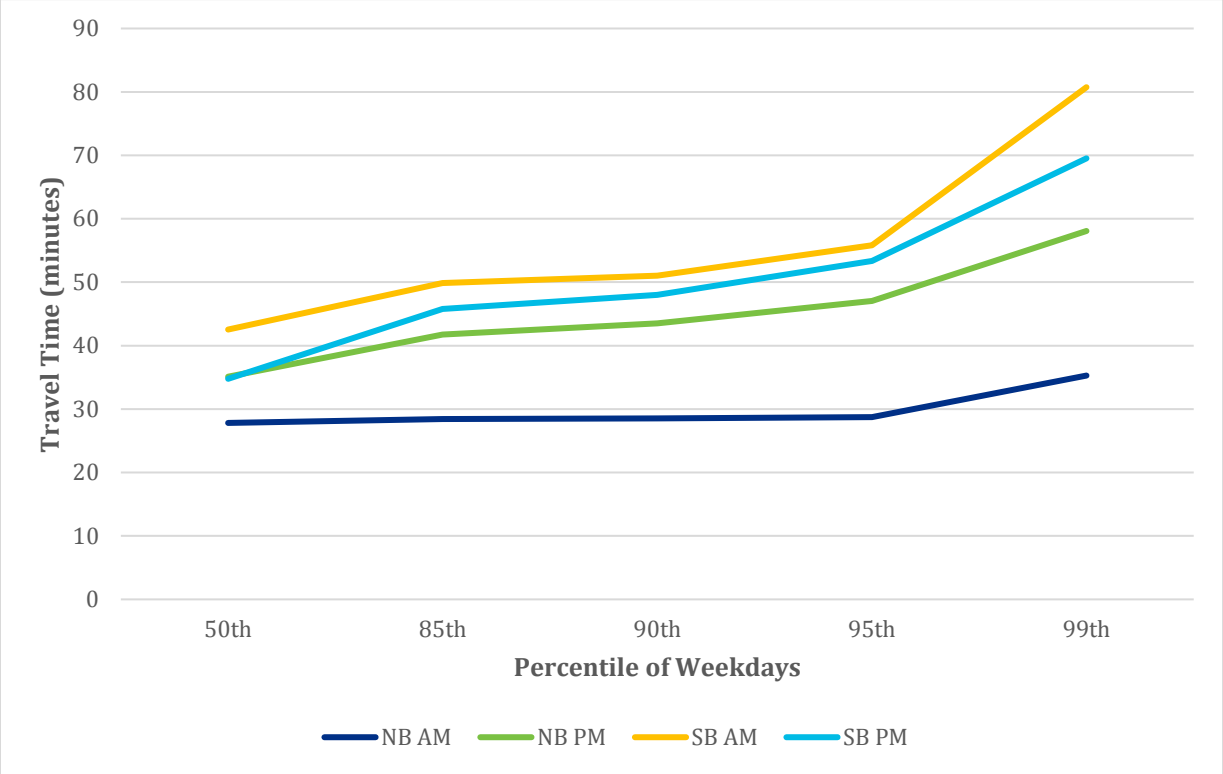
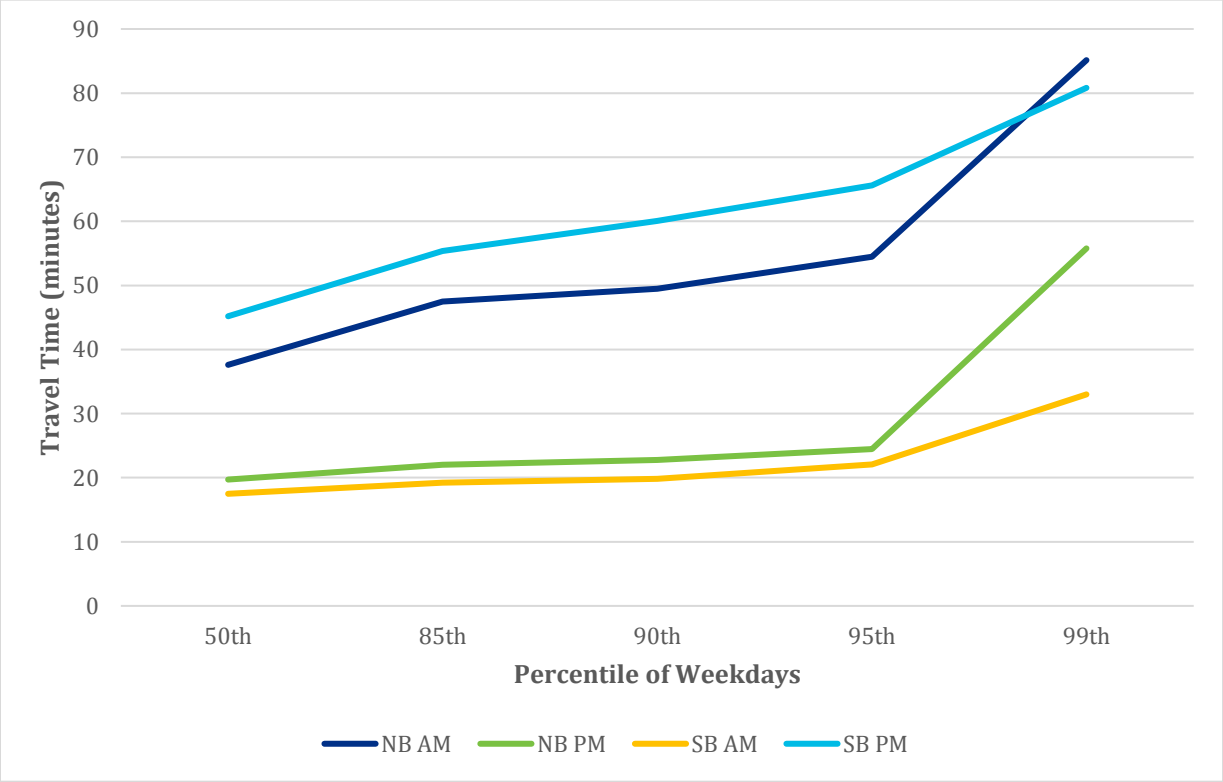


Figure 3-6: State Route 1 Travel Times for 2016 Weekdays – Santa Cruz County



The 50th percentile (median) condition provides a representation of average travel conditions, but does not completely describe the range of congestion that travelers experience along the study corridor. There is a large gap between the 95th and 99th percentile conditions, indicating that the 99th percentile likely includes a number of days with atypical incident conditions. The 95th percentile travel time was therefore selected as the representative condition to determine speed patterns for all but the worst days on the study corridor which presumably correspond to major incidents.

For each segment, peak period, and direction, the travel time and speed profiles were evaluated for several days that had travel times consistent with the 50th or 95th percentile corridor times. Data days occurring during summer months were not included in the evaluation. The most representative speed profiles were selected based on this comparison and evaluation. For the Monterey County section, the focus was on the congestion profiles in the southern area between SR 68 and SR 156.

Speed Contour Maps

Speed contour maps were prepared for each segment and 15-minute time period representing the 50th (median) and 95th percentile travel time day for each corridor and time period. The congestion and queues shown for the 95th percentile represent the typical maximum travel times over what is experienced on weekdays during the course of a year (all but the worst five percent of weekdays, which most likely include major incident conditions).

Speed profiles along the study area located in Monterey County are provided in **Table 3-4** through **Table 3-11**. A discussion on traffic operations along the study corridor located in Monterey County is provided below.

Northbound SR 1 in Monterey County

- **AM Peak Period** - While there was no significant congestion along northbound SR 1 on the 95th percentile travel time day during the AM peak period, there was minor congestion occurring near SR-68 and between Merritt Street and Salinas Road that lasted for the entire AM peak period.
- **PM Peak Period** - Three areas of congestion were observed along northbound SR 1 during the PM peak period. They include:
  - Minor congestion occurring around the SR-68 interchange that lasted the entire PM peak period;
  - Significant congestion that started around the SR 218 interchange at 3:30 PM and extended as far back as the SR-68 before dissipating at around 6:45 PM; and
  - Significant congestion between SR 156 and Salinas Road which lasted the entire PM peak period.

Southbound SR 1 in Monterey County

- **AM Peak Period** - Three areas of congestion were observed along southbound SR 1 during the AM peak period. They are as follows:
  - Light congestion between Struve Road and Dolan Road that lasted the entire AM peak period;
  - Minor congestion around SR-68 that extended as far as Soledad Drive and lasted the entire AM peak period; and
  - Significant congestion starting near SR 218 at 7:30 AM and lasted until at least 10 AM when it began to clear. At its peak (7:45 AM – 8:30 AM), this congestion extended to Reservation Road.
- **PM Peak Period** - Two areas of congestion were observed along southbound SR 1 during the PM peak period, including significant congestions:
  - Between Salinas Road and Merritt Street which lasted the entire PM peak period, but was the most critical starting around 5 PM, and
  - Near SR-68 which lasted the entire PM peak period.

Overall, for the portion of the study corridor located within Monterey County, traffic operations are worse along southbound SR 1 during the AM peak period and along northbound SR 1 during the PM peak period.

Table 3-4: Weekday 50th Percentile (Median) Speeds – Northbound AM (Monterey County)

Time	Capenter Street to SR-68	SR-68 to Munras Avenue	Munras Avenue to Soledad Drive	Soledad Drive to Aguajito Road	Aguajito Road to Sloat Avenue	Sloat Avenue to SR-68	SR-68 to Casa Verde Way	Casa Verde Way to Del Monte Avenue	Del Monte Avenue to SR-218	SR-218 to Fremont Boulevard	Fremont Boulevard to Lightfighter Drive	Lightfighter Drive to 1st Avenue	1st Avenue to Del Monte Boulevard	Del Monte Boulevard to Reservation Road	Reservation Road to Del Monte Boulevard	Del Monte Boulevard to Molera Road	Molera Road to SR-156	SR-156 to Merritt Street	Merritt Street to Doland Road	Doland Road to Struve Road	Struve Road to Salinas Road	Salinas Road to Trafton Road	Trafton Road to Riverside Drive
5:00	50	57	64	64	60	58	60	54	61	63	67	68	62	64	66	61	64	62	54	53	53	59	58
5:15	50	57	64	60	60	59	68	60	58	60	71	74	72	72	71	66	70	64	56	53	54	59	58
5:30	50	57	64	65	60	62	61	64	64	64	66	69	69	71	70	59	69	67	62	58	57	69	66
5:45	50	57	64	65	60	62	60	64	64	64	62	65	65	67	66	59	61	62	53	53	56	65	65
6:00	49	59	65	66	62	61	61	62	68	69	72	67	68	69	67	60	57	63	54	48	52	61	62
6:15	49	57	62	62	61	60	65	65	65	66	70	67	75	75	74	71	71	63	47	51	52	61	62
6:30	49	59	62	60	60	60	69	68	65	66	70	72	71	70	70	67	64	63	48	49	51	61	62
6:45	49	59	65	62	61	61	65	65	62	63	70	72	72	71	73	72	68	68	48	35	53	65	67
7:00	40	52	61	62	60	57	57	62	61	62	66	67	68	68	68	62	61	61	46	46	57	64	65
7:15	40	52	61	62	60	60	60	62	61	60	70	68	68	70	68	32	58	56	53	53	55	63	65
7:30	40	52	60	60	60	61	61	62	61	60	66	68	68	69	67	66	64	61	55	54	57	64	64
7:45	40	52	61	60	60	60	60	61	58	61	63	68	65	65	66	66	66	61	55	53	56	66	65
8:00	46	58	61	60	60	60	60	61	59	62	63	65	69	69	68	63	61	60	53	55	57	71	71
8:15	43	57	60	60	60	60	60	61	59	59	63	63	61	63	66	64	61	60	52	52	54	62	64
8:30	45	57	60	60	60	60	59	60	61	63	64	65	65	66	67	64	63	61	53	51	54	61	63
8:45	39	54	60	60	60	60	59	66	70	68	73	65	64	65	66	65	63	62	52	52	53	60	65
9:00	31	53	60	59	60	60	65	66	65	71	67	73	72	72	69	64	62	49	48	50	53	61	62
9:15	56	56	60	60	60	60	64	64	64	70	70	68	67	70	70	67	64	51	51	55	56	64	63
9:30	30	56	60	60	60	58	61	57	62	65	65	67	66	67	71	68	66	58	54	53	57	65	63
9:45	41	53	59	60	59	57	57	50	59	64	63	64	66	64	64	65	64	60	53	53	54	66	65
10:00	46	57	60	60	60	59	60	60	59	66	70	72	69	71	68	70	71	56	51	54	56	67	67

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-5: Weekday 95th Percentile Speeds – Northbound AM (Monterey County)

Time	Capenter Street to SR-68	SR-68 to Munras Avenue	Munras Avenue to Soledad Drive	Soledad Drive to Aguajito Road	Aguajito Road to Sloat Avenue	Sloat Avenue to SR-68	SR-68 to Casa Verde Way	Casa Verde Way to Del Monte Avenue	Del Monte Avenue to SR-218	SR-218 to Fremont Boulevard	Fremont Boulevard to Lightfighter Drive	Lightfighter Drive to 1st Avenue	1st Avenue to Del Monte Boulevard	Del Monte Boulevard to Reservation Road	Reservation Road to Del Monte Boulevard	Del Monte Boulevard to Molera Road	Molera Road to SR-156	SR-156 to Merritt Street	Merritt Street to Doland Road	Doland Road to Struve Road	Struve Road to Salinas Road	Salinas Road to Trafton Road	Trafton Road to Riverside Drive
5:00	50	54	60	60	60	60	64	68	67	66	64	65	63	63	61	58	61	59	54	54	54	63	68
5:15	51	54	59	59	59	60	61	63	63	64	64	65	63	63	61	62	62	59	54	54	54	62	54
5:30	51	54	59	59	59	60	61	63	62	63	63	66	61	63	64	63	61	58	53	54	54	59	60
5:45	51	54	59	59	59	60	61	63	62	59	61	64	60	64	64	64	62	53	49	53	54	62	65
6:00	47	53	62	63	63	60	65	63	64	62	59	61	59	61	64	62	63	64	52	53	54	62	64
6:15	47	55	61	61	61	60	66	65	65	65	67	66	64	65	71	67	61	61	51	51	51	65	65
6:30	47	55	61	61	60	61	68	67	66	63	55	67	68	69	66	66	71	66	46	36	46	61	61
6:45	47	53	62	63	62	65	65	65	64	65	37	62	61	64	64	63	62	64	22	25	43	61	64
7:00	44	57	64	65	64	64	64	72	71	70	56	69	69	69	67	64	62	61	23	32	46	62	65
7:15	44	57	64	65	64	64	64	72	75	69	67	72	71	69	68	71	73	60	45	47	54	63	64
7:30	44	55	64	65	64	64	64	70	74	67	65	67	69	70	67	69	64	62	57	54	55	63	64
7:45	45	54	64	61	60	61	65	67	67	69	71	64	61	62	62	63	58	67	54	54	52	61	63
8:00	40	51	61	59	55	58	59	56	59	59	62	64	67	68	67	68	58	66	53	53	54	62	64
8:15	41	50	57	57	55	51	54	58	64	63	61	64	64	64	62	63	61	65	54	52	54	62	64
8:30	47	56	60	60	60	60	71	66	67	67	66	65	64	65	64	63	61	57	54	52	55	62	64
8:45	45	55	60	60	59	61	62	65	62	65	64	66	65	66	65	64	68	59	53	54	56	63	65
9:00	45	57	60	60	60	60	59	65	62	67	63	63	61	61	61	62	60	54	53	53	54	60	61
9:15	42	50	56	57	57	57	58	59	57	61	62	64	62	66	65	61	61	60	51	52	55	60	59
9:30	45	57	59	59	60	58	61	60	60	61	63	64	63	65	65	63	64	53	52	53	56	66	68
9:45	46	56	60	60	60	53	61	61	58	61	64	66	64	66	67	68	67	55	53	54	56	64	66
10:00	42	54	60	60	60	60	63	62	62	64	64	67	62	63	63	66	66	46	54	55	57	62	65

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-6: Weekday 50th Percentile (Median) Speeds – Northbound PM (Monterey County)

Time	Capenter Street to SR-68	SR-68 to Munras Avenue	Munras Avenue to Soledad Drive	Soledad Drive to Aguajito Road	Aguajito Road to Sloat Avenue	Sloat Avenue to SR-68	SR-68 to Casa Verde Way	Casa Verde Way to Del Monte Avenue	Del Monte Avenue to SR-218	SR-218 to Fremont Boulevard	Fremont Boulevard to Lightfighter Drive	Lightfighter Drive to 1st Avenue	1st Avenue to Del Monte Boulevard	Del Monte Boulevard to Reservation Road	Reservation Road to Del Monte Boulevard	Del Monte Boulevard to Molera Road	Molera Road to SR-156	SR-156 to Merritt Street	Merritt Street to Doland Road	Doland Road to Struve Road	Struve Road to Salinas Road	Salinas Road to Trafton Road	Trafton Road to Riverside Drive
15:00	37	52	58	60	56	59	61	62	60	62	65	68	70	69	69	67	64	50	41	52	52	59	61
15:15	44	54	58	59	56	58	61	59	52	57	62	61	62	66	66	61	63	56	40	51	52	60	61
15:30	40	56	59	59	58	58	58	62	61	62	65	63	65	66	65	63	62	57	47	51	53	62	61
15:45	38	54	60	59	59	60	62	57	43	53	65	68	66	68	65	63	62	57	49	49	50	59	61
16:00	42	57	60	60	57	50	43	29	18	44	65	64	64	67	66	64	64	33	44	52	52	60	65
16:15	38	54	60	50	19	17	16	13	19	41	65	69	72	66	66	64	61	19	46	45	47	61	64
16:30	41	51	39	22	17	19	17	14	23	44	67	69	68	69	67	65	61	19	42	33	46	63	64
16:45	42	53	41	25	17	16	15	14	16	46	65	66	67	70	70	68	63	25	31	26	38	63	64
17:00	40	57	54	34	17	16	13	13	16	46	64	65	64	68	68	63	63	54	21	21	40	67	73
17:15	45	55	60	43	17	17	14	11	13	47	67	67	64	68	70	68	66	43	18	35	35	66	69
17:30	43	54	60	56	16	14	14	13	15	43	68	68	69	69	70	67	64	36	22	33	35	65	66
17:45	42	51	60	58	52	22	21	17	18	41	66	68	70	68	70	66	66	57	26	28	38	65	66
18:00	34	56	60	59	58	32	27	31	27	45	65	69	70	68	71	68	65	39	32	25	39	65	67
18:15	43	53	60	57	56	47	48	68	66	60	67	71	70	70	66	65	69	37	40	40	39	62	65
18:30	41	57	60	59	59	59	65	65	66	65	70	69	70	72	69	65	65	36	37	44	41	63	61
18:45	40	53	59	58	50	48	54	59	56	66	71	67	63	63	66	66	69	51	56	53	53	70	67
19:00	42	53	62	61	56	60	65	63	65	71	69	72	70	73	71	69	69	58	53	55	54	70	73

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-7: Weekday 95th Percentile Speeds – Northbound PM (Monterey County)

Time	Capenter Street to SR-68	SR-68 to Munras Avenue	Munras Avenue to Soledad Drive	Soledad Drive to Aguajito Road	Aguajito Road to Sloat Avenue	Sloat Avenue to SR-68	SR-68 to Casa Verde Way	Casa Verde Way to Del Monte Avenue	Del Monte Avenue to SR-218	SR-218 to Fremont Boulevard	Fremont Boulevard to Lightfighter Drive	Lightfighter Drive to 1st Avenue	1st Avenue to Del Monte Boulevard	Del Monte Boulevard to Reservation Road	Reservation Road to Del Monte Boulevard	Del Monte Boulevard to Molera Road	Molera Road to SR-156	SR-156 to Merritt Street	Merritt Street to Doland Road	Doland Road to Struve Road	Struve Road to Salinas Road	Salinas Road to Trafton Road	Trafton Road to Riverside Drive
15:00	43	55	60	60	54	52	65	48	49	57	66	66	65	67	69	65	62	40	46	24	45	63	63
15:15	41	55	60	60	57	57	57	52	37	54	63	66	65	67	67	67	61	40	45	18	41	63	63
15:30	37	53	60	59	47	48	45	20	16	42	63	65	62	64	65	64	62	40	24	16	44	61	62
15:45	42	57	58	40	17	17	16	14	14	43	65	65	65	67	66	62	63	40	20	19	48	70	65
16:00	39	54	20	18	13	14	11	14	15	44	64	64	66	67	66	63	64	15	19	28	48	63	65
16:15	37	36	22	14	15	10	10	9	11	38	64	65	65	67	67	70	71	17	23	27	50	60	62
16:30	23	13	9	16	17	16	13	11	15	44	64	68	67	72	69	65	63	11	25	30	49	62	62
16:45	26	17	9	14	22	10	10	12	17	42	65	67	68	69	67	65	65	8	17	32	49	62	64
17:00	35	21	7	12	12	13	12	10	13	41	62	67	67	68	66	63	71	19	20	23	52	66	65
17:15	28	17	10	11	21	19	18	12	12	41	63	67	64	68	64	62	65	18	26	24	49	65	67
17:30	31	17	6	20	16	15	20	14	17	46	65	70	65	68	68	62	64	11	19	26	50	71	67
17:45	38	25	10	15	17	18	15	20	17	42	64	68	67	68	68	66	67	9	16	32	51	64	65
18:00	42	48	15	23	18	20	19	15	15	47	65	69	63	64	72	66	61	9	18	32	51	68	67
18:15	43	54	60	54	30	16	13	18	18	43	65	66	68	72	70	68	63	27	21	29	52	71	73
18:30	44	56	60	60	46	24	17	19	20	44	62	66	65	70	68	65	62	44	28	36	45	69	64
18:45	46	57	60	60	57	55	63	64	59	61	62	65	63	66	63	64	62	58	31	27	52	64	63
19:00	37	57	60	60	55	59	57	59	60	60	66	66	61	67	68	68	68	59	51	46	53	62	64

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-8: Weekday 50th Percentile (Median) Speeds – Southbound AM (Monterey County)

Time	Harkins Slough Road to Riverside Drive	Riverside Drive to Salinas Road	Salinas Road to Struve Road	Struve Road to Doland Road	Doland Road to Merritt Street	Merritt Street to SR-156	SR-156 to Molera Road	Molera Road to Del Monte Boulevard	Del Monte Boulevard to Reservation Road	Reservation Road to Del Monte Boulevard	Del Monte Boulevard to 1st Avenue	1st Avenue to Lightfighter Drive	Lightfighter Drive to Fremont Boulevard	Fremont Boulevard to SR-218	SR-218 to Del Monte Avenue	Del Monte Avenue to Casa Verde Way	Casa Verde Way to SR-68	SR-68 to Sloat Avenue	Sloat Avenue to Aguajito Road	Aguajito Road to Soledad Drive	Soledad Drive to Munras Avenue	Munras Avenue to SR-68	SR-68 to Carpenter Street
5:00	62	57	55	52	51	58	66	62	61	61	62	58	60	60	59	62	63	57	59	54	50	45	47
5:15	64	56	60	54	49	54	62	60	62	62	60	58	59	58	56	62	63	56	58	54	46	45	47
5:30	66	55	60	52	55	63	68	67	65	64	60	62	74	61	56	59	59	53	56	53	46	44	42
5:45	64	55	55	51	52	58	68	68	70	70	71	74	75	69	68	63	64	56	58	54	50	45	44
6:00	66	60	56	52	52	55	66	63	62	61	60	61	64	62	63	62	60	55	59	58	57	49	45
6:15	71	62	57	56	55	55	64	65	62	61	62	60	61	61	56	61	59	56	58	58	59	52	45
6:30	65	59	49	53	52	55	63	65	64	61	64	63	66	63	60	61	61	56	57	57	53	46	45
6:45	65	62	42	52	52	55	64	64	64	63	64	64	64	62	60	66	67	59	59	58	58	51	50
7:00	68	63	43	50	52	56	66	65	66	64	66	69	69	66	65	66	67	59	60	60	60	49	46
7:15	68	62	51	52	52	55	67	63	65	63	64	53	51	53	61	61	62	56	59	59	57	51	42
7:30	72	69	55	51	38	56	64	67	68	52	23	26	27	51	54	57	60	54	59	57	55	47	36
7:45	65	67	59	53	33	55	68	69	69	56	28	33	27	37	53	47	39	50	56	56	55	48	29
8:00	68	62	54	52	44	55	64	65	66	67	70	49	23	42	50	37	28	47	53	53	52	47	33
8:15	63	60	54	52	45	57	64	63	67	67	65	63	47	41	50	43	48	41	38	46	53	48	35
8:30	65	63	55	53	46	56	61	62	66	66	63	63	55	45	55	57	48	55	56	50	53	45	34
8:45	63	63	55	50	49	53	64	66	65	63	65	67	63	60	61	59	57	53	58	54	52	48	31
9:00	67	62	55	52	49	51	68	69	69	69	66	66	66	63	60	61	61	56	60	60	57	51	31
9:15	64	59	52	57	50	56	68	69	71	70	67	67	66	65	64	62	62	56	60	59	52	50	43
9:30	60	59	52	53	51	55	64	64	65	66	64	66	64	67	64	67	67	56	59	59	58	52	41
9:45	60	60	55	51	50	55	64	63	62	64	66	62	67	67	57	60	61	56	60	57	57	49	41
10:00	65	62	56	51	51	54	65	65	65	65	65	65	66	66	59	62	62	56	59	56	55	52	42

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-9: Weekday 95th Percentile Speeds – Southbound AM (Monterey County)

Time	Harkins Slough Road to Riverside Drive	Riverside Drive to Salinas Road	Salinas Road to Struve Road	Struve Road to Doland Road	Doland Road to Merritt Street	Merritt Street to SR-156	SR-156 to Molera Road	Molera Road to Del Monte Boulevard	Del Monte Boulevard to Reservation Road	Reservation Road to Del Monte Boulevard	Del Monte Boulevard to 1st Avenue	1st Avenue to Lightfighter Drive	Lightfighter Drive to Fremont Boulevard	Fremont Boulevard to SR-218	SR-218 to Del Monte Avenue	Del Monte Avenue to Casa Verde Way	Casa Verde Way to SR-68	SR-68 to Sloat Avenue	Sloat Avenue to Aguajito Road	Aguajito Road to Soledad Drive	Soledad Drive to Munras Avenue	Munras Avenue to SR-68	SR-68 to Carpenter Street
5:00	65	59	59	54	53	56	60	59	61	61	57	62	64	60	59	60	60	57	60	56	52	46	46
5:15	64	49	64	63	53	57	62	64	64	62	61	60	60	60	59	60	60	55	58	56	52	47	45
5:30	60	58	59	56	56	59	64	65	67	65	66	65	65	64	62	65	62	57	60	60	55	55	52
5:45	63	57	57	53	54	57	61	62	64	64	65	65	63	62	62	60	60	54	59	57	54	54	54
6:00	61	58	55	52	53	59	64	62	63	63	62	61	56	58	58	59	59	55	59	56	54	48	45
6:15	64	59	60	55	54	56	62	62	61	64	60	68	66	63	62	62	62	56	59	56	53	43	43
6:30	68	59	57	56	54	58	64	64	64	64	62	63	61	66	64	66	66	57	59	58	56	49	49
6:45	65	59	55	53	55	58	64	63	65	66	67	65	62	61	58	59	59	55	58	56	53	48	47
7:00	63	57	54	51	52	57	61	61	62	62	62	64	66	63	58	71	62	57	60	58	53	48	43
7:15	66	59	49	50	52	56	63	61	62	60	50	46	37	37	51	58	59	57	59	59	56	50	43
7:30	63	63	41	51	51	57	63	62	59	28	17	18	17	29	49	62	62	54	58	58	58	52	43
7:45	63	61	50	51	51	57	66	67	60	15	11	12	16	27	48	56	50	52	56	59	59	50	43
8:00	67	68	57	51	53	58	65	64	61	12	8	12	15	23	46	56	54	53	56	56	55	46	44
8:15	63	59	55	52	52	59	64	63	61	16	12	13	16	26	49	59	62	55	59	58	57	50	49
8:30	69	66	54	52	51	56	60	62	62	21	9	13	17	30	51	61	60	55	60	58	57	49	48
8:45	65	60	54	49	50	60	65	62	61	20	17	15	15	28	51	56	58	54	59	59	60	53	52
9:00	64	61	56	52	51	58	67	64	64	38	17	15	17	27	52	62	60	53	58	58	59	46	43
9:15	63	60	55	50	52	57	63	64	65	66	44	21	17	27	47	58	59	55	58	57	55	46	40
9:30	59	58	56	52	52	56	65	65	67	66	63	36	20	37	50	56	57	43	56	58	57	51	45
9:45	61	63	54	50	51	56	67	66	66	69	46	62	34	27	47	60	58	53	58	58	55	48	44
10:00	61	64	56	52	51	56	66	66	66	71	73	71	60	39	53	62	59	54	58	58	57	51	48

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-10: Weekday 50th Percentile (Median) Speeds – Southbound PM (Monterey County)

Time	Harkins Slough Road to Riverside Drive	Riverside Drive to Salinas Road	Salinas Road to Struve Road	Struve Road to Doland Road	Doland Road to Merritt Street	Merritt Street to SR-156	SR-156 to Molera Road	Molera Road to Del Monte Boulevard	Del Monte Boulevard to Reservation Road	Reservation Road to Del Monte Boulevard	Del Monte Boulevard to 1st Avenue	1st Avenue to Lightfighter Drive	Lightfighter Drive to Fremont Boulevard	Fremont Boulevard to SR-218	SR-218 to Del Monte Avenue	Del Monte Avenue to Casa Verde Way	Casa Verde Way to SR-68	CA-68 On-Ramp to CA-68 Off-Ramp	Sloat Avenue to Aguajito Road	Aguajito Road to Soledad Drive	Soledad Drive to Munras Avenue	Munras Avenue to SR-68	SR-68 to Carpenter Street
15:00	65	66	57	55	52	56	68	72	73	72	72	71	68	64	67	69	65	63	60	59	59	47	44
15:15	62	62	55	50	51	57	67	68	68	71	70	72	68	68	61	63	63	63	59	59	59	50	35
15:30	65	64	56	51	49	55	63	66	67	68	64	66	64	62	57	62	63	63	59	58	53	52	33
15:45	69	70	55	51	51	53	63	66	69	65	69	64	67	60	52	63	62	61	59	58	56	52	32
16:00	70	72	59	51	45	55	65	66	64	68	68	68	71	72	63	67	65	64	60	58	57	50	24
16:15	66	67	55	42	49	55	69	64	67	66	68	69	70	69	62	63	62	60	60	58	58	51	33
16:30	66	65	38	32	49	55	67	67	64	65	67	68	68	71	67	67	66	64	60	58	59	49	30
16:45	68	65	24	37	50	56	69	67	69	69	70	73	70	70	69	67	63	62	60	60	60	52	37
17:00	63	60	26	46	48	58	71	69	69	70	70	72	71	67	70	69	69	65	60	58	58	49	38
17:15	74	67	23	39	50	59	67	66	65	68	70	68	66	65	59	62	61	61	59	60	60	36	47
17:30	64	64	21	37	51	57	65	64	65	69	67	66	65	66	67	68	58	56	57	57	59	21	36
17:45	65	64	22	27	52	57	70	67	68	65	62	65	68	66	64	62	63	62	61	60	58	44	48
18:00	65	72	23	29	52	58	68	70	73	72	75	74	69	71	68	64	62	63	61	60	60	54	47
18:15	65	65	35	43	52	63	73	67	69	68	67	69	67	69	64	69	69	69	60	60	60	56	51
18:30	69	53	57	55	48	63	72	70	71	69	67	68	66	61	57	64	65	65	60	60	60	54	46
18:45	63	64	49	51	38	59	71	70	72	74	65	69	70	59	55	58	61	61	59	59	59	53	42
19:00	64	64	46	52	32	53	65	65	66	73	54	62	61	62	60	62	63	62	62	59	60	54	48

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-11: Weekday 95th Percentile Speeds – Southbound PM (Monterey County)

Time	Harkins Slough Road to Riverside Drive	Riverside Drive to Salinas Road	Salinas Road to Struve Road	Struve Road to Doland Road	Doland Road to Merritt Street	Merritt Street to SR-156	SR-156 to Molera Road	Molera Road to Del Monte Boulevard	Del Monte Boulevard to Reservation Road	Reservation Road to Del Monte Boulevard	Del Monte Boulevard to 1st Avenue	1st Avenue to Lightfighter Drive	Lightfighter Drive to Fremont Boulevard	Fremont Boulevard to SR-218	SR-218 to Del Monte Avenue	Del Monte Avenue to Casa Verde Way	Casa Verde Way to SR-68	SR-68 to Sloat Avenue	Sloat Avenue to Aguajito Road	Aguajito Road to Soledad Drive	Soledad Drive to Munras Avenue	Munras Avenue to SR-68	SR-68 to Carpenter Street
15:00	69	64	51	42	49	56	64	66	70	73	67	67	70	70	62	56	57	58	60	60	59	47	29
15:15	66	66	51	47	48	54	69	66	69	69	71	68	67	60	57	65	60	55	59	59	59	52	33
15:30	66	66	51	49	43	54	61	60	62	61	62	63	62	62	58	60	60	54	57	57	57	50	28
15:45	64	69	42	43	46	55	70	70	71	69	63	65	66	62	57	62	62	55	59	57	57	48	36
16:00	65	68	47	38	50	55	65	67	72	73	70	73	69	65	65	69	70	58	59	59	59	57	38
16:15	68	72	54	46	46	54	67	65	67	67	65	67	69	68	65	60	70	60	60	60	56	57	45
16:30	69	70	57	42	50	57	68	65	66	67	63	65	67	64	60	67	69	57	60	57	58	56	43
16:45	69	65	49	41	50	58	68	67	69	67	68	70	67	66	54	63	64	60	60	58	58	53	25
17:00	67	61	35	31	47	53	66	66	68	69	69	70	72	65	61	65	66	58	60	59	59	54	39
17:15	68	69	20	27	47	51	70	65	66	66	66	67	68	61	52	61	57	55	56	59	60	40	39
17:30	69	68	9	22	47	54	67	65	67	69	66	68	69	56	55	61	61	54	58	57	58	47	31
17:45	72	72	7	17	39	50	71	72	73	74	72	72	69	66	54	60	59	54	53	57	59	31	37
18:00	69	70	7	25	34	50	65	63	65	68	72	70	72	69	60	68	68	57	60	60	59	16	45
18:15	66	67	10	30	36	52	64	63	66	66	65	70	69	66	63	65	66	58	60	60	61	41	50
18:30	67	63	15	26	47	54	72	70	72	68	68	72	74	68	64	65	65	51	61	60	60	59	45
18:45	68	63	12	25	44	56	71	68	68	67	65	66	66	63	62	66	67	59	60	60	59	56	45
19:00	60	64	22	26	49	55	74	74	71	69	71	68	70	72	66	68	71	60	60	60	60	59	53

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Speed profiles along the study area located in Santa Cruz County are provided in **Table 3-12** through **Table 3-19**. A discussion on traffic operations along the study corridor located in Santa Cruz County is provided below.

Santa Cruz County Northbound

- **AM Peak Period** - Traffic congestion was observed along northbound SR 1 at the following locations in Santa Cruz County:
  - Near SR 17 that started before 5 AM and ended after 10 AM; and
  - Between Mar Monte Avenue and 41st Avenue starting around 7 AM and extending past 10 AM.
- **PM Peak Period** - Similar to the AM peak period, traffic congestion was observed along northbound SR 1 during the PM peak period near SR 17 for the entire analysis period (3 PM – 7 PM). Additionally, minor congestion was observed from Mar Monte Avenue to SR 17 between about 4:45 PM and 6 PM, with the worst congestion between Larkin Valley Road and Rio Del Mar Boulevard (from 5 PM to 6 PM).

Santa Cruz County Southbound

- **AM Peak Period** - During a typical weekday, congestion was observed along southbound SR 1 located in Santa Cruz County during the AM peak period at the following locations:
  - Near SR 17 that lasted for the entire duration of the AM peak period; and
  - Between Morrissey Boulevard and Bay Avenue from 7:45 AM to 9:30 AM.

PM Peak Period

During the PM peak period, congestion was observed along southbound SR 1 near SR 17. Additionally, significant congestion was observed between SR 17 and Rio Del Mar Boulevard that began before 3 PM and ended after 7 PM.

Overall, for the portion of the study corridor located within Santa Cruz County, traffic operations are worse along northbound SR 1 during the AM peak period and along southbound SR 1 during the PM peak period.

Table 3-12: Weekday 50th Percentile (Median) Speeds – Northbound AM (Santa Cruz County)

Time	Riverside Drive to Harkins Slough Road	Harkins Slough Road to SR-152	SR-152 to Airport Boulevard	Airport Boulevard to Buena Vista Drive	Buena Vista Drive to La Selva Drive	La Selva Drive to Larkin Valley Road	Larkin Valley Road to Freedom Boulevard	Freedom Boulevard to Rio Del Mar Boulevard	Rio Del Mar Boulevard to State Park Drive	State Park Drive to Park Avenue	Park Avenue to Bay Avenue	Bay Avenue to 41st Avenue	41st Avenue to Commercial Way	Commercial Way to Morrissey Boulevard	Morrissey Boulevard to Emeline Avenue	Emeline Avenue to SR-17	SR-17 to River Street
5:00	58	57	56	53	53	55	55	56	55	56	56	53	55	59	59	46	45
5:15	62	64	63	62	63	65	64	64	62	60	59	57	59	61	60	46	42
5:30	61	63	60	59	60	63	63	63	64	67	71	72	68	72	67	46	39
5:45	62	64	62	63	67	65	65	66	64	61	62	60	59	65	66	44	44
6:00	59	60	56	55	58	60	63	64	64	69	69	68	67	66	60	48	34
6:15	62	62	60	62	63	63	65	62	63	63	60	60	58	61	56	47	37
6:30	70	70	67	68	65	63	62	61	61	60	58	58	57	61	53	45	32
6:45	61	63	61	63	57	59	57	38	53	58	58	55	52	62	58	46	29
7:00	64	64	60	68	56	22	31	31	52	59	57	45	42	57	59	44	36
7:15	69	68	60	68	37	16	18	34	57	60	58	59	59	64	61	45	31
7:30	70	66	64	68	48	10	14	26	53	55	45	36	40	58	56	41	26
7:45	66	65	62	70	69	14	13	21	40	30	18	20	37	56	56	39	23
8:00	66	67	64	66	66	33	9	11	18	22	20	24	37	58	58	38	13
8:15	68	69	69	70	68	34	9	13	21	21	24	24	36	59	57	39	13
8:30	67	67	63	64	64	44	15	17	19	19	23	24	37	58	56	34	16
8:45	64	65	61	60	62	49	12	17	19	22	30	27	37	61	57	42	25
9:00	67	67	66	71	66	63	11	17	24	31	28	29	33	56	55	41	28
9:15	64	66	64	71	70	65	37	22	33	39	40	48	49	57	56	36	32
9:30	67	69	66	71	68	68	68	48	44	51	44	51	46	59	57	39	35
9:45	73	73	68	71	67	67	67	67	51	40	38	38	39	56	55	31	31
10:00	67	69	63	68	69	66	68	63	61	62	45	50	46	57	58	30	22

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-13: Weekday 95th Percentile Speeds – Northbound AM (Santa Cruz County)

Time	Riverside Drive to Harkins Slough Road	Harkins Slough Road to SR-152	SR-152 to Airport Boulevard	Airport Boulevard to Buena Vista Drive	Buena Vista Drive to La Selva Drive	La Selva Drive to Larkin Valley Road	Larkin Valley Road to Freedom Boulevard	Freedom Boulevard to Rio Del Mar Boulevard	Rio Del Mar Boulevard to State Park Drive	State Park Drive to Park Avenue	Park Avenue to Bay Avenue	Bay Avenue to 41st Avenue	41st Avenue to Commercial Way	Commercial Way to Morrissey Boulevard	Morrissey Boulevard to Emeline Avenue	Emeline Avenue to SR-17	SR-17 to River Street
5:00	61	63	60	61	61	60	60	60	58	58	59	56	55	56	57	40	39
5:15	58	61	58	60	61	65	65	64	65	64	65	62	63	63	60	40	38
5:30	61	62	59	60	59	60	60	60	61	60	64	62	61	68	66	40	38
5:45	60	62	60	61	60	62	62	62	63	63	63	61	64	65	68	42	31
6:00	62	62	60	61	62	60	65	64	62	64	63	58	59	66	44	42	32
6:15	62	63	60	59	59	61	62	63	62	62	64	62	63	65	20	41	43
6:30	63	65	62	60	60	60	60	57	58	58	58	57	60	62	26	42	38
6:45	60	63	59	60	54	42	53	51	46	55	55	55	56	58	55	42	36
7:00	60	63	62	66	29	26	30	25	29	56	59	58	58	62	62	46	37
7:15	62	65	68	67	18	12	15	22	29	51	60	59	57	60	60	46	41
7:30	67	66	63	64	19	8	11	18	27	35	55	54	55	57	61	44	29
7:45	68	69	66	69	27	6	8	14	22	39	50	42	47	63	61	39	21
8:00	65	68	66	68	61	7	8	15	23	24	23	22	36	62	57	42	19
8:15	61	71	65	66	66	10	10	12	17	18	21	23	34	61	59	45	14
8:30	67	68	62	70	68	8	7	12	16	17	21	20	32	56	57	44	13
8:45	68	65	63	66	65	8	9	12	19	20	22	23	32	56	57	40	15
9:00	68	69	65	71	54	10	10	16	25	26	24	25	35	59	62	42	18
9:15	61	63	59	63	60	13	12	22	34	27	31	34	38	59	64	41	24
9:30	65	68	65	65	64	19	15	20	29	27	28	27	36	62	64	39	34
9:45	67	67	67	64	65	38	14	15	17	28	33	23	36	63	61	41	37
10:00	65	67	63	66	65	53	13	17	22	37	32	23	36	58	57	43	30

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-14: Weekday 50th Percentile (Median) Speeds – Northbound PM (Santa Cruz County)

Time	Riverside Drive to Harkins Slough Road	Harkins Slough Road to SR-152	SR-152 to Airport Boulevard	Airport Boulevard to Buena Vista Drive	Buena Vista Drive to La Selva Drive	La Selva Drive to Larkin Valley Road	Larkin Valley Road to Freedom Boulevard	Freedom Boulevard to Rio Del Mar Boulevard	Rio Del Mar Boulevard to State Park Drive	State Park Drive to Park Avenue	Park Avenue to Bay Avenue	Bay Avenue to 41st Avenue	41st Avenue to Commercial Way	Commercial Way to Morrissey Boulevard	Morrissey Boulevard to Emeline Avenue	Emeline Avenue to SR-17	SR-17 to River Street
15:00	64	65	62	65	67	65	64	63	61	63	68	60	58	62	56	40	23
15:15	66	67	63	67	67	66	64	67	64	68	62	57	56	59	59	45	22
15:30	65	66	59	65	67	67	64	63	62	63	60	60	58	62	60	44	24
15:45	62	62	58	60	60	62	62	61	60	60	61	58	59	61	61	45	37
16:00	62	68	65	64	64	63	63	62	62	60	60	55	55	61	58	44	21
16:15	61	64	59	61	65	64	67	64	63	64	66	60	59	63	62	42	35
16:30	64	64	60	63	64	64	66	65	63	63	58	57	58	61	60	43	27
16:45	66	67	65	67	66	67	69	66	63	64	58	57	55	63	58	45	39
17:00	64	65	61	65	65	65	64	61	60	59	55	54	55	59	56	43	32
17:15	65	68	59	64	63	68	64	62	61	61	47	47	49	56	55	39	11
17:30	66	67	62	64	64	59	60	58	57	48	32	46	47	53	55	26	11
17:45	65	67	62	69	66	67	66	64	63	56	53	55	55	57	54	41	20
18:00	62	64	61	65	64	64	61	61	61	56	43	55	55	57	55	41	25
18:15	65	67	63	65	65	62	62	61	61	60	56	56	56	57	55	41	35
18:30	72	75	70	69	67	69	69	64	59	60	56	54	60	66	58	41	36
18:45	69	71	68	67	67	72	71	65	61	60	62	61	60	64	61	41	34
19:00	65	66	64	61	64	63	70	68	65	63	65	62	59	63	58	45	40

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-15: Weekday 95th Percentile Speeds – Northbound PM (Santa Cruz County)

Time	Riverside Drive to Harkins Slough Road	Harkins Slough Road to SR-152	SR-152 to Airport Boulevard	Airport Boulevard to Buena Vista Drive	Buena Vista Drive to La Selva Drive	La Selva Drive to Larkin Valley Road	Larkin Valley Road to Freedom Boulevard	Freedom Boulevard to Rio Del Mar Boulevard	Rio Del Mar Boulevard to State Park Drive	State Park Drive to Park Avenue	Park Avenue to Bay Avenue	Bay Avenue to 41st Avenue	41st Avenue to Commercial Way	Commercial Way to Morrissey Boulevard	Morrissey Boulevard to Emeline Avenue	Emeline Avenue to SR-17	SR-17 to River Street
15:00	67	67	64	66	68	65	64	65	59	59	56	55	53	58	57	41	20
15:15	68	67	61	63	63	61	60	61	60	59	48	52	54	55	54	39	13
15:30	63	61	62	63	63	62	61	59	60	57	38	48	52	58	54	41	11
15:45	64	64	61	64	64	60	63	57	58	58	52	47	50	57	55	27	12
16:00	61	64	61	62	61	56	61	60	58	58	58	56	56	59	57	32	18
16:15	62	64	60	63	62	55	60	60	59	59	57	55	56	60	56	42	19
16:30	65	66	63	61	64	65	66	62	59	60	60	59	56	58	57	36	24
16:45	62	65	63	64	65	67	65	40	52	58	54	55	53	55	53	38	21
17:00	64	63	60	63	63	59	44	37	45	54	50	56	46	55	50	36	20
17:15	63	63	60	61	61	57	47	30	38	48	39	54	52	52	48	36	20
17:30	63	62	57	62	60	40	27	34	48	46	32	51	51	53	49	36	14
17:45	61	63	58	65	57	55	34	35	45	49	32	51	50	54	54	39	18
18:00	62	64	61	62	61	59	51	47	46	56	38	44	47	56	56	39	25
18:15	62	65	65	63	64	59	63	61	60	61	59	56	57	57	56	40	34
18:30	62	63	59	60	61	64	61	57	55	59	58	51	52	54	56	39	35
18:45	62	63	62	63	61	58	58	55	55	55	55	51	56	55	56	40	33
19:00	63	64	63	64	66	61	61	59	58	55	56	44	48	53	56	44	35

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-16: Weekday 50th Percentile (Median) Speeds – Southbound AM (Santa Cruz County)

Time	River Street to SR-17	SR-17 to Morrissey Boulevard	Morrissey Boulevard to Soquel Drive	Soquel Drive to 41st Avenue	41st Avenue to Bay Avenue	Bay Avenue to Park Avenue	Park Avenue to State Park Drive	State Park Drive to Rio Del Mar Boulevard	Rio Del Mar Boulevard to Freedom Boulevard	Freedom Boulevard to Larkin Valley Road	Larkin Valley Road to La Selva Drive	La Selva Drive to Buena Vista Drive	Buena Vista Drive to Airport Boulevard	Airport Boulevard to SR-152	SR-152 to Harkins Slough Road
5:00	43	65	65	65	66	62	65	60	62	59	63	62	63	60	63
5:15	43	66	65	68	68	66	68	67	68	66	71	69	70	66	70
5:30	48	58	64	61	67	67	67	65	67	66	69	70	73	69	68
5:45	48	60	65	65	60	62	65	63	63	62	67	64	68	67	68
6:00	40	58	62	62	58	60	64	66	64	64	68	57	67	66	68
6:15	41	64	64	63	61	62	63	61	63	61	65	65	66	63	66
6:30	43	62	63	63	65	66	69	69	66	66	69	65	64	61	69
6:45	41	63	63	61	59	60	65	67	63	63	64	64	64	62	67
7:00	37	56	63	65	64	65	66	64	70	67	70	69	72	65	71
7:15	40	57	63	65	65	65	68	67	69	68	70	67	69	72	68
7:30	45	62	62	62	61	63	65	63	64	63	67	67	66	63	66
7:45	35	65	49	51	43	56	60	62	65	65	70	69	67	63	67
8:00	30	59	45	37	29	41	58	58	60	60	65	63	64	62	64
8:15	38	59	64	53	46	53	63	56	61	54	62	64	65	61	64
8:30	41	60	61	57	55	60	62	59	62	60	65	65	68	71	71
8:45	31	58	62	54	55	57	68	60	66	61	71	67	66	62	66
9:00	39	60	62	63	61	62	65	60	63	61	69	69	69	64	66
9:15	28	62	61	58	58	59	61	57	60	60	68	67	69	63	67
9:30	26	62	62	59	56	58	61	59	63	61	65	67	69	66	67
9:45	39	65	64	59	56	60	61	59	62	58	62	66	66	62	65
10:00	39	65	64	63	61	59	62	58	60	59	63	66	68	63	72

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-17: Weekday 95th Percentile Speeds – Southbound AM (Santa Cruz County)

Time	River Street to SR-17	SR-17 to Morrissey Boulevard	Morrissey Boulevard to Soquel Drive	Soquel Drive to 41st Avenue	41st Avenue to Bay Avenue	Bay Avenue to Park Avenue	Park Avenue to State Park Drive	State Park Drive to Rio Del Mar Boulevard	Rio Del Mar Boulevard to Freedom Boulevard	Freedom Boulevard to Larkin Valley Road	Larkin Valley Road to La Selva Drive	La Selva Drive to Buena Vista Drive	Buena Vista Drive to Airport Boulevard	Airport Boulevard to SR 152	SR-152 to Harkins Slough Road
5:00	51	59	62	61	54	57	59	62	66	62	63	62	63	61	65
5:15	51	61	64	67	55	61	68	64	65	60	70	68	69	60	64
5:30	45	60	66	64	58	61	63	62	61	57	66	66	66	61	64
5:45	39	61	56	56	53	56	62	63	63	60	65	60	63	59	67
6:00	40	60	51	56	54	53	55	58	63	59	67	63	65	64	68
6:15	43	59	61	60	57	54	57	55	57	57	58	57	61	61	65
6:30	43	57	61	60	57	57	60	59	59	57	63	62	63	61	62
6:45	41	58	63	61	59	59	61	61	64	61	66	65	64	63	67
7:00	42	60	49	57	55	57	59	59	62	66	66	65	65	63	68
7:15	39	59	53	58	58	62	61	62	67	58	65	63	64	62	67
7:30	47	57	57	59	63	64	63	66	72	57	68	65	67	64	65
7:45	41	53	53	54	37	49	57	57	59	56	65	63	67	67	68
8:00	32	56	35	53	39	49	57	56	56	52	64	61	62	59	65
8:15	31	58	34	50	52	55	59	59	60	58	64	64	64	63	65
8:30	39	55	46	46	53	57	60	61	62	60	68	65	61	63	67
8:45	39	53	46	46	45	57	58	57	58	55	64	59	65	63	64
9:00	40	56	45	52	51	57	60	58	58	57	67	65	70	67	67
9:15	34	59	55	57	54	57	60	60	61	54	64	64	64	61	66
9:30	36	60	55	58	55	57	62	60	59	59	62	62	64	60	61
9:45	31	56	55	55	52	57	61	59	58	64	61	62	64	62	65
10:00	40	59	60	63	55	58	60	58	58	62	63	61	61	58	61

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-18: Weekday 50th Percentile (Median) Speeds – Southbound PM (Santa Cruz County)

Time	River Street to SR-17	SR-17 to Morrissey Boulevard	Morrissey Boulevard to Soquel Drive	Soquel Drive to 41st Avenue	41st Avenue to Bay Avenue	Bay Avenue to Park Avenue	Park Avenue to State Park Drive	State Park Drive to Rio Del Mar Boulevard	Rio Del Mar Boulevard to Freedom Boulevard	Freedom Boulevard to Larkin Valley Road	Larkin Valley Road to La Selva Drive	La Selva Drive to Buena Vista Drive	Buena Vista Drive to Airport Boulevard	Airport Boulevard to SR-152	SR-152 to Harkins Slough Road
15:00	32	55	18	34	24	41	61	61	62	60	70	67	67	63	65
15:15	42	67	27	16	15	41	60	62	66	64	74	70	71	62	73
15:30	41	59	21	14	18	39	44	39	59	55	69	66	65	62	68
15:45	39	58	13	15	15	26	30	30	60	57	73	68	64	66	72
16:00	25	64	13	14	12	27	25	30	58	55	66	65	64	61	63
16:15	30	59	10	11	10	19	24	30	61	59	69	67	66	63	68
16:30	38	63	16	13	8	13	28	37	61	59	67	65	65	62	67
16:45	34	55	11	10	19	18	33	36	55	56	65	64	67	66	71
17:00	42	54	10	10	15	20	23	32	61	60	67	67	68	66	69
17:15	52	51	8	5	15	16	22	29	66	57	69	66	69	64	68
17:30	37	41	6	5	6	16	21	28	67	52	70	66	69	65	63
17:45	35	40	6	5	8	16	22	34	58	54	67	65	65	56	66
18:00	40	38	7	8	11	24	23	34	56	53	66	66	68	61	65
18:15	40	47	18	12	13	19	22	31	57	54	67	62	64	56	64
18:30	40	55	25	17	24	32	29	27	58	60	66	65	65	62	65
18:45	37	59	47	19	22	34	39	31	60	63	69	64	61	58	62
19:00	38	59	59	40	32	46	55	32	58	54	67	59	56	54	60

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Table 3-19: Weekday 95th Percentile Speeds – Southbound PM (Santa Cruz County)

Time	River Street to SR-17	SR-17 to Morrissey Boulevard	Morrissey Boulevard to Soquel Drive	Soquel Drive to 41st Avenue	41st Avenue to Bay Avenue	Bay Avenue to Park Avenue	Park Avenue to State Park Drive	State Park Drive to Rio Del Mar Boulevard	Rio Del Mar Boulevard to Freedom Boulevard	Freedom Boulevard to Larkin Valley Road	Larkin Valley Road to La Selva Drive	La Selva Drive to Buena Vista Drive	Buena Vista Drive to Airport Boulevard	Airport Boulevard to SR-152	SR-152 to Harkins Slough Road
15:00	41	45	14	19	16	34	40	55	59	59	67	66	68	64	67
15:15	33	52	13	12	10	26	34	47	61	60	69	66	67	66	67
15:30	38	54	8	10	11	20	31	36	60	59	65	63	68	68	71
15:45	33	17	9	11	12	23	30	28	56	57	62	61	62	63	66
16:00	35	10	6	7	11	18	24	28	57	60	70	66	69	64	65
16:15	37	8	5	6	8	15	22	23	58	61	71	67	71	66	72
16:30	40	7	4	5	8	13	21	26	63	59	68	66	67	65	65
16:45	44	8	7	4	10	13	18	24	59	58	65	64	66	61	65
17:00	39	9	7	5	9	12	16	27	61	62	70	67	70	67	69
17:15	38	15	2	5	7	13	22	32	58	60	70	68	67	61	65
17:30	36	8	4	6	11	15	21	29	56	60	69	65	70	64	71
17:45	41	13	9	6	8	13	19	27	56	59	65	64	67	64	71
18:00	40	8	11	8	8	12	16	29	57	61	67	65	68	57	66
18:15	35	14	7	13	10	17	23	27	69	61	67	67	68	59	67
18:30	34	19	6	13	12	22	20	34	62	62	70	67	73	64	70
18:45	41	47	6	10	12	24	33	32	57	60	66	64	69	62	65
19:00	43	61	15	18	20	25	40	44	61	61	66	65	68	65	68

Legend

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Traffic Forecasts

Traffic forecasts for year 2040 were obtained from the Caltrans Transportation Concept Draft Report for State Route 1, May 2017. These forecasts were derived from the regional travel demand model maintained by AMBAG. The 2040 forecasts are summarized in **Table 3-20**. These numbers provide a broad overview of the nature of the traffic growth that is anticipated in the future in both counties.

Table 3-20: State Route 1 Daily Traffic Forecasts

County	Limits of SR 1 Segment		Average Annual Daily Traffic		
	Southern	Northern	2015[A]	2040[B]	Percent Change
Monterey	Ocean Avenue, Carmel	SR-68/Holman Highway	46,100	47,500	3.0%
Monterey	SR-68/Holman Highway	Aguajito Road	52,000	56,400	8.5%
Monterey	Aguajito Road	SR-68/Salinas Highway	77,000	83,200	8.1%
Monterey	SR-68/Salinas Highway	Del Monte Avenue, Monterey	58,000	63,300	9.1%
Monterey	Del Monte Avenue, Monterey	Fremont Boulevard, Seaside	72,000	79,600	10.6%
Monterey	Fremont Boulevard, Seaside	Imjin Parkway	83,000	98,400	18.6%
Monterey	Imjin Parkway	Del Monte Boulevard, Marina	64,900	92,200	42.1%
Monterey	Del Monte Boulevard, Marina	SR 156	47,000	52,900	12.6%
Monterey	SR 156	SR 183	17,700	20,200	14.1%
Monterey	SR 183	Santa Cruz/Monterey County Line	37,000	40,000	8.1%
Santa Cruz	Santa Cruz/Monterey County Line	SR 129	37,000	41,100	11.1%
Santa Cruz	SR 129	SR 152	40,000	45,600	14.0%
Santa Cruz	SR 152	Larkin Valley Road	60,000	72,800	21.3%
Santa Cruz	Larkin Valley Road	Freedom Boulevard	68,000	79,200	16.5%
Santa Cruz	Freedom Boulevard	Bay Avenue	88,000	112,200	27.5%
Santa Cruz	Bay Avenue	41st Avenue	97,000	114,000	17.5%
Santa Cruz	41st Avenue	Soquel Avenue	88,000	102,100	16.0%
Santa Cruz	Soquel Avenue	Morrissey Boulevard	94,000	105,000	11.7%
Santa Cruz	Morrissey Boulevard	SR 17	86,000	93,000	8.1%
Santa Cruz	SR 17	SR-9/River Street	61,000	67,900	11.3%
Santa Cruz	SR 9/River Street	Mission Street	47,000	52,700	12.1%

Notes:

[A]Source: Caltrans, 2015 Traffic Volumes on California State Highways. (http://www.dot.ca.gov/trafficops/census/)

[B]Source: Caltrans, Transportation Concept Report, State Route 1, Draft May 2, 2017.

Traffic on most segments of the study corridor is projected to grow at much less than one percent per year over the next 25 years. The highest growth of 42.1 percent (1.7 percent per year) is forecasted between Imjin Parkway and Del Monte Boulevard in Monterey County. This growth is likely to be associated with planned development at the former Fort Ord and the California State University, Monterey Bay campus. Annual growth rates of about one percent are projected for the southern part of Santa Cruz County, near Freedom Boulevard and Bay Avenue. Lower annual growth rates of 0.5 percent are projected in Monterey County, south of Seaside and in northern parts of Santa Cruz County closer to SR 17.

Existing Transit Conditions

Transit service within the study area is provided and operated by two transit providers – MST and METRO.

MST operates bus service in Monterey County and southern portion of Santa Cruz County. It serves about 294 square-miles of Monterey and Santa Cruz Counties, primarily serving the greater Monterey and Salinas areas; however, it extends limited regional service to faraway places like San Jose, Santa Cruz, Watsonville, Paso Robles, and Big Sur. Currently, MST provides 55 fixed-route services, five demand-responsive dial-a-ride services, paratransit services, and a free trolley. MST operates four transit centers in Monterey County – the Monterey Transit Plaza, the Salinas Transit Center, the Sand City Station, and the Marina Transit Exchange.

MST has partnerships with various military establishments. In partnership with Fort Hunter Liggett, the Naval Postgraduate School, and the Presidio of Monterey, MST has developed military bus lines and schedules. These lines primarily operate during peak traffic periods along Highway 1 between Marina and Seaside. MST transports about 50,000 military and civilian personnel each month to/from work.

METRO serves Santa Cruz County providing 33 fixed-route bus lines, two seasonal bus routes to the University of California at Santa Cruz (UCSC), and demand-responsive paratransit services. It provides one regional service between Santa Cruz and San Jose. METRO operates four transit centers in Santa Cruz County – the Santa Cruz METRO Center, the Capitola Mall Transit Center, the Watsonville Transit Center, and the Cavallaro Transit Center in Scotts Valley.

Transit Services along Study Corridor

Currently, 16 fixed-route transit lines operate along SR 1 within the study area. Of these, 12 lines are operated by MST (Lines 12, 18, 19, 20, 21, 55, 67, 72, 74, 75, 76, and 78) and four lines by METRO (Lines 55, 69A, 69W, and 91X). Most of the bus lines operating within the study corridor are intra-county, local routes serving locally in Monterey and Santa Cruz Counties. However, two lines, MST Lines 55 and 78 are intercounty, regional services connecting Monterey County with Santa Clara and Santa Cruz Counties, respectively. The details of the bus lines and routes are provided below. The details of MST lines provided in this chapter were based on data collected in September 2016. As such, data analysis includes that of Line 10, even though it was recently discontinued in September 2017.

A summary of the bus lines including their operating areas along SR 1 is provided in **Table 3-21**.

The majority of the 15 transit lines traveling along the study corridor operate in one of these two areas:

- Greater Monterey Peninsula between Fremont Street and SR 156 interchanges, or
- Santa Cruz County between Main Street and Ocean Street interchanges.

One route, MST Line 78 operates intermittently along SR 1 between Monterey and Santa Cruz. However, this line operates only six buses on each of the weekdays, three each to Santa Cruz and Monterey. The average travel distance of transit lines along the study corridor is about 5 miles, with METRO Line 76 traversing the shortest distance of about 1.6 miles along SR 1 and MST Line 78 traversing the longest distance of about 32 miles.

Figure 3-7 and **Figure 3-8** exhibit areas along the study corridor that are used by MST and METRO buses, while the distribution of bus lines along the study corridor is summarized in **Table** 3-22.

Table 3-21: Transit Services along Study Corridor

Transit Operator	Bus Line	Description	Service Region	Operating Area along State Route 1	
				Limits	Approximate Distance (miles)
Monterey-Salinas Transit	10[1]	Marina – Monterey	Greater Monterey Peninsula	Fremont Boulevard – Del Monte Boulevard Fremont Street – Del Monte Boulevard (Line 10 Select)	4.0 7.3 (Line 10 Select)
	12	The Dunes – NPS	Greater Monterey Peninsula	Fremont Street – Imjin Parkway (Line 12 Express)	6.6
	18	Monterey – The Dunes	Greater Monterey Peninsula	Fremont Boulevard – Lightfighter Drive (Line 18 Express)	1.9
	19	Del Monte Center – CSUMB[2] East Campus	Greater Monterey Peninsula	Fremont Street – Lightfighter Drive Soledad Drive – Imjin Parkway (Line 19 Express)	5.1 8.0 (Line 19 Express)
	20	Monterey – Salinas	Greater Monterey Peninsula and Greater Salinas	Fremont Boulevard – Del Monte Boulevard	4.0
	21	Pebble Beach – Salinas Express	Greater Monterey Peninsula and Greater Salinas	Fremont Street – Del Monte Boulevard	7.3
	55	Monterey – San Jose Express	Greater Monterey Peninsula and North County	Del Monte Avenue – SR 156	11.8
	67[3]	Presidio – Marina	Greater Monterey Peninsula	Del Monte Avenue – Lightfighter Drive Imjin Parkway – Del Monte Boulevard	4.2
	72	Presidio – North Salinas Express	Greater Monterey Peninsula and Greater Salinas	Del Monte Avenue – Del Monte Boulevard	6.0
	74	Presidio – Toro Park Express	Greater Monterey Peninsula and Greater Salinas	Del Monte Avenue – Lightfighter Drive (Line 74 Express)	3.9
	75	Presidio – Marshal Park Express	Greater Monterey Peninsula	Del Monte Avenue – Lightfighter Drive (Line 75 Select)	3.9
	76	Presidio – Stillwell Park Express	Greater Monterey Peninsula	Del Monte Avenue – Fremont Boulevard	1.6
	78	Presidio – Santa Cruz Express	Greater Monterey Peninsula and North County	Del Monte Avenue – Del Monte Boulevard Reservation Road – SR 156 Merritt Street – State Park Drive Soquel Drive – Ocean Street	32.2

Transit Operator	Bus Line	Description	Service Region	Operating Area along State Route 1	
				Limits	Approximate Distance (miles)
Santa Cruz METRO	55	Rio Del Mar	Mid Santa Cruz County	Larkin Valley Road – State Park Drive (along northbound SR 1 only)	2.6
	69A	Capitola Road/Watsonville via Airport B	Cabrillo/South Santa Cruz County	Airport Boulevard – 41st Avenue	10.3
	69W	Capitola Road/Watsonville	Cabrillo/South Santa Cruz County	Main Street – State Park Drive	7.7
	91X	Commuter Express Santa Cruz/Watsonville	Cabrillo/South Santa Cruz County	Main Street – State Park Drive Park Avenue – Morrissey Boulevard	9.5 – 11.1

Notes:
[1]This bus line was discontinued in September 2017.
[2]California State University at Monterey Bay
[3]This bus line was introduced in September 2017.

Figure 3-7: Transit Operating Areas along SR 1 – Santa Cruz County

Figure 3-8: Transit Operating Areas along SR 1 – Monterey County

Table 3-22: Distribution of Bus Lines in Focus Areas

SR 1 Segment		Number of MST and METRO Bus Lines Operating
Southern Limit	Northern Limit	
Monterey County		
Soledad Drive	Fremont Street	1
Fremont Street	SR-68/Salinas Highway	4
SR-68/Salinas Highway	Del Monte Avenue	4
Del Monte Avenue	SR 218/Canyon Del Rey Boulevard	10
SR 218/Canyon Del Rey Boulevard	Fremont Boulevard	10
Fremont Boulevard	Lightfighter Drive	11
Lightfighter Drive	Imjin Parkway	8
Imjin Parkway	Del Monte Boulevard (South)	6
Del Monte Boulevard (South)	Reservation Road	1
Reservation Road	Del Monte Boulevard (North)	2
Del Monte Boulevard (North)	Nashua Road	2
Nashua Road	SR 156	2
Santa Cruz County		
Main Street	Airport Boulevard	3
Airport Boulevard	Buena Vista Drive	4
Buena Vista Drive	Mar Monte Avenue	4
Mar Monte Avenue	Larkin Valley Road/San Andreas Road	4
Larkin Valley Road/San Andreas Road	Freedom Boulevard	5
Freedom Boulevard	Rio Del Mar Boulevard	5
Rio Del Mar Boulevard	State Park Drive	5
State Park Drive	Park Avenue	1
Park Avenue	Bay Avenue/Porter Street	3
Bay Avenue/Porter Street	41st Avenue	3
41st Avenue	Soquel Drive	2
Soquel Drive	Morrissey Boulevard	2
Morrissey Boulevard	SR 17	-
SR 17	Ocean Street	-

In Monterey County, the central portion of the bus-on-shoulder concept focus area, between Del Monte Avenue (Monterey) and Del Monte Boulevard (Marina) is used by the majority of the bus lines, serving 6 to 10 MST lines. The northern (between Del Monte Boulevard and SR 156) and southern (between Del Monte Avenue and Soledad Drive) segments of the Monterey County focus area are used by four or fewer bus lines.

In the Santa Cruz County focus area, the study corridor located between Airport Boulevard and State Park Drive serves the most number of METRO and MST bus lines (four or five routes). The remaining portions of the Santa Cruz focus area (between Main Street and Airport Boulevard and between State Park Drive and Ocean Street) serve three or fewer bus routes.

Weekday Transit Operations

A summary of operations of the 16 transit lines that are currently operating along the study SR 1 corridor during a typical weekday is provided in **Table 3-23**. As mentioned earlier, since there is minimal or no traffic congestion on SR 1 on a typical weekend day, the bus-on-shoulder concept is being studied for weekday conditions only. As such, transit operations along the study corridor were summarized for a typical weekday only.

Of the 12 MST bus lines operating along the study corridor, consistent and regular service throughout a weekday is provided by four lines only – MST Lines 10, 12, 18, and 20. MST Lines 10 and 20 operate at about 30-minute headways during the AM (from 6 AM to 10 PM) and PM (from 3 PM to 7 PM) peak periods, MST Line 18 Express operates at about 60-minute headways during the PM peak period, and MST Line 12 operates with slightly longer headways of about 60-90 minutes during the AM and PM peak periods. The remaining nine bus lines provide limited or irregular service on weekdays.

Table 3-23: Transit Operations during a Weekday

Bus Line	Direction	Times of Operation at Origin	Service Headway (minutes)		
			Daily	AM Peak Period[1]	PM Peak Period[1]
MST Line 10[2]	Northbound	7:30 AM – 8:30 AM, 3:05 PM – 5:05 PM	30	30	30
	Southbound	6:55 AM – 8:50 AM, 3:45 PM – 4:15 PM	30	30	30
MST Line 12	Northbound	7:15 AM – 8:45 AM, 12:05 PM – 1:40 PM, 3:10 PM – 5:15 PM	60-90	90	60
	Southbound	6:45 AM – 9 AM, 12:45 PM, 2:20 PM – 4:55 PM	15-85	15-70	60-85
MST Line 18	Northbound	6:05 AM – 10:05 PM	60	60	60
	Southbound	6:15 AM – 9:15 PM	50-100	60	60
MST Line 19	Northbound[3]	3:25 PM – 2 AM	80-100	-	90
	Southbound[3]	2:30 PM – 1:35 AM	80-90	-	90
MST Line 20	Northbound	5 AM – 9:20 PM	20-60	20-40	30
	Southbound	4:45 AM – 10:25 PM	25-60	30-35	30
MST Line 21	Northbound[4]	3:10 PM – 5:40 PM	55-95	-	55-95
	Southbound[4]	5 AM – 7:05 AM	65	65	-
MST Line 55	Northbound[5]	9:50 AM and 3:10 PM	320	-	-
	Southbound[5]	8:29 AM and 12:50 PM	221	-	-
MST Line 67	Northbound[3]	2:15 PM – 8:15 PM	120	-	120
	Southbound[3]	3:15 PM – 9:15 PM	120	-	120
MST Line 72	Northbound[5]	7:37 AM and 4:35 PM	538	-	-
	Southbound[5]	6 AM and 4:13 PM	613	-	-
MST Line 74	Northbound[6]	7:05 AM and 4:35 PM	570	-	-
	Southbound[6]	6:29 AM	-	-	-
MST Line 75	Northbound[7]	12:10 PM – 9:20 PM	45-120	-	45-95
	Southbound	5:55 AM – 10 PM	30-116	35	45-106

Bus Line	Direction	Times of Operation at Origin	Service Headway (minutes)		
			Daily	AM Peak Period[1]	PM Peak Period[1]
MST Line 76	Northbound[8]	4:06 AM – 6:10 AM, 4 PM, and 4:30 PM	30-580	-	30
MST Line 78	Southbound[8]	4:10 AM – 6:10 AM, 4:37 PM, and 5:07 PM	30-629	-	30
	Northbound[9]	4:30 AM, 7:31 AM, and 4:40 PM	121-549	-	-
METRO Line 55	Southbound[9]	6 AM, 4:22 PM, and 7 PM	158-622	-	-
	Circular Service	8:30 AM – 5:30 PM	60	60	60
METRO Line 69A	Northbound	7:05 AM – 5:50 PM	60-65	60-65	60
	Southbound	6:45 AM – 6 PM	53-60	60	60
METRO Line 69W	Northbound	6:20 AM – 9:20 PM	60	60	60
	Southbound	6:40 AM – 8:40 PM	53-127	60	60
METRO Line 91X	Northbound	5:57 AM – 4:20 PM	15-60	15-52	60
	Southbound	6:55 AM – 5:25 PM	23-37	23-37	25-35

Notes:
[1]AM Peak Period – 6 AM to 10 AM, PM Peak Period – 3 PM to 7 PM
[2] This bus route was discontinued in September 2017.
[3]Operates on Friday evenings and nights only during weekdays.
[4]Operates only five buses daily – two southbound buses in the morning and three northbound buses in the evening.
[5]Operates only four buses daily – two buses in each direction, one each in the morning and afternoon/evening periods.
[6]Operates only three buses daily – one southbound bus in the morning and two northbound buses, one each in the morning and evening periods.
[7]Operates during the afternoon and evening periods only.
[8]Operates only 11 buses daily, five in the southbound direction and six in the northbound direction.
[9]Operates only six buses daily, three in each direction.

Unlike the MST bus routes, all of the METRO bus routes operating along the study corridor provide consistent and regular service throughout a weekday. METRO Lines 55, 69A, and 69W operate with about 60-minute headways during the AM and PM peak periods, while METRO Line 91X operates with headways varying between 15 and 60 minutes during the AM and PM peak periods.

Transit Performance

As discussed above, traffic operations along the study corridor are poor during a typical weekday in the peak directions of travel, which are northbound AM peak and southbound PM peak for the Santa Cruz County focus area and southbound AM peak and northbound PM peak for the Monterey County focus area. Therefore, to maximize travel time benefits to bus services, the bus-on-shoulder concept is being considered during a weekday in the peak directions of travel only.

The performance of METRO-operated routes was not evaluated due to the unavailability of bus performance data.

Performance of MST bus routes was evaluated using the HASTUS software, which is a software package providing transit planning, scheduling, and operations modeling/monitoring solutions.

Run time graphs from HASTUS software for each of the nine MST lines operating in the peak directions of travel, as mentioned above, were provided by MST.

Typically, the 10 MST lines have variable run times that are distributed within a 10-15-minute time period around the scheduled time, suggesting that all of the 10 MST lines have on-time performance issues as show in **Table 3-24**.

All of the MST lines operate with at least half their trips delayed during the peak periods in the peak directions of travel. MST regularly adjusts its schedule to account for increased traffic and congestion on SR 1. However, as discussed above, with the increase in traffic congestion, on-time performance and travel time reliability of a transit trip reduces, despite schedule adjustments.

Table 3-24: Transit Performance in Peak Directions of Travel

Bus Line	Approximate Scheduled Travel Time (minutes)		Range of Typically Observed Travel Times (minutes)		Consistent On-Time Performance?
	Southbound AM[A]	Northbound PM[B]	Southbound AM[A]	Northbound PM[B]	
MST Line 10[C]	19	18	9-29	11-20	No
MST Line 12[D]	N.A.	N.A.	N.A.	N.A.	N.A.
MST Line 18[E]	N.A.	16	N.A.	12-18	No
MST Line 19[F]	N.A.	13	N.A.	12-23	No
MST Line 20	19	w18	9-29	11-20	No
MST Line 21	23	16	11-30	12-27	No
MST Line 55[G]	N.A.	N.A.	N.A.	N.A.	N.A.
MST Line 67[H]	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
MST Line 72[F]	N.A.	21	N.A.	16-26	No
MST Line 74[F]	N.A.	17	N.A.	12-23	No
MST Line 75[F]	N.A.	12	N.A.	8-22	No
MST Line 76[F]	N.A.	13	N.A.	10-22	No
MST Line 78	18	20	16-22	13-27	No

Source: HASTUS run time graphs for services between May 2016 and March 2017, Monterey-Salinas Transit.
Notes:
[A]Represents travel along southbound SR 1 during the AM peak period of traffic (6 AM – 10 AM).
[B]Represents travel along northbound SR 1 during the PM peak period of traffic (3 PM – 7 PM).
[C] This bus route was discontinued in September 2017.
[D]Operates on arterials only. Line 12 Express operates on SR 1, but does not have service in the peak directions of travel.
[E] MST Line 18 Express does not operate during the AM peak period of traffic.
[F]Does not have service along southbound SR 1 during the AM peak period of traffic.
[G]Does not have service in the peak directions of travel.
[H] This bus route was introduced in September 2017; as such, data is unavailable.
N.A. – Not applicable (since no service is provided in the peak directions of travel)

Transit Ridership on SR 1

For the MST bus routes operating along the study corridor in the peak directions of travel (southbound AM peak and northbound PM peak), estimates of average ridership on SR 1 during the weekday peak periods are provided in **Table 3-25**. Even though MST Line 10 has been recently discontinued in September 2017, its ridership is evaluated and reported in this section, since its ridership is expected to be transferred to other bus routes, predominantly MST Line 20. Transit ridership estimates on SR 1 for the MST lines were developed using the transit rider data provided by MST for the month of September 2016. MST Line 20 has the highest total ridership of about 200 passengers on SR 1 during both the southbound AM and northbound PM peak periods.

Table 3-25: Weekday Transit Ridership on SR 1 in Peak Directions of Travel – Monterey County

MST Bus Line	Approximate Total Ridership on SR 1 during Peak Periods	
	Southbound AM[A]	Northbound PM[B]
10[C]	55	55
12	N.A.	N.A.
18	N.A.	85
19	N.A.	10
20	200	200
21	15	15
55	N.A.	N.A.
67[D]	Unavailable	Unavailable
72	N.A.	10
74	N.A.	10
75	N.A.	60
76[E]	N.A.	Unavailable
78	10	10

Source: Monterey-Salinas Transit Ridership Data and CDM Smith, 2017.
Notes:
[A]Represents travel along southbound SR 1 during the AM peak period of traffic (6 AM – 10 AM).
[B]Represents travel along northbound SR 1 during the PM peak period of traffic (3 PM – 7 PM).
[C]This bus route was discontinued in September 2017.
[D]Data unavailable due to recent introduction of bus route in September 2017.
[E]Transit rider data of MST Line 76 was unavailable.
N.A. – Not Applicable (since no service is provided in the peak directions of travel)

For the METRO bus routes operating along the study corridor in the peak directions of travel (northbound AM peak and southbound PM peak), estimates of average weekday ridership on SR 1 during the weekday peak periods are provided in **Table 3-26**. Since transit rider data was not available for METRO buses, transit ridership estimates on SR 1 were developed by assuming them to be about one half of the average boardings per trip. METRO Line 91X has an average boarding per trip of 22 riders and it operates seven northbound buses during the AM peak period and five southbound buses during the PM peak period. Assuming about 11 passengers per trip would travel on SR 1, approximate ridership of Line 91X on SR 1 is estimated to be 77 and 55 passengers during the northbound AM and southbound PM peak periods, respectively. METRO Line 55 has an average boarding per trip of 16 riders and operates one bus along northbound SR 1 during the AM peak period resulting in an estimate of 8 passengers on SR 1. METRO Line 55 does not

operate along southbound SR 1. Ridership data was not available for METRO Lines 69A and 69W to estimate transit ridership on SR 1.

Table 3-26: Weekday Transit Ridership on SR 1 in Peak Directions of Travel – Santa Cruz County

METRO Bus Line	Approximate Total Ridership on SR 1 during Peak Periods	
	Northbound AM[A]	Southbound PM[B]
55	8	N.A.
69A	Unavailable	Unavailable
69W	Unavailable	Unavailable
91X	77	55

Source: METRO and CDM Smith, 2017.
Notes:
[A]Represents travel along northbound SR 1 during the AM peak period of traffic (6 AM – 10 AM).
[B]Represents travel along southbound SR 1 during the PM peak period of traffic (3 PM – 7 PM).
N.A. – Not Applicable (since Line 55 does not operate along southbound SR 1)

Currently, with the extreme traffic congestion, METRO specifically does not use SR 1 extensively, because of associated travel time reliability issues and schedule impacts. However, with transit priority on SR 1, METRO would realign services to take advantage of travel time reliability.

Geometric Design & Operating Guidelines

This section examines the design and operating parameters that would be appropriate to use for bus-on-shoulder operations and for bus operations of the Monterey Branch Line.

Forms of Bus-on-Shoulder Concept

A principal strength of the bus-on-shoulder concept is that it tends to be inexpensive and easy to implement, provided that the existing shoulder area is wide enough, clear of overhead and roadside obstacles and has the pavement structure to support bus operations. The low cost and minimal disruptive impacts often allow the concept to be implemented on a pilot or demonstration basis. It is important to note that bus-on- shoulder concepts differ from most other shoulder traffic use concepts. Bus-on-shoulder concepts involve special training for bus drivers and management of safe operating protocols. Use by untrained drivers and at higher volumes increase geometric design needs and complicate normal use of shoulders for disabled vehicles, enforcement, and maintenance. Higher speeds and less disciplined drivers might argue for wider shoulders and full highway geometric design speeds, including the addition of pullouts along the corridor. Typically, bus-on-shoulder lanes carry less than 20 buses per hour, managed lanes carry about 1,000 vehicles per hour, and open shoulders can carry up to 2,000 vehicles per hour. If major costs are needed to upgrade shoulders, consideration of flexibility to expand use might be warranted. An important resource for bus-on-shoulder planning and operations is the Transit Cooperative Research Program Report 151. This guide and other related resources were used to compile the information in this section.

Buses are typically 10 feet - 7 inches wide with side mirrors. Fitting side mirror buses into narrow 10-foot-wide shoulders can be eased by use of on-lane assist technology or virtual side mirror technology.

There are three basic forms of the bus-on-shoulder concept:

1. Right side shoulder lane,
2. Left side shoulder lane, and
3. Off ramp bypass.

Right Side Shoulder Lane

This is the most common form of bus-on-shoulder concept and has proven safe in more than 25 years of operation. The Twin Cities metro area currently has about 300 miles of bus-on-shoulder facilities and all except one use the right-side shoulder. The I-35 Managed Lanes segment uses the left side shoulder and allows buses to operate on this facility. The Minneapolis experience has been widely used as a template for right side bus-on-shoulder operations and provides a sound basis for shoulders design and operations protocols in Monterey and Santa Cruz Counties.

MnDOT guidelines for bus on right shoulder are as follows:

- Design Speed: Maximum of 35 miles per hour, with 15 miles per hour maximum speed differential with general-purpose traffic
- Shoulder Width: Minimum of 10 feet, with 12 feet desirable, except over bridges where 11.5-foot minimum shoulder is required
- Stopping Sight Distance: Minimum of 250 feet
- Cross Slope: Maximum 6 percent
- Vertical Clearance: 14 feet

Invariably, the horizontal and vertical features of the highway are adequate for slower moving buses. While most modern and rebuilt pavement sections are adequate for bus-on-shoulder operations, some older shoulders are substandard. For short pilot period assessments of bus-on-shoulder use, even these substandard shoulders have proven adequate. Rebuilt shoulders should meet full pavement standards for general-purpose traffic lanes.

There is no minimum length specified for right shoulders, and the Minnesota Department of Transportation uses pinch-point signs to advise bus drivers of inadequate shoulder widths. Bus drivers merely remerge with general traffic at these pinch-points, often a bridge abutment. Remerges are also the operating protocol across double lane on and off ramps. Entering and leaving right side shoulders tends to be quite easy with the low volumes and low speeds. Motorists generally understand that the bus is not disadvantaging them and is simply crossing their lane. Ramp volumes under 1,000 vehicles per hour have not proven a problem in Minnesota, but volumes of 1,000 to 1,500 vehicles per hour can be problematic and warrant special design attention.

The California right side shoulder pilot also restricted use of the shoulder when it rained, due to ponding concerns. This protocol conflicts with the practice in Minneapolis where the greatest travel time and reliability benefits occurred during bad weather (snow).

Left Side Shoulder Lane

In addition to the Minneapolis left side manage lane on I-35, the two left side shoulder applications are in Cincinnati and Chicago. The Cincinnati pilot I-71 left side shoulder project began in 2007 and used minimal signage. The bus segment is about 10 miles in length and allows buses to use the left shoulder whenever general-purpose traffic speeds drop below 30 miles per hour. Buses can run up to 15 miles per hour faster than general traffic, with a maximum speed of 45 miles per hour. Shoulders are 12 feet or wider. The Chicago I-55 left side shoulder project began in 2011 and uses more extensive signage including overhead lane use signage. Buses can use the shoulder at any time on the driver's discretion when general traffic speeds drop below 35 miles per hour. Buses cannot exceed 35 miles per hour when using the shoulder and cannot exceed 15 miles per hour faster than general traffic speeds. The I-55 left side shoulder project is about 16 miles in length.

Suggested guidelines for left side bus use of shoulders are as follows:

- Design speed: 35 miles per hour maximum with 15 miles per hour maximum differential speed
- Shoulder Width: Minimum 12-foot wide
- Cross Slope: Six percent maximum
- Vertical Clearance: 14 feet
- Minimum Length: 5,000 feet

Where shoulders are too narrow or other obstacles existing to use of the shoulder by buses, such as approaching a two-lane off-ramp, bus can bypass the obstacle or "pinch-point" by exiting the shoulder and merging into the adjacent lane. Once past the obstacle the buses can re-enter the shoulder. However, if there are too many of these pinch-point or obstacles much of the purpose of the bus-on-shoulder use would be defeated. There is no strict guideline for this, but one obstacle per mile would be about the maximum that would be acceptable.

The key difference for left side shoulder buses is that greater difficulty is encountered while weaving to enter and exit the left side shoulder. The merge sight lines on the right side of buses are also not as good as on the left side where the driver sits. Thus, bus remerges to finesse pinch-points is less practical and generally should be avoided. Providing a left-shoulder operation with only a single ingress point at the beginning of the corridor and a single egress point at the end of the corridor would minimize or avoid the issue of multiple and frequent bus remerging. Access to/from left side shoulders generally requires weaving across two or more traffic lanes. Motorists in these lanes tend to be more accepting of buses crossing their lane than for remerging into their traffic lane.

One advantage of buses operating on the left side is that they encounter fewer ramp weave conflicts; therefore, they might be allowed to operate at higher speeds than buses operating on the right-side shoulder. Based on the Chicago left side shoulder model, however, a 35-miles-per-hour maximum speed (the same as for right shoulders) is suggested for planning purposes for left side shoulder bus operations. For a hypothetical five-mile segment, the travel time difference would be about 2 minutes for 35 miles per hour running and 45 miles per hour running.

One important note is that the existence of a right-side shoulder is critical for emergency stops and for use by the California Highway Patrol and emergency vehicles. If a narrow left-side shoulder exists, but the right-side shoulder is adequate, it is not advisable to consider shifting the freeway lanes, so that the right-side shoulder is narrowed in order to allow the left-side shoulder to be widened. This is also a very expensive idea, as the paved area used by the freeway lanes would need to be widened, which is much more costly than just widening the shoulder area.

Off-Ramp Bypass

Sometimes congestion on off-ramps significantly delays buses. In these instances, a short bypass shoulder use might prove attractive. Typically, they would follow the right-side shoulder guidelines but could be relatively short (less than a mile).

Existing Highway Geometrics

As discussed above, except for one bus route (MST Line 78), all of the bus routes operating along the study corridor operate on focus areas located near the northern and southern termini of the study area –between Main Street and Ocean Street interchanges in Santa Cruz County and between Fremont Street and SR 156 interchanges in Monterey County. Only one bus route, MST Line 78 operates in the central portion of the study corridor, between SR 156 and Main Street interchanges. However, MST Line 78 operates intermittently, providing only six buses per weekday, three in each direction. As such, to provide benefits to multiple bus routes, potential sites for the bus-on-shoulder concept are identified near the northern and southern termini of the study area, but not in the central portion of the corridor.

Santa Cruz County

METRO currently operates buses on segments of State Route 1 with most routes connecting to the downtown Santa Cruz Transit Center via Soquel Avenue and to Watsonville via either Main Street or Freedom Boulevard. Current service totals under 10 buses an hour north of Freedom Boulevard and about 4 buses per hour on the segment south to Main Street.

METRO is more interested in left side bus-on-shoulder operations than for right side shoulder operations because they plan to operate buses non-stop on the freeway between Watsonville and Downtown Santa Cruz.

For discussion purposes, SR 1 was segregated into 15 segments in both the northbound and southbound travel directions. The segments were defined by overpass and interchange facilities. Overall, it is about 15 miles from Santa Cruz to Watsonville. A summary of total available rights-of-way and shoulder widths along SR 1 in Santa Cruz County is provided in **Table 3-27**.

Northbound Travel

- **Main Street to Airport Boulevard** – Beginning in Watsonville at the Main Street On-Ramp and continuing to Airport Boulevard, the median is about 42 feet in width with the northbound paved section about 8 feet and the unpaved median area about 21 feet wide. Thus, the left shoulder median could accommodate bus-on-shoulder operations, if improved. The right-side shoulder is also about 8 feet in width. Airport Boulevard overpasses SR 1 and its bridge has a center pier that constrains median width available for improving the left side shoulder.

- **Airport Boulevard to Buena Vista Drive** – North of Airport Boulevard, the median widens to about 56 feet with the paved northbound shoulder being 13 feet wide approximately. Approaching the SR 1 overpass of Buena Vista Drive, the northbound left shoulder is dropped. The northbound and southbound overpasses are separated by about 50 feet, but the northbound overpass would need to be widened to provide a continuous left shoulder. The right shoulder is about 10 feet wide except at the overpass where it narrows to about 6 feet.

- **Buena Vista Drive to Mar Monte Avenue** – North of Buena Vista Drive, the median widens to 56 feet with an 8-foot-wide northbound hard left shoulder and a 10-foot right shoulder. About a mile north of the Buena Vista Drive interchange, the northbound and southbound lanes separate, and the northbound paved shoulder is 10 feet wide. The northbound and southbound lanes re-converge about a half mile south of the Mar Monte Avenue interchange. The approach to Mar Monte Avenue interchange has an 84-foot median with a ten-foot wide northbound left shoulder. The Mar Monte Avenue overpass of SR 1 has a center pier support, but adequate space exists in the median for a full left shoulder and there is space for a full right shoulder.

- **Mar Monte Avenue to San Andreas Road –** The median for this segment is 80 feet wide and provides for a 16-foot-wide northbound hard left shoulder and an 8-foot wide right shoulder. The SR 1 overpass of San Andreas Road has minimal shoulders and the overpasses would need to be widened to provide a 12-foot left shoulder for buses. The right shoulder is about 8 feet wide beneath the overpass.

- **San Andreas Road to Freedom Boulevard** – This segment has a 70-foot-wide median, a 10-foot-wide hard left shoulder, and a 10-foot-wide right shoulder. The Freedom Boulevard overpass of SR 1 allows a 50-foot-wide median on SR 1 with a hard, left shoulder of 10 feet in width. Freedom Boulevard is an access point for Santa Cruz Metro buses. The on- and off-ramps are on the right side, requiring buses to weave across mainline traffic to access the left side shoulders. The shoulders on both right and left sides probably could be improved under the overpass to provide shoulder operations.

- **Freedom Boulevard to Rio Del Mar Boulevard** – This segment has a 34-foot median with a narrow 4-foot northbound hard left shoulder and an 8-foot-wide right shoulder. Passing under the Rio Del Mar Boulevard overpass, SR 1 has a 30-footwide median center pier support and would allow for shoulder use.

- **Rio Del Mar Boulevard to Spreckels Drive** – This section has a narrow 12-foot-wide median with minimal right and left shoulders. Major costs, disruptions, and impacts would likely be required to upgrade this section for shoulder operations. The northbound right shoulder is about 6 feet wide and its right-of-way possibly could be used to provide left side shoulders. The railroad overpass of SR 1 is a constraining point with no left side shoulders and about a 6-foot right side shoulder. Because the railroad overpass does not provide adequate shoulder width, any bus-on-shoulder operations would require a costly lengthening of the railroad bridge or buses would have to exit the shoulder prior to the overpass and then re-enter the shoulder after the overpass. This works for right side shoulder operations, but would not work for left-side operations where such a maneuver would be very difficult for the transit operators.
- **Spreckels Drive to State Park Drive** – The short section has a narrow median south of the railroad overcrossing and widens to 20 feet north of it. No right-side shoulder is provided and the railroad overcrossing has a center pier support with no shoulders provided under the overcrossing. SR 1 under State Park Drive has a 4-foot left and 6-foot right shoulder. The rail bridge is a major obstacle to bus-on-shoulder as noted above.

Table 3-27: Typical Rights-of-Way – Santa Cruz County Focus Area

State Route 1 Location	Northbound Direction			Southbound Direction		
	Left Shoulder (feet)	Right Shoulder (feet)	Total Right-of-Way (feet)	Left Shoulder (feet)	Right Shoulder (feet)	Total Right-of-Way (feet)
1. Main Street – Airport Boulevard	8	8	35-55	10	8	45-60
2. Airport Boulevard – Buena Vista Drive	13	6-10	50-70	6	8	50-75
3. Buena Vista Drive – Mar Monte Avenue	8-10	10	60-75	8	11	50-80
4. Mar Monte Avenue – San Andreas Road	16	8	55-70	8	11	40-80
5. San Andreas Road – Freedom Boulevard	10	10	45-70	6	7	70-75
6. Freedom Boulevard – Rio Del Mar Boulevard	4	8	45-65	3	12	45-65
7. Rio Del Mar Boulevard – Spreckels Drive	0-6	6	25-50	0-4	0-10	25-45
8. Spreckels Drive – State Park Drive	0-4	0-6	40-45	10	10	35-45
9. State Park Drive – Park Avenue	3-5	5-8	50-55	14	10	50
10. Park Avenue – Bay Avenue	0-6	4-10	35-50	12	11	40-50
11. Bay Avenue – Wharf Road	0	10	35-55	0	0-6	35-55
12. Wharf Road – 41st Avenue	0-13	8	45	0	6	45
13. 41st Avenue – Soquel Drive	6-10	6-10	55	12	8	50-55
14. Soquel Drive – La Fonda Avenue	6	10	40-55	6-8	7-10	50-55
15. La Fonda Avenue – Morrissey Boulevard	8	12	40-55	10-11	6-10	55-65

- **State Park Drive to Park Avenue** – Minimum shoulders are provided along this segment with about 5 feet wide shoulders provided on both the right and left sides for shoulders. A 34-foot-wide total center median however exists. Crossing over Park Avenue, SR 1 has a 3-foot left shoulder and an 8-foot right shoulder.
- **Park Avenue to Bay Avenue** – Six-foot shoulders are provided on both the right and left sides for northbound travel with a total 20-foot-wide center median for this highway section. On the approach to the Capitola Avenue overpass of SR 1, the median narrows to 16 feet and the shoulders narrow to 4 feet wide. Approaching Bay Avenue interchange the median drops to 12 feet and the left shoulder is dropped. The right-side shoulder is about 10 feet in width.
- **Bay Avenue to Wharf Road** – A 10-foot right shoulder is provided, but no left-side shoulder is provided. A 6-foot median separates the northbound and southbound traffic lanes. No left shoulder, but a ten-foot right shoulder is provided crossing over Wharf Road.
- **Wharf Road to 41st Avenue** – The right shoulder narrows to 8 feet and the median widens approaching the 41st Avenue interchange overcrossing. Under the 41st Avenue overpass, northbound SR 1 has a wide 12-foot-plus left shoulder and a narrow right shoulder.
- **41st Avenue to Soquel Drive** – The right-side shoulder narrows to about 6 feet and the left side shoulder widens to about 10 feet. A 36-foot-wide median separates the northbound and southbound traffic lanes. Underneath the Soquel overpass, SR 1 has a 10-foot-right and 6-foot-left shoulder.
- **Soquel Drive to La Fonda Avenue** – The right shoulder is 10 feet wide and the left shoulder is 6 feet wide. An 18-foot median separates the northbound and southbound traffic lanes.
- **La Fonda Avenue to Morrissey Boulevard** – The right shoulder is 12 feet wide and the left shoulder is about 8 feet wide on this segment. The center median is about 24 feet wide.

The most severe congestion occurs north of Aptos. Left side shoulder operations would be hindered at the Airport Boulevard interchange, Buena Vista Drive interchange, San Andreas Road interchange, and from Freedom boulevard to Wharf Road by narrow shoulder widths. However, left-side bus-on-shoulder operations seem possible for a short segment between Mar Monte Avenue and San Andreas Road along northbound SR 1. Though it should be noted that typically buses need longer distances to weave in and out of a left-side shoulder than a right-side shoulder. Right-side shoulder operations appear more feasible north of Bay Avenue and even the segment between Bay Avenue and Park Avenue might potentially be upgraded. The viable left side shoulder segments (Wharf Road to Soquel Drive) could not be fully used as buses would need distance to weave to and from the left side shoulders.

METRO is primarily looking for a bus-on-shoulder concept north of State Park Drive, since replacement of the rail bridge located just south of State Park Drive would be extremely expensive and complicated. A low-cost concept involving no rebuilding of interchanges would encounter the issues mentioned above. However, a more expensive concept involving

replacement of a few interchanges may encounter fewer issues. More details about different concepts are discussed in Chapter 4.

Southbound Travel

- **Soquel Drive to 41st Avenue** – North of Soquel Drive, southbound SR 1 has a 10-foot right shoulder and a 4-foot left shoulder. Between Soquel Drive and 41st Avenue, the right shoulder narrows to 8 feet and the left shoulder widens to 12 feet.
- **41st Avenue to Wharf Road** – The right shoulder is about 6 feet wide, but no left shoulder is provided.
- **Wharf Road to Bay Avenue** – The right shoulder transitions to an off-ramp and no left shoulder is provided.
- **Bay Avenue to Park Avenue** – An 11-foot right shoulder and a 12-foot left shoulder are provided in the southbound direction.
- **Park Avenue to State Park Drive** – The right shoulder is about 10 feet wide and the left one is about 14 feet wide.
- **State Park Drive to Spreckels Road** – Both left and right shoulders are about 10 feet wide.
- **Spreckels Road to Rio Del Mar Boulevard** – The right shoulder is about 10 feet wide north of the railroad overcrossing where the shoulder is dropped before widening back to 10 feet south of the railroad overcrossing. The left shoulder is about 4 feet wide north of the railroad and it is also dropped passing beneath the railroad. It returns at 4 feet wide south of the railroad.
- **Rio Del Mar Boulevard to Freedom Boulevard** – The right shoulder is about 12 feet wide and the left shoulder is about 3 feet wide. It seems very possible to widen the left shoulder into the unpaved median.
- **Freedom Boulevard to San Andreas Road** – The right shoulder is about 7 feet wide and the left shoulder is about 6 feet wide.
- **San Andreas Road to Mar Monte Avenue** – The right shoulder is about 11 feet wide and the left shoulders is about 8 feet wide. The left shoulder could be widened into the unpaved median.
- **Mar Monte Avenue to Buena Vista Drive** – The southbound section is similar to the above section with 11-foot right shoulders and 8-foot left shoulders.
- **Bueno Vista Drive to Airport Boulevard** – The right shoulder is 8 feet wide and the left shoulder is 6 feet wide.
- **Airport Boulevard to Main Street** – The right shoulder is 8 feet wide and the left shoulder is 10 feet wide.

Potential sites for the bus-on-shoulder concept in Santa Cruz County are illustrated in **Figure 3-9**.

Monterey County

MST operates its buses on several sections of SR 1 and includes service to Santa Cruz. Major hubs include the Marina Transit Exchange and Sand City Station. Many of the buses exit SR 1 onto Del Monte Boulevard or Fremont Avenue on the way into Monterey. Bus-on-shoulder operations were assessed for the segment between Castroville (Junction SR 156) to Soledad Drive/ Munras Avenue. The focus was on right shoulder use. A summary of typical rights-of-way and shoulder widths available along SR 1 in Monterey County is provided in **Table 3-28**.

Northbound Travel

- **Soledad Drive/Munras Avenue to Aguajito Road** – The northbound on-ramp from Soledad Drive is a right side on-ramp. The right shoulder is about 8 to 11 feet wide north to Aguajito Road, except for the bridge crossing of Iris Canyon where the right shoulder narrows to about 7 feet. The overpass of Aguajito Road also narrows the shoulder to about 6 feet.

- **Aguajito Road to Fremont Boulevard** – This section includes a long overpass. The right shoulder is about 6 feet wide and the left shoulder is about 4 feet wide except on the overpass where it is only 2 feet wide. Fremont Boulevard on-ramp is a double lane high volume ramp.

- **Fremont Boulevard to SR-68** – Minimal shoulders of 2 to 3 feet in width are provided on both sides of this highway segment. It is also a high-volume weave segment interchanging traffic between two state highways and providing access to Fremont Street. The off-ramp is a double lane facility.

- **SR-68 to Casa Verde Way** – The right shoulder is about 6 feet wide and the left shoulder about 7 feet wide.

- **Casa Verde Way to Del Monte Avenue** – An auxiliary lane is provided between these two interchanges along the right side. Buses could potentially use this auxiliary lane.

- **Del Monte Avenue to Canyon Del Rey Boulevard** – Similarly, an auxiliary lane is provided on this segment which buses could use. No shoulders are provided. No shoulder exists after the Canyon Del Rey Boulevard off-ramp, so widening would be required or buses would need to remerge into general-purpose lanes. The SR 1 overcrossing of Canyon Del Rey Boulevard has only 6-foot-wide right-side shoulder, so this overcrossing would need to be widened or buses would need to remerge and use general-purpose lanes.

Figure 3-9: Potential Bus-on-Shoulder Sites in Santa Cruz County

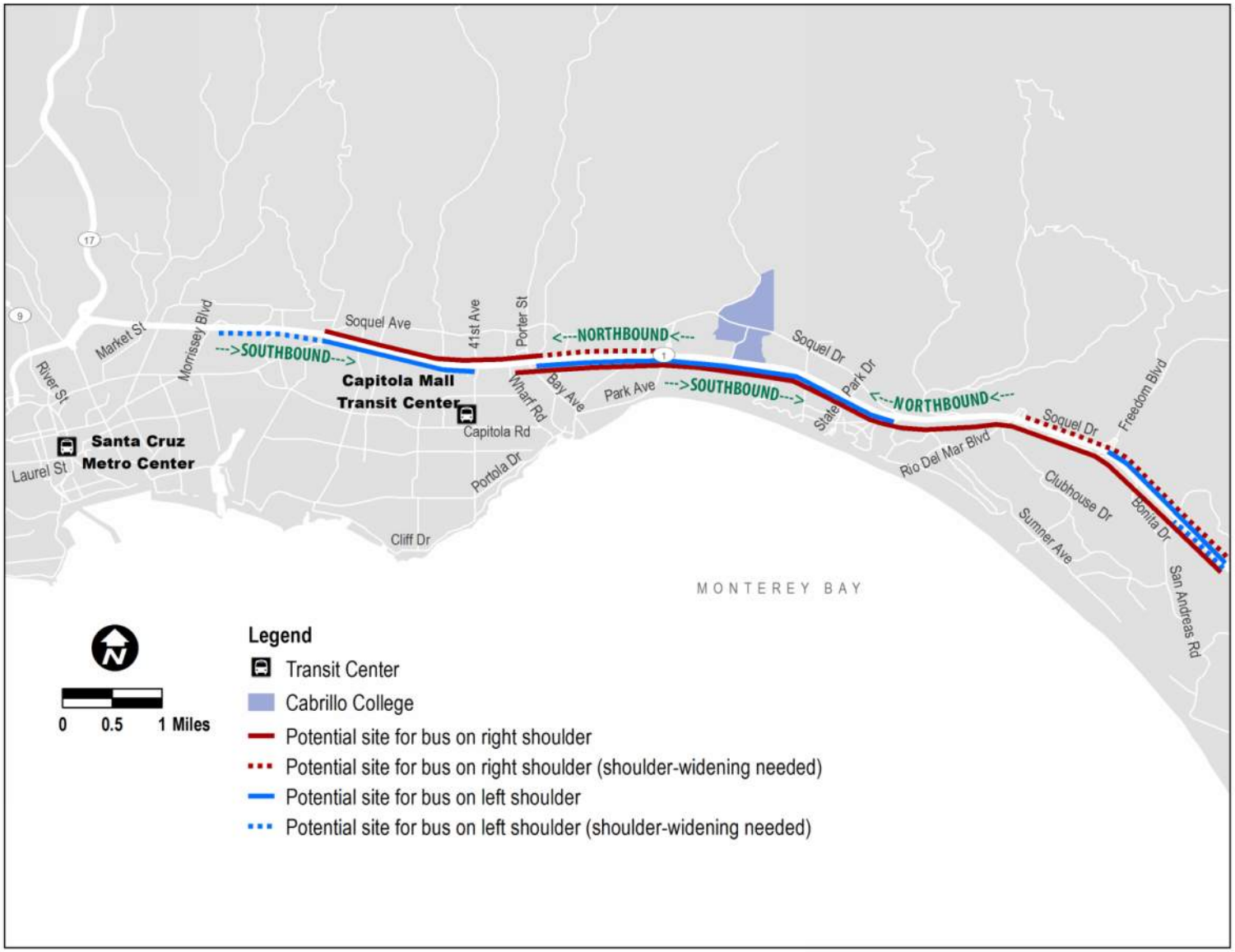


Table 3-28: Typical Rights-of-Way – Monterey County Focus Area

State Route 1 Location	Northbound Direction			Southbound Direction		
	Left Shoulder (feet)	Right Shoulder (feet)	Total Right-of-Way (feet)	Left Shoulder (feet)	Right Shoulder (feet)	Total Right-of-Way (feet)
1. Soledad Drive/Munras Avenue – Aguajito Road	4-6	7-11	35-45	4-6	6-8	35-45
2. Aguajito Road – Fremont Boulevard	2-4	6	35-50	0-6	0-8	40-50
3. Fremont Boulevard – SR-68	2-3	2-3	50-70	0-6	0-8	50-60
4. SR-68 – Casa Verde Way	7	6	35-55	46	4-6	35-55
5. Casa Verde Way – Del Monte Avenue	4-5	6-7	40-55	5-6	4-6	35-55
6. Del Monte Avenue – Canyon Del Rey Boulevard	0	0-6	35-50	0	0	35-50
7. Canyon Del Rey Boulevard – Tioga Avenue	4-6	8	40-50	3-6	9	40
8. Tioga Avenue – Fremont Boulevard	4-6	0-7	35-50	4-6	7-10	35-60
9. Fremont Boulevard – Lightfighter Drive	4-6	8-12	50-65	5-7	9	45-65
10. Lightfighter Drive – Imjin Parkway	4-6	8-15	50-70	4-6	8-9	50-80
11. Imjin Parkway – Del Monte Boulevard	6-8	7-10	70-85	4-6	10-11	60-75
12. Del Monte Boulevard – Reservation Road	4-6	10-12	35-60	4-6	10-11	35-50
13. Reservation Road – Del Monte Boulevard	4-6	8-10	40-60	3-6	8-11	40-50
14. Del Monte Boulevard – Salinas River	4-7	6-8	40	4-6	9	40
15. Salinas River – Nashua Road	4-6	10	40	3-5	8-10	50
16. Nashua Road – SR 156	4-6	9	50	3-5	9-10	50

- **Canyon Del Rey Boulevard to Tioga Avenue** – The right shoulder is about 8 feet wide including passing beneath the Tioga overpass. The overpass has a center support pier and it appears the right shoulder could be widened, but not easily.
- **Tioga Avenue to Fremont Boulevard** – The right shoulder is about 7 feet wide but is dropped at the overcrossing of Fremont Boulevard.
- **Fremont Boulevard to Lightfighter Drive** – The right shoulder is 10 to 12 feet wide along this segment, but does narrow a little at the Lightfighter Drive overpass (to 8 feet).
- **Lightfighter Drive to Imjin** Parkway – The right shoulder width varies along this segment ranging from 8 to 15 feet. Drifting sand is also evident along this shoulder segment.
- **Imjin Parkway to Del Monte Boulevard** – The Del Monte Boulevard off-ramp is an adequate lane facility. The right shoulder is about 10 feet in width, but has sand cover on most of its length. At the overcrossing of Lake Drive the shoulder narrows to 7 feet.
- **Del Monte Boulevard to Reservation Road** – The right shoulder is 10 to 12 feet wide on this segment, but narrows to 8 feet on the overcrossing of Reservation Road.
- **Reservation Road to Del Monte Boulevard** – The right shoulder is 8 to 10 feet wide.
- **Del Monte to Salinas River** – The right shoulder is about 8 feet wide except for the bridge over the Salinas River where it narrows to 6 feet.
- **Salinas River to Nashua Road** – The right shoulder widens to 10 feet north of the river to Nashua Road.
- **Nashua Road to SR 156** – The right shoulder is about 9 feet in width.

Southbound Travel

- **SR 156 to Nashua Road** – The southbound right shoulder is 9 to 10 feet wide on this segment.
- **Nashua Road to Salinas River** – A ten-foot right shoulder is provided on this segment except on the bridge crossing the Salinas River where it narrows to 8 feet.
- **Salinas River to Del Monte Boulevard** – The shoulder is about 9 feet wide on the right side of southbound SR 1.
- **Del Monte Boulevard to Reservation Road** – A 10 to 11-foot shoulder is provided, except for the overcrossing of a private road connecting to a sand quarry where it narrows to 8 feet. Buses would likely need to remerge with traffic over this bridge.
- **Reservation Road to Imjin Parkway** – A 10 to 11-foot right shoulder is provided on this segment. Drifting sand might be a problem for these shoulders.
- **Imjin Parkway to Lightfighter Drive –** The right shoulder is 8 to 9 feet wide on this section and could be widened assuming environmental constraints would permit. SR 1

passes beneath an overcrossing that provides access to Stilwell Hall located in the Fort Ord Dunes State Park.

- **Lightfighter Drive to Fremont Boulevard –** The right shoulder is generally about 9 feet wide and appears possible to widen to 10 to 11 feet if environmental constraints are addressed.
- **Del Monte Boulevard to Tioga Avenue –** The right shoulder is more than 10-feet-wide except at the overcrossing of Playa Avenue, where it narrows to 7 feet.
- **Tioga Avenue to Canyon Del Rey Boulevard –** The right shoulder is about 9 feet wide and appears to have drifting sand issues.
- **Canyon Del Rey Boulevard to Casa Verde Way** – Right shoulder becomes an auxiliary traffic lane on this segment. Buses could use the auxiliary lane, but it is dropped without shoulder at Casa Verde Way.
- **Casa Verde Way to SR-68** – Narrow shoulders of less than 6 feet are provided along this segment.
- **SR-68 to Aguajito Road** – Either no shoulder is provided or shoulder less than an 8-foot-wide is provided.
- **Aguajito Road to Soledad Drive** – The shoulders are less than 8 feet wide and appear difficult to be widened on this section.

Potential sites for bus-on-shoulder concepts in Monterey County are illustrated in **Figure 3-10**.

Monterey Branch Line

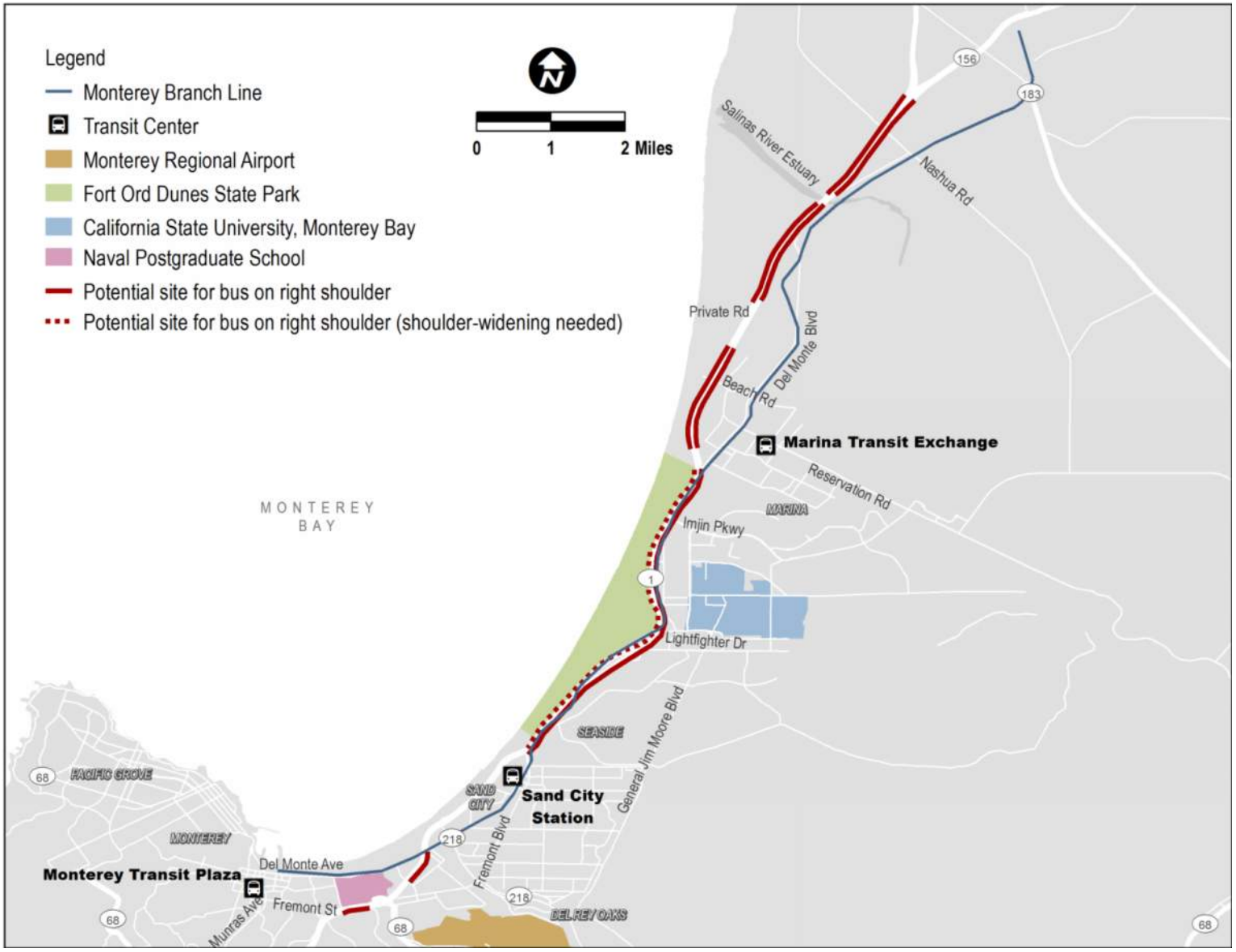
The Monterey Branch was built in 1879 and opened to traffic on January 1, 1880; it linked San Francisco to the Hotel Del Monte and Pebble Beach. It branched from the Southern Pacific Coast Line main line in Castroville. Gradually, traffic on the line diminished and it fell into disrepair. TAMC purchased the line from the Union Pacific Railroad in 2003. The *Alternatives Analysis Monterey Peninsula Fixed Guideway Corridor Study* conducted by TAMC examined both light rail and bus alternatives on the branch line right-of-way. Lack of funding has precluded moving forward with the project.

The branch line right-of-way is generally 100 feet wide. TAMC owns the portion from Watsonville to Canyon Del Rey Boulevard in Seaside. The remainder of the right-of-way is owned by the City of Monterey and has been converted to a pedestrian/bicycle trail that extends to Pacific Grove. The right-of-way parallels SR 1 extending south from Castroville under SR 156 and following the route of Monte Road and Lapis Road to and through the City of Marina. From there it crosses under SR 1 and continues south, just west of SR 1 until it turns to the southeast and crosses under SR 1 again, entering Sand City at the northern junction of Fremont and Del Monte Boulevards. From here it continues south just east of Del Monte Boulevard and west of California Avenue continuing into Seaside south to Canyon Del Rey Boulevard. Private businesses have encroached on major portions of the right-of-way in this area. However, these businesses are leasing the right-of-way from TAMC with the provision that the leases could be terminated when another use

for the right-of-way is identified. The SR 1 structures also pose some constraints on the right-of-way.

The use of the Branch Line right-of-way would be an option for buses all the way from Castroville south to Monterey. However, since the highest density of MST bus services in the corridor now occurs between Marina and Monterey, this segment of the right-of-way is of most interest. Buses could use the right-of-way on an exclusive bus-only roadway from the Marina Transit Exchange and continue south via the right-of-way along the west side of SR 1, stopping at Sand City Station and then continuing south to a possible new transit center in Seaside near Canyon Del Rey Boulevard. This section of the right-of-way through Sand City and Seaside would also be a candidate for a pedestrian bicycle path. This path would connect with the Monterey Peninsula Recreational Trail at SR 1 in Sand City and then with the Monterey Bay Coastal Trail at Canyon Del Rey Boulevard.

Figure 3-10: Potential Bus-on-Shoulder Sites in Monterey County



The desired and minimum design criteria for busway use of the railroad right-of-way depend on the desired facility usage, including speed. The railroad right-of-way potentially could be used for a two-way busway, for a one-way reversible busway, and possibly a combined busway and bikeway facility. It is also possible that some segments could be operated with "block signals" and operate as one-way reversible for short segments if the bus volumes are modest. Because the current pattern of commuter travel is dominant in the southbound direction in the morning and northbound in the evening, a one-lane busway could function to serve peak direction buses and then the buses could use SR 1 and local streets in the off-peak direction.

Given these considerations the options are as follows:

1. Two-lane exclusive busway,
2. Single-lane bi-directional busway with passing pullouts and signals, and
3. Single-lane reversible peak direction only busway.

AASHTO in their Guide for Geometric Design of Transit Facilities on Highways and Streets suggests a 48-foot cross section for a two-way busway on separate right-of-way and a 38-foot wide cross-section for reduced standards. These criteria are generally consistent with transit median facility criteria for freeways. The National Cooperative Highway Research Program (NCHRP) Report 155 suggests a 30-foot wide cross-section as the minimum width for two-way busway and 36 feet desirable for two-way busway. Station stops would add to the minimum widths. A 20-foot minimum width would be desirable for reversible or bi-directional busway, but short pinch-point segments of 12 feet might prove feasible. Provision of a two-way bikeway adjacent to the busway would increase the required widths by a minimum of 12 feet. A two-way cycle-track with a separate pedestrian path would be 18 to 22 feet in width.

Given these standards it should be feasible to accommodate both a two-way busway and a pedestrian/bicycle path in the 100-foot right-of-way. It may even be possible to retain the existing railroad tracks which are typically in the center of the right-of-way.

Chapter 4
Project Alternatives

A description of the project alternatives is provided in this chapter. Separate alternatives were developed for Monterey and Santa Cruz Counties. These alternatives were developed to allow buses to bypass traffic congestion on SR 1 during morning and evening peak traffic periods.

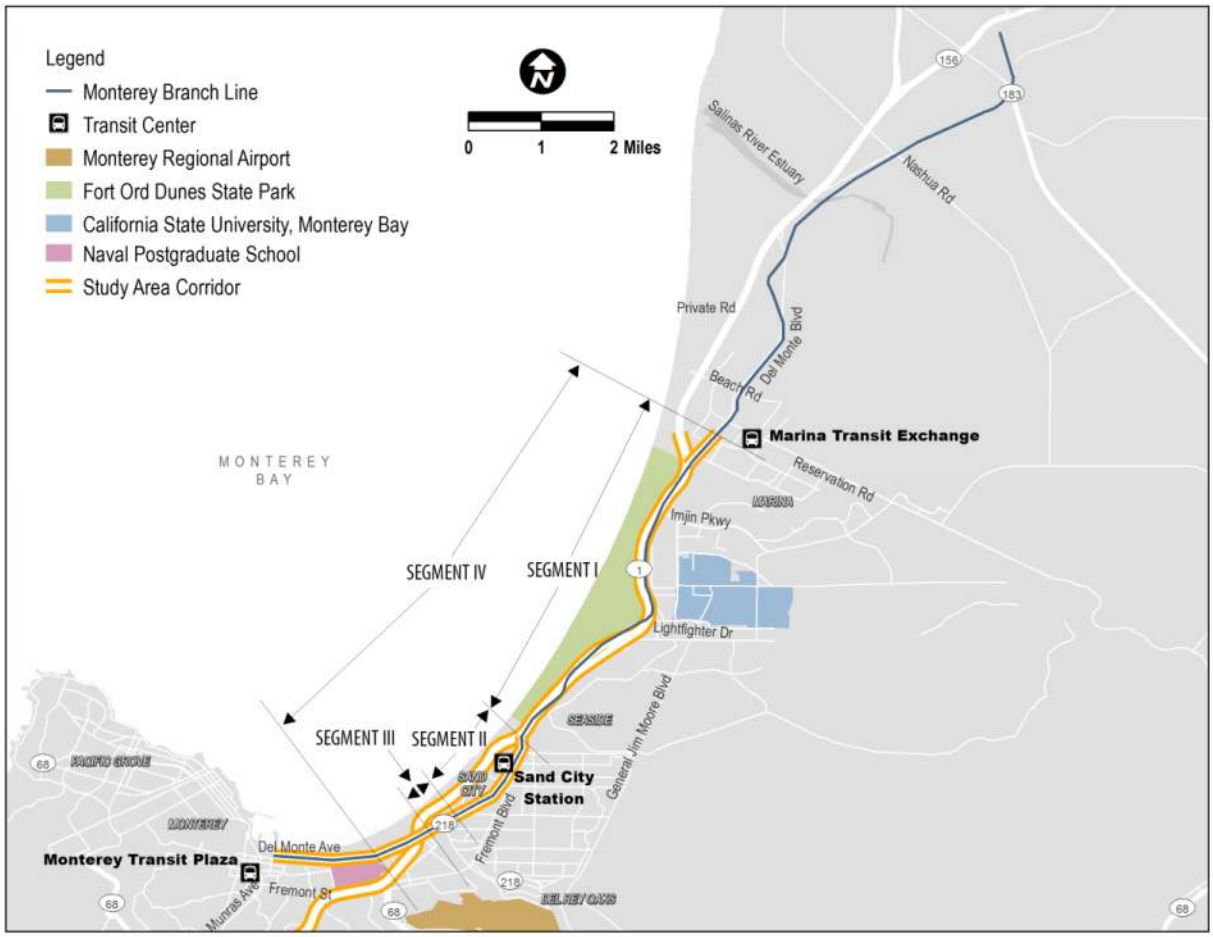
Monterey County

In Monterey County, severe traffic congestion is observed along southbound SR 1 between Reservation Road and Del Monte Avenue interchanges during the morning peak period and along northbound SR 1 between Carpenter Street and Fremont Boulevard during the evening peak period. Therefore, project options to improve bus operations along SR 1 were developed for an approximately eight-mile stretch between Reservation Road in Marina and Casa Verde Way in Monterey. In Monterey County, because of the number of options and variations of options that were identified, the corridor has been divided into four segments (see **Figure 4-1**) and within each segment different options have been defined as shown in the list below. Then, alternatives, spanning the length of the corridor were created by making logical combinations of the options from each segment of the corridor. For example, the Bus-on-Shoulder – Alternative 1, discussed in Chapter 5, was created by combining Option I-A from Segment I, Option II-A from Segment II, and Option III-B from Segment III.

- Segment I: Reservation Road/SR 1 (Marina) to Fremont Boulevard/SR 1 (Sand City)
  - Option I-A – Southbound Bus-on-Shoulder
  - Option I-B – Monterey Branch Line Busway
  - Option I-C – Caltrans Bike/Pedestrian Trail
- Segment II: Fremont Boulevard/SR 1 (Sand City) to SR 218 (Seaside)
  - Option II-A – Southbound Bus-on-shoulder
  - Option II-B – Monterey Branch Line Busway
- Segment III: SR 218 (Seaside) to Del Monte Avenue (Monterey)
  - Option III-A – BRT to English Avenue
  - Option III-B – Southbound Bus-on-Shoulder
- Segment IV: Casa Verde Way/SR 1 (Monterey) and Fremont Boulevard/SR 1 (Sand City)
  - Option IV-A – Northbound Bus-on-Shoulder

Details of these options are provided below.

Figure 4-1: Study Corridor Segments – Monterey County



Segment I: Reservation Road/SR 1 to Fremont Boulevard/SR 1

For the 5.5-mile segment between the junction of Reservation Road and Del Monte Boulevard in Marina, and the Fremont Boulevard/SR 1 interchange in Sand City, three options were developed. Each of the three options would involve the following common features:

- Queue jump lanes at the Reservation Road/Del Monte Boulevard and the Reservation Road/Palm Avenue intersections in Marina, and Fremont Boulevard/Monterey Road/SR 1 ramps intersection in Sand City
- Connections to the new intermodal corridor station that would be located at the junction of 8th and 9th Streets in Marina and the planned Marina-Salinas Multimodal Corridor along 8th and 2nd Avenues via:
  - 9th Street and Monterey Peninsula Recreation Trail, or
  - 9th Street, 5th Street, 1st Avenue, and Divarty Street
- New bus stations at Monterey Peninsula Recreational Trail/Divarty Street junction in Marina and Fremont Boulevard/Monterey Road/SR 1 ramps intersection in Sand City

Project options for Segment I along with their common features are illustrated in **Figure 4-2**, while descriptions of the options are provided in the sections below.

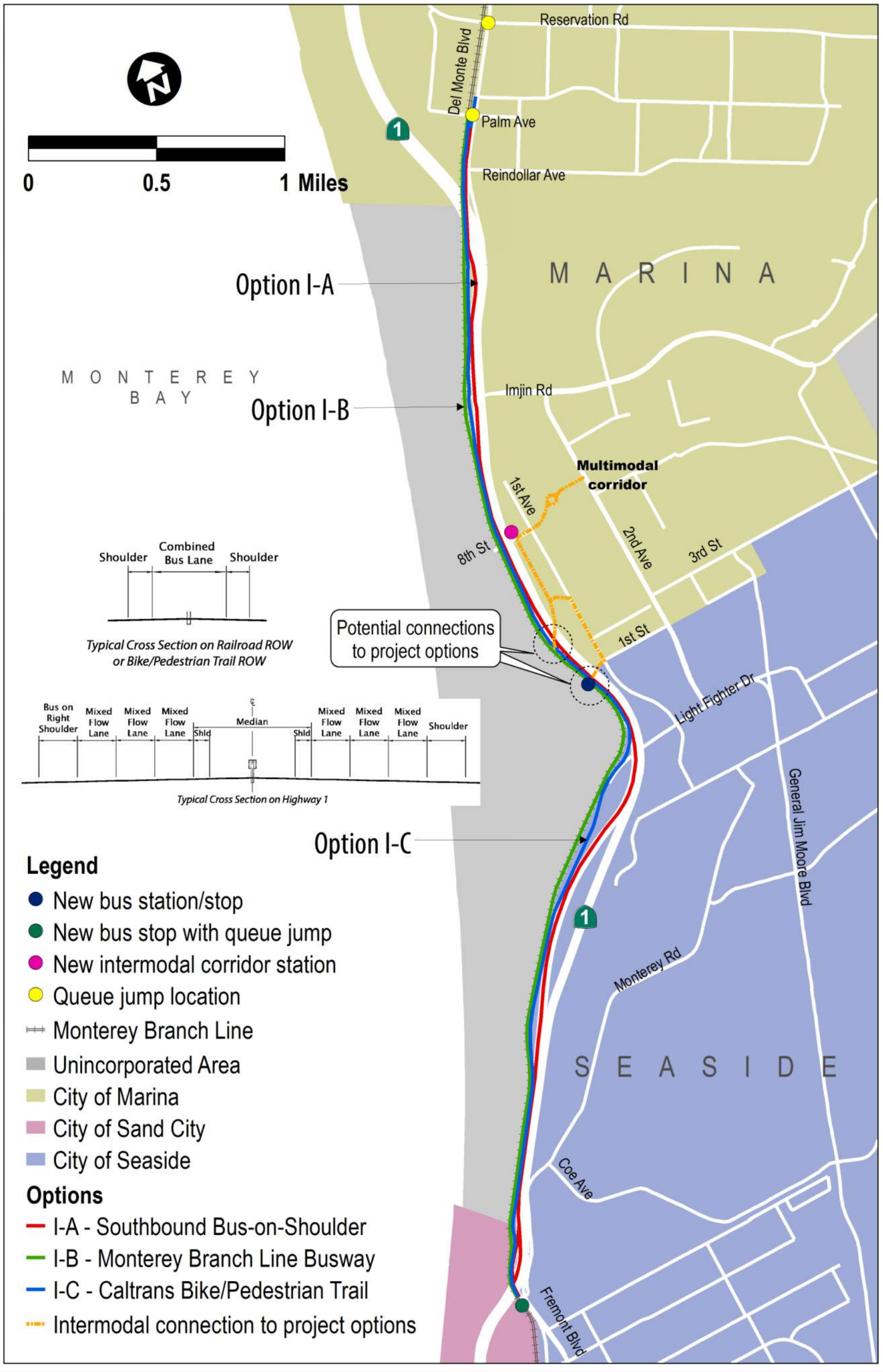
Option I-A: Southbound Bus-on-Shoulder

Option I-A would support bus-on-shoulder operations on the right shoulder of southbound SR 1 between Del Monte Boulevard in Marina on-ramp and the Fremont Boulevard/SR 1 interchange. Buses will be able to use the right shoulder of the southbound on-ramp from Del Monte Boulevard in Marina as well. Vehicle-to-infrastructure technology will be used to enhance bus-on-shoulder operations. For example, this technology can be used at on-ramp junctions to momentarily stop on-ramp traffic whenever a bus approaches and crosses the on-ramp. Option I-A would provide bus on right-shoulder operations primarily during the morning peak period (7-10 AM), since southbound SR 1 experiences major congestion during morning periods only. Generally, southbound right shoulders in Segment I are 9 to 11 feet wide currently, but additional right-of-way is available to widen the right shoulders to at least 10 feet to accommodate bus-on-shoulder operations.

Advantages:

- *Independent of Off-Ramp Queue Spillovers:* Traffic spilling back from a congested off-ramp onto freeway would not affect bus speeds, except at the off-ramp junction where buses would go across the off-ramp.
- *Cost Effective:* Option I-A involves minor construction. Most of the construction would be related to minor shoulder widening, signage, and striping. Maintenance could be performed as part of normal freeway maintenance.

Figure 4-2: Monterey Segment I Options



Disadvantages and Potential Issues:

- *Shared Shoulders:* Shoulders will not be available for the exclusive use of emergency vehicles.
- *Speed Limits:* Bus speeds are no more than 10 miles per hour faster than adjacent traffic and are determined by the speed of congested traffic in the right-most travel lane.
- *Structures:* The old rail spur overcrossing south of 5th Street has a narrow shoulder and buses will need to bypass by merging out of the shoulder and back into the right traffic lane and then moving back to the shoulder after the bridge is crossed.

Option I-B: Monterey Branch Line Busway

Option 1-B will construct a 12-foot dedicated, reversible busway with shoulders within the Monterey Branch Line's right-of-way and allow buses to operate in both directions. In Segment I, the Monterey Branch Line runs parallel to SR 1 on the west side. Buses will operate in the southbound direction during the morning peak period and the northbound direction during the evening peak period. At the north end, buses will access the busway at the intersection of Del Monte Boulevard and Reservation Road or Del Monte Boulevard and Palm Avenue. The southern terminus of this option would be at the Monterey Road/California Avenue/Fremont Boulevard intersection.

Advantages:

- *Dedicated* Right-of-Way*:* Due to a dedicated right-of-way, busways will have a constant speed limit that is independent of freeway traffic speeds and congestion. Also, buses will travel at the speed limits, improving their travel time and reliability.
- *Autonomous Buses:* Due to a dedicated right-of-way separated from traffic, it is reasonable to consider operating autonomous buses as part of this option.
- *Open Shoulders:* Freeway shoulders will be available for the exclusive use of emergency vehicles.

Disadvantages and Potential Issues:

- *Limited Access:* The busway will have limited access points; as such, this option is suitable for express and limited bus lines, but not for local bus lines.
- *Structures:* Narrow overcrossing of unknown condition at Divarty Street will most likely need to be replaced
- *Costlier than Bus-on-Shoulder Operations:* Option B involves busway construction costs and is expected to be more expensive that Option I-A. As a new, separate facility from the freeway it will require its own maintenance program.

Option I-C: Caltrans Bike/Pedestrian Trail

Option 1-C is similar to Option 1-B, except that the dedicated, reversible busway will be provided within the right-of-way of the Caltrans Bike/Pedestrian Trail (Monterey Peninsula Recreational Trail) that runs between SR 1 and the Monterey Branch Line parallel and adjacent to SR 1. Buses

will primarily operate in southbound direction during the morning peak period and northbound direction during the evening peak period. Also, buses will access the north end of the busway at the intersection of Reservation Road and Palm Avenue. The southern terminus of this option would be at the Monterey Road/California Avenue/Fremont Boulevard intersection. There is a short section of the recreational trail north and west of this intersection where the two parallel trails are combined. This section would be displaced by the busway and this alterative includes replacement of this section of trail using the Branch Line right-of-way.

Advantages:

- *Dedicated* Right-of-Way*:* Due to a dedicated right-of-way, busways will have a constant speed limit that is independent of freeway traffic speeds and congestion. Also, buses will travel at the speed limits, improving their travel time and reliability.
- *Autonomous Buses:* Due to a dedicated right-of-way separated from traffic, it is reasonable to consider operating autonomous buses as part of this option.
- *Open Shoulders:* Freeway shoulders will be available for the exclusive use of emergency vehicles.

Disadvantages and Potential Issues:

- *Limited Access:* The busway will have limited access points; as such, this option is suitable for express and limited bus lines, but not for local bus lines.
- *Costlier than Bus-on-Shoulder Operations:* Option I-C involves busway construction costs and is expected to be more expensive that Option I-A.
- *Trail Displacement:* Option I-C displaces the Monterey Peninsula Recreational Trail. There is an alternative trail to west that serves the same function. However, there is an active bicycling contingency which may object to discontinuing the use of the recreation trail. A section where the two trails merge into one will be replaced as part of this option.

Segment II: Fremont Boulevard/SR 1 to SR 218

To improve bus operations for the 1.5-2-mile stretch between the Fremont Boulevard/SR 1 interchange in Sand City and SR 218 (Canyon Del Rey Boulevard) in Seaside, two options were developed – one along SR 1 and the other along the Monterey Branch Line. These options are extensions of Options I-A, I-B and I-C in Segment I. Project options for Segment II are illustrated in **Figure 4-3**.

Option II-A: Southbound Bus-on-Shoulder

Option II-A is an extension of Option I-A, a continuation of bus-on-shoulder. It could be paired with Options I-B or I-C also, but a costly connector to the freeway from either the Monterey Branch Line or the Monterey Peninsula Recreational Trail would need to be constructed. This option will provide for bus operations on the southbound right shoulder of SR 1 between the Fremont Boulevard and SR 218 interchanges with SR 1. Vehicle-to-infrastructure technology will be used to enhance bus-on-shoulder operations at on-ramps. Similar to Option I-A, Option II-A will provide bus on right-shoulder operations primarily during the morning peak period (7-10 AM).

Southbound right shoulders in Segment II are 7 to 10 feet wide. However, additional right-of-way is available to widen the right shoulders to at least 10 feet to accommodate bus-on-shoulder operations.

Advantages:

- *Independent of Off-Ramp Queue Spillovers:* Traffic spilling back from a congested off-ramp onto freeway would not affect bus speeds, except at the off-ramp junction where buses would go across the off-ramp.
- *Cost Effective:* Option II-A involves minimal construction (as long as structure widening is avoided). Most of the construction would be related to minor shoulder widening, signage, and striping. Maintenance could be performed as part of normal freeway maintenance.

Disadvantages and Potential Issues:

- *Shared Shoulders:* Shoulders will not be available for the exclusive use of emergency vehicles.
- *Speed Limits:* Bus speeds are no more than 10 miles per hour faster than adjacent traffic and are determined by the speed of congested traffic in the right-most travel lane.
- *Structures:* There are three major structures, the crossing of the railroad and the southbound off-road to Fremont Boulevard, the crossing of the Monterey Peninsula Recreational Trail and the crossing of SR 218 in this segment. All of these have narrow shoulders requiring buses to bypass each bridge by merging out of the shoulder and back into the right traffic lane and then moving back to the shoulder after the bridge is crossed. The option to these is to widen these structures. This however, represents a cost of $25-35 million for each structure, which would make the project infeasible in terms of cost-effectiveness.

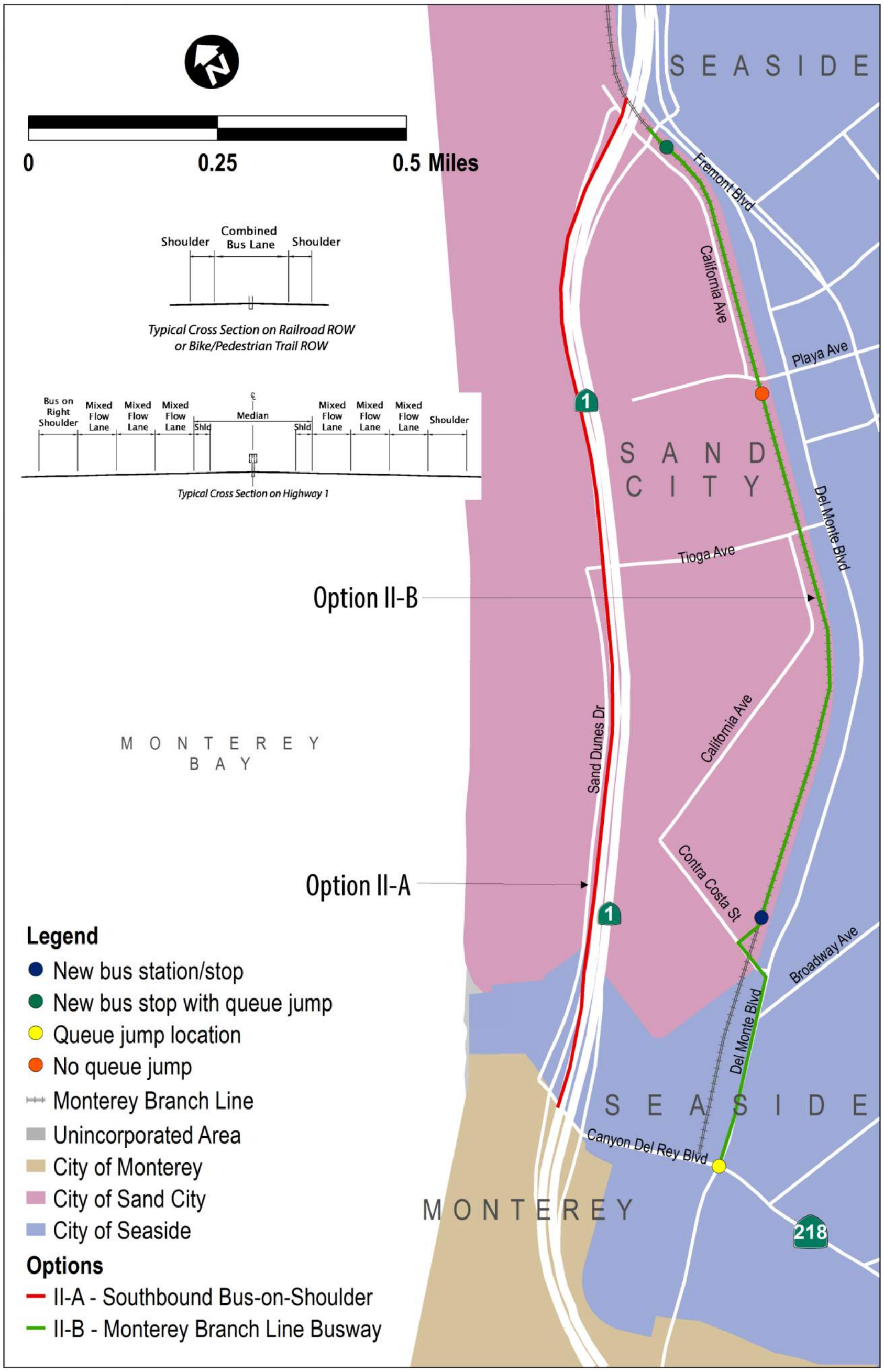
Option II-B: Monterey Branch Line Busway

Option II-B is an extension of Option I-B. This option will involve buses operating along a dedicated, reversible busway constructed within the Monterey Branch Line's right-of-way. Similar to Option I-B, to avoid freeway congestion, buses will primarily operate in southbound direction during the morning peak period and northbound direction during the evening peak period.

South of the Fremont Boulevard/SR 1 interchange, the Monterey Branch Line crosses under SR 1 and runs parallel to Del Monte Boulevard until Contra Costa Street. As such, as part of Option II-B, buses will operate as follows:

- Between SR 1 and Contra Costa Street – Along the Monterey Branch Line in a dedicated busway. The busway will cross under Monterey Road and will cross Playa and Tioga Avenues at grade with new traffic signals (or traffic roundabouts) at both locations.
- At Contra Costa Street – The busway will end, and buses will enter Del Monte Boulevard via Orange Avenue and Contra Costa Street.

Figure 4-3: Monterey Segment II Options



- Between Contra Costa Street and SR 218 – The buses would use Del Monte Boulevard in mixed traffic.

Bus stops and queue jump lanes will be provided as follows:

- A bus stop along the Monterey Branch Line between Playa and Tioga Avenues to serve Sand City Station,
- A bus stop along Orange Avenue at its junction with the Monterey Branch Line, and
- Queue jump lanes at the intersection of Del Monte and Canyon Del Rey Boulevards.

Advantages:

- *Dedicated* Right-of-Way*:* Due to a dedicated right-of-way, busways will have a constant speed limit that is independent of freeway traffic speeds and congestion. Also, buses will travel at the speed limits, improving their travel time and reliability.
- *Autonomous Buses:* Due to a dedicated right-of-way separated from traffic, it is reasonable to consider operating autonomous buses as part of this option.
- *Open Shoulders:* Freeway shoulders will be available for the exclusive use of emergency vehicles.

Disadvantages and Potential Issues:

- *Limited Access:* The busway will have limited access points; as such, this option is suitable for express and limited bus lines, but not for local bus lines.
- *Encroachment* – Private businesses have been allowed to use the right-of-way in Sand City for parking for storage purposes on a month-to-month lease basis. The construction of the busway would require that these leases be terminated, and the businesses would have to adapt to operating without use of the rail right-of-way.
- *Costlier than Bus-on-Shoulder Operations:* Option II-B involves busway construction costs and is expected to be more expensive that Option II-A. As a new, separate facility from the freeway it will require its own maintenance program.
- *Street Crossings:* The busway will cross Playa and Tioga Avenues at-grade, creating a new intersection very close to existing intersections on either side. New traffic signals or roundabouts are possible solutions, but care will need to be taken not to worsen an already difficult traffic operations issue.
- *Sand City Station Transfers:* Option II-B will have a bus stop about 800 feet away from Sand City Station; as such, bus patrons at Sand City Station would have to walk to/from Sand City Station to make transfer connections.

Segment III: SR 218 to Del Monte Avenue

For the half-mile stretch between SR 218 (Seaside) and Del Monte Avenue (Monterey), two project options were developed – one along SR 1 and the other along the parallel arterial, Del Monte Avenue. Options for Segment III are illustrated in **Figure 4-4**.

Option III-A: BRT to English Avenue

Option III-A is consistent with the alignment of the Monterey Bay BRT along Del Monte Boulevard/Avenue in Seaside, Sand City, and Monterey that was evaluated and studied by MST as presented in the report *Monterey Bay BRT* prepared by MST in 2014 in coordination with the cities of Monterey, Seaside, Sand City, and Marina, as well as the California State Parks, California State University Monterey Bay, and the Fort Ord Reuse Authority. Option III-A would allow northbound and southbound buses to travel in mixed-flow lanes along Del Monte Boulevard/Avenue for about 0.3 miles between Canyon Del Rey Boulevard and English Avenue. Beyond English Avenue the alignment could transition into mixed flow operation of buses with traffic on Del Monte Avenue or could merge into a busway using the Monterey Branch Line right-of-way which is owned by the City of Monterey as was envisioned in the *Monterey Bay BRT* report. Note, however, that the alignment being evaluated in this report does not include any improvement southwest of English Avenue.

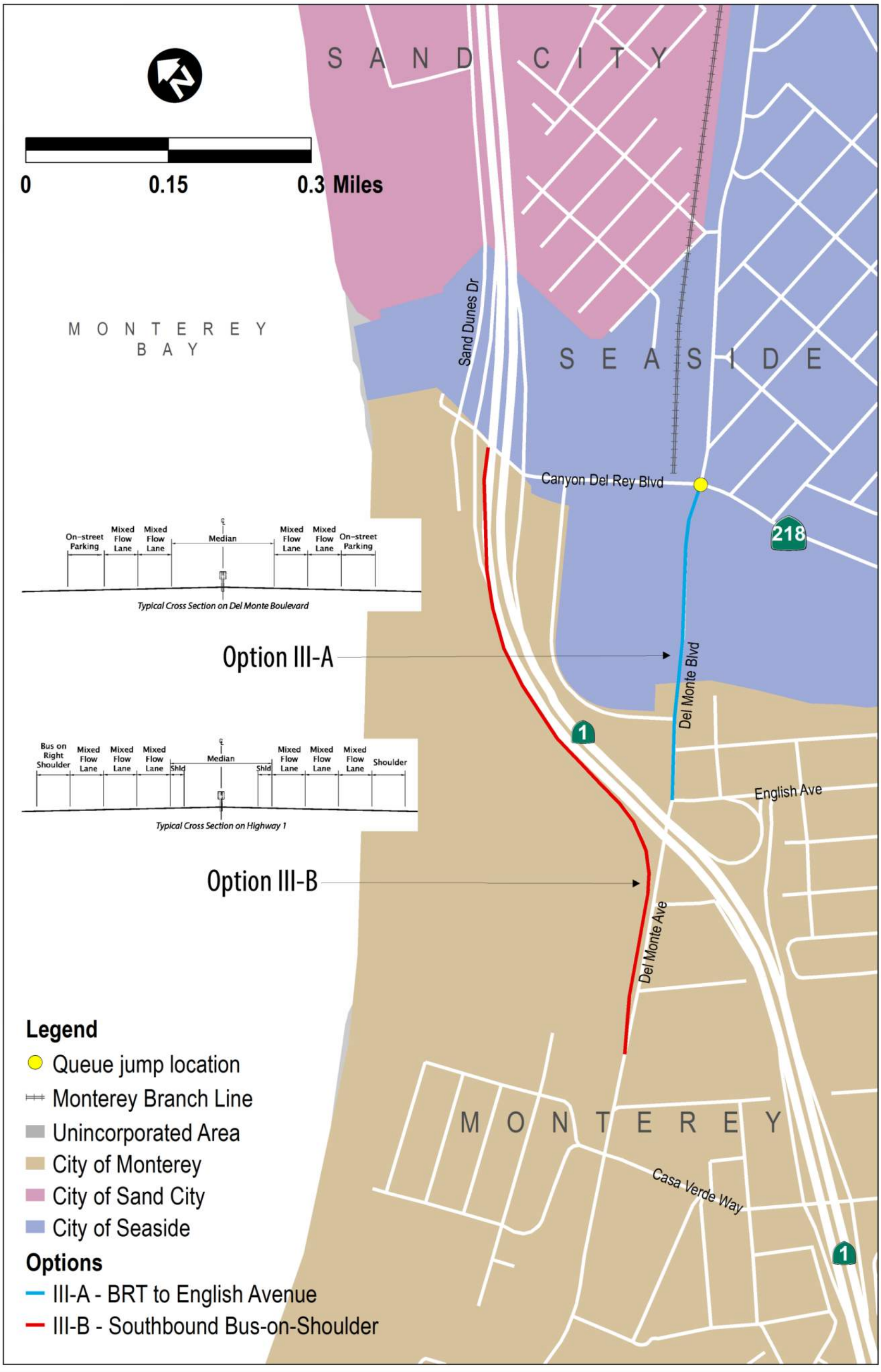
Advantages:

- *Connectivity:* This option serves the intersection of Del Monte Avenue and SR 218, which is a major transfer location for connections to other MST lines.

Disadvantages:

- *Operation in Mixed-Flow:* Travel with general traffic may cause transit delays

Figure 4-4: Monterey Segment III Options



Option III-B: Southbound Bus-on-Shoulder

Option III-B is an extension of combined Options I-A and II-A. Option III-B will provide bus-on-shoulder operations along the right shoulder of southbound SR 1 between SR 218 and the Del Monte Avenue off-ramp, including along the off-ramp. Option III-B will end at the ramp terminus of the southbound off-ramp to Del Monte Avenue. Similar to Options I-A and II-A, vehicle-to-infrastructure technology will be used to enhance bus-on-shoulder operations. Option III-B will primarily operate during the morning peak period (7-10 AM).

Advantages:

- *Independent of Off-Ramp Queue Spillovers:* Traffic spilling back from a congested off-ramp onto freeway would not affect bus speeds, except at the off-ramp junction where buses would go across the off-ramp.
- *Cost Effective:* Option III-B involves minimal construction and should be cost-effective. Most of the construction would be related to minor shoulder widening, signage, and striping. Maintenance could be performed as part of normal freeway maintenance.
- *Provision of Shoulders:* Currently, there are narrow shoulders along southbound SR 1 in Segment III. Provision of wider shoulders to accommodate bus-on-shoulder operations would also benefit emergency vehicles and regular traffic during emergency situations, especially during off-peak periods.

Disadvantages and Potential Issues:

- *Shared Shoulders:* Shoulders will not be available for the exclusive use of emergency vehicles.
- *Speed Limits:* Bus speeds are no more than 10 miles per hour faster than adjacent traffic and are determined by the speed of congested traffic in the right-most travel lane.
- *Shoulders:* As mentioned above, there are narrow shoulders along southbound SR 1 in Segment III. Widening right shoulders in Segment III would be challenging.
- *Connectivity:* This option would not provide a connection to the numerous MST lines that pass through the nearby intersection of Del Monte Boulevard and SR 218.

Segment IV: Casa Verde Way/SR 1 to Fremont Boulevard/SR 1

Option IV-A: Northbound Bus-on-Shoulder

Option IV-A will provide bus-on-shoulder operations along the right shoulder of northbound SR 1 between the Casa Verde Way/SR 1 in Monterey and the Fremont Boulevard/SR 1 interchanges in Sand City (about two miles long). If needed, buses will be able to use the right shoulder of the northbound on-ramp from Casa Verde Way. Since traffic congestion along northbound SR 1 is observed primarily during evening periods, Option IV-A will operate during the evening peak period (3-7 PM).

Currently, northbound SR 1 has narrow right shoulders in Segment IV (8 feet wide or less). Therefore, the right shoulders have to be widened all along northbound SR 1 to accommodate bus-on-shoulder operations.

The alignment of Option IV-A is exhibited in **Figure 4-5**.

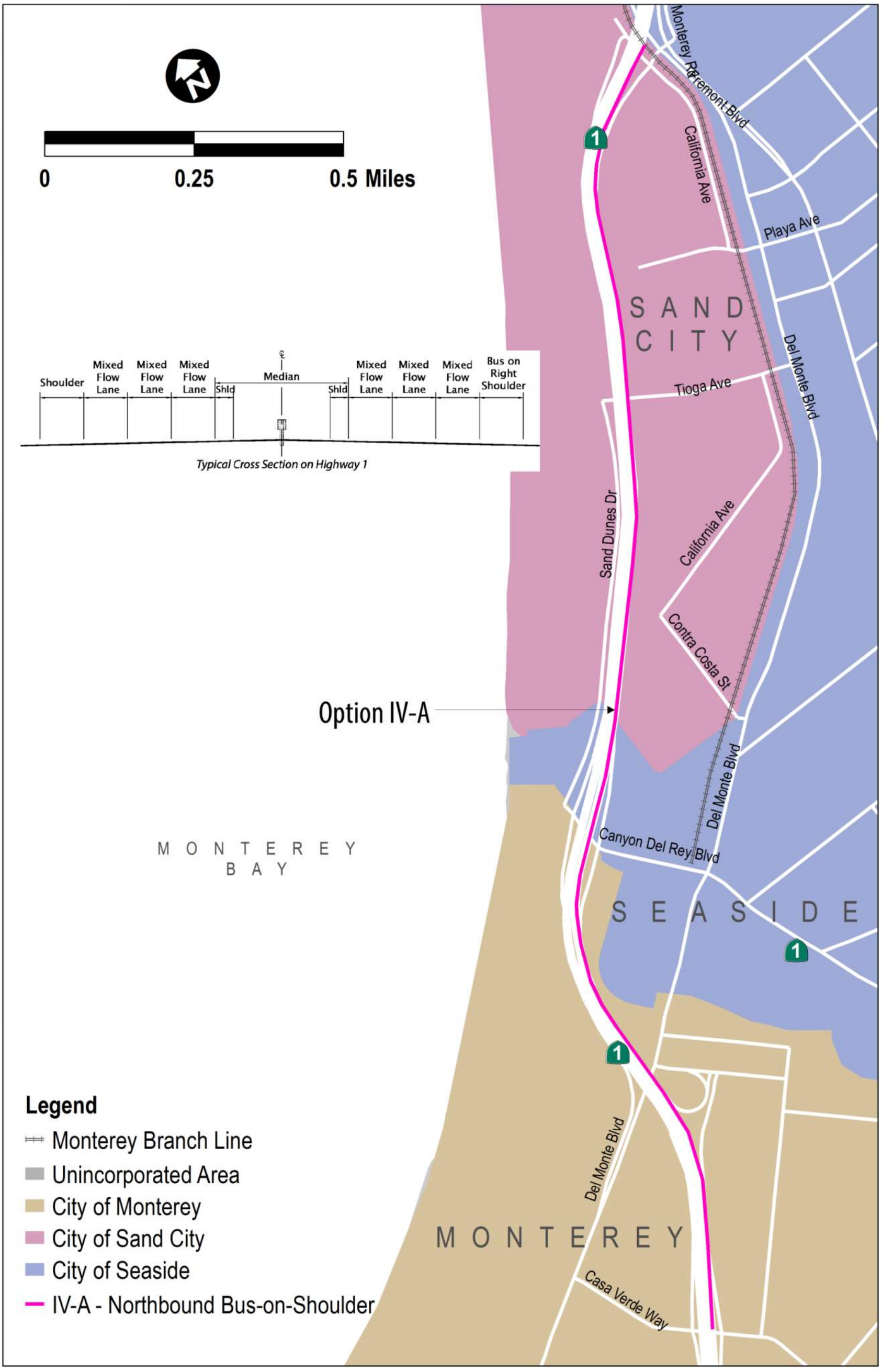
Advantages:

- *Independent of Off-Ramp Queue Spillovers:* Traffic spilling back from a congested off-ramp onto freeway would not affect bus speeds, except at the off-ramp junction where buses would go across the off-ramp.
- *Cost Effective:* Option IV-A involves a moderate level of construction and should be cost-effective. Most of the construction would be related to shoulder widening, signage, and striping. Maintenance could be performed as part of normal freeway maintenance.

Disadvantages and Potential Issues:

- *Shared Shoulders:* Shoulders will not be available for the exclusive use of emergency vehicles.
- *Speed Limits:* Bus speeds are no more than 10 miles per hour faster than adjacent traffic and are determined by the speed of congested traffic in the right-most travel lane.
- *Structures:* There are three major structures, the crossing of the Monterey Peninsula Recreational Trail the crossing of SR 218, and the crossing of Del Monte Avenue in this segment. All of these have narrow shoulders requiring buses to bypass each bridge by merging out of the shoulder and back into the right traffic lane and then moving back to the shoulder after the bridge is crossed. The option to these is to widen these structures. This however, represents a cost of $25-35 million for each structure, which would make the project infeasible in terms of cost-effectiveness.
- *Narrow Shoulders:* Currently, northbound SR 1 has right shoulders narrower than six feet along certain stretches between Del Monte Avenue and SR 218, and between Tioga Avenue and Fremont Boulevard. Widening right shoulders at these locations would be challenging.

Figure 4-5: Monterey Option IV-A



Santa Cruz County

In Santa Cruz County, severe traffic congestion is observed between the SR 17 and Buena Vista Drive interchanges on SR 1. Traffic congestion is primarily directional, with northbound SR 1 congested during the morning peak period and southbound SR 1 congested during the evening peak period. The following project alternatives were developed to improve freeway bus operations in Santa Cruz County for an approximately 7.5-mile stretch between Morrissey Boulevard in Santa Cruz and Freedom Boulevard in Aptos:

- Right-Shoulder Alternatives
  - Alternative 1 – Interim Southbound Bus-on-Shoulder
  - Alternative 2 – Bus-on-Shoulder with Auxiliary Lanes
    - *Option A: Hybrid-Auxiliary Lanes*
    - *Option B: Bus-on-Shoulder*
- Left-Side Alternative
  - Alternative 3 – HOV Lane Project

These project alternatives were developed accounting for the short-term and long-term highway improvements planned as part of the Highway 1 Corridor Investment Program[1], led by SCCRTC.

Right-Shoulder Alternatives

As part of the Highway 1 Corridor Investment Program, southbound and northbound auxiliary lanes will be constructed at the following locations:

- Auxiliary Lane 1: Between Soquel Avenue and 41st Avenue interchanges
- Auxiliary Lane 2: Between Porter Street and Park Avenue interchanges
- Auxiliary Lane 3: Between Park Avenue and State Park Drive interchanges
- Auxiliary Lane 4: Between State Park Drive and Rio Del Mar Boulevard interchanges
- Auxiliary Lane 5: Between Rio Del Mar Boulevard and Freedom Boulevard interchanges

It is important to note that the Auxiliary Lane 4 and 5 phases are considered more as long-range improvements. They are not currently funded by Measure D and they require significant mainline reconstruction and railroad bridge replacements.

Additionally, right shoulders in either direction will be improved and widened and should be 10 feet wide in most areas. However, construction of these auxiliary lanes will be completed in stages. Auxiliary Lane 1 will be starting construction by year 2021, Auxiliary Lanes 2 and 3 will begin construction by year 2023-24, but this is contingent upon the availability of funds. The

[1] Webpage: https://sccrtc.org/projects/streets-highways/hwy1corridor/

construction timeframe for Auxiliary Lanes 4 and 5 is currently unavailable. An interim bus-on-shoulder alternative was developed to provide improved transit operations prior to the implementation of the auxiliary lanes.

Alternative 1: Interim Southbound Bus-on-Shoulder

Alternative 1 provides an interim solution for bus-on-shoulder operations until the auxiliary lane projects will be constructed along SR 1. As each phase of the Auxiliary lane project proceeds, the interim bus-on-shoulder operation in that area would be discontinued. Alternative 1 will operate buses on shoulders where existing right shoulders are at least 10 feet wide or require minimal widening to be 10 feet. This alternative will avoid any major construction, including widening of interchanges, Capitola Avenue overpass, and railroad bridges located south of State Park Drive interchange. As part of Alternative 1, interim bus-on-shoulder operations will be provided along the southbound right-shoulder, primarily during the evening peak period, since southbound SR 1 experiences major congestion during evening periods only. As northbound right shoulders are typically narrower than 10 feet, bus-on-shoulder operations will not be provided along northbound SR 1. Alternative 1 will provide southbound bus-on-shoulder operations at the following three segments:

- Segment A: Soquel Avenue to 41st Avenue
- Segment B: Capitola Avenue to State Park Drive
- Segment C: South Railroad Bridge to Freedom Boulevard

At other locations, buses will operate along general-purpose lanes. The schematic layout of Alternative 1 is provided in **Figure 4-6**.

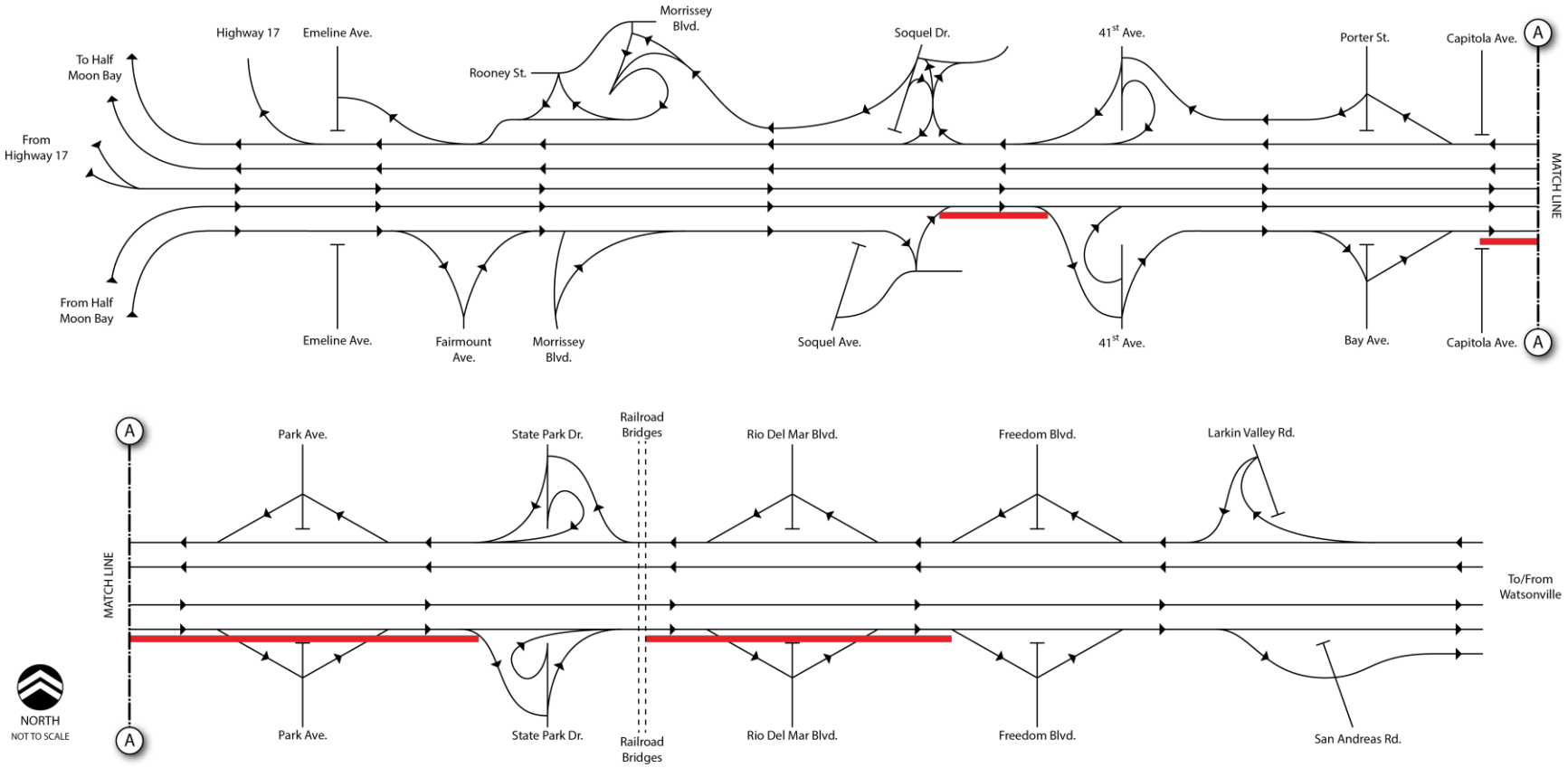
Advantages:

- *Interim Solution:* Alternative 1 provides an option to improve bus operations along SR 1 until Auxiliary Lanes 1 through 3 are constructed.
- *Cost Effective:* This alternative involves minimal construction. The majority of the construction would be related to shoulder widening, signage and striping. However, timing is important as the interim bus-on-shoulder should be in operation for at least 5 years prior to the auxiliary lane construction in order to represent a worthwhile investment. This may rule out the use of interim bus-on-shoulder operations prior to the Auxiliary Lane 1, 2 and 3 stages, as construction of these is planned to start within the next 5 years. To the extent possible interim bus-on-shoulder improvements should be designed so that they would be compatible with the future auxiliary lane project and not have to be removed when the auxiliary lane construction starts.
- *Flexibility during Construction:* During construction of an auxiliary lane, bus-on-shoulder operations could be eliminated for that segment but could be continued for other segments located outside of the construction zone.

Disadvantages and Potential Issues:

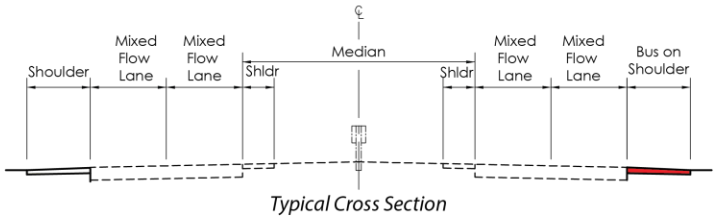
- *Operations during Construction:* Interim bus-on-shoulder operations would have to be discontinued in the construction zone when each stage of construction of auxiliary lanes begins.
- *Capital Costs:* Alternative 1 and its associated capital costs are temporary in nature, although it may be possible to design the improvements, so they would not have to removed when the auxiliary lane project moves forward, although this is not likely.
- *Speed Limits:* Bus speeds are not fixed and are determined by the speed of congested traffic in the right-most travel lane.
- *Structures/Obstacles:* Buses will need to bypass areas where shoulders are inadequate and were two-lane off ramps exists. This requires weaving out of the shoulder lane and entering the right most traffic lane until the obstacle is bypassed. This is a normal aspect of bus-on-shoulder operations, however, too many of these obstacles will degrade the benefits of bus-on-shoulder operations.

Figure 4-6: Santa Cruz Alternative 1



Note: Buses will travel on right shoulders.

Proposed Bus on right shoulder operations



Typical Cross Section

Alternative 2: Bus-on-Shoulder with Auxiliary Lanes

Alternative 2 provides a longer-term solution after year 2026 when Auxiliary Lanes 1 through 3 will be constructed along Highway 1. Alternative 2 will provide northbound and southbound bus-on-shoulder operations along SR 1 between the Morrissey Boulevard and State Park Drive interchanges. The following two options were developed for Alternative 2. Both options are assumed to eventually extend all the way from Morrissey Boulevard to Freedom Boulevard with the assumption that the bus-on-shoulder operations would be implemented at the same time or shortly after each of the five stages of auxiliary lane construction is complete. However, as no funding is currently identified for the two final stages of the auxiliary lane construction between State Park Drive and Freedom Boulevard, this portion of the project is considered very long-term and is not included as part of the project cost estimate.

Option A: Hybrid-Auxiliary Lanes

Option A will provide bus-only lanes between auxiliary lanes across interchanges. The bus-only lane will serve as an extension of the auxiliary lane across an interchange between the off-ramp and the on-ramp. These lanes could be provided on the right shoulder. As part of Option A, buses will operate on:

- Auxiliary lanes between interchanges, and
- Bus-only lanes across interchanges.

At locations with a two-lane off-ramp, buses will operate on the outermost non-exit-only lane otherwise buses would have to merge across two off-ramp lanes in order to enter the bus only lane under the overpass. Once past the off-ramps the bus can move into the bus only lane. After construction of Auxiliary Lanes 1 through 3, Option A will be provided between Morrissey Boulevard and State Park Drive interchanges, but will be extended to Freedom Boulevard interchange after construction of Auxiliary Lanes 4 and 5 occurs. The schematic layout of Alternative 2: Option A is provided in **Figure 4-7**.

Advantages:

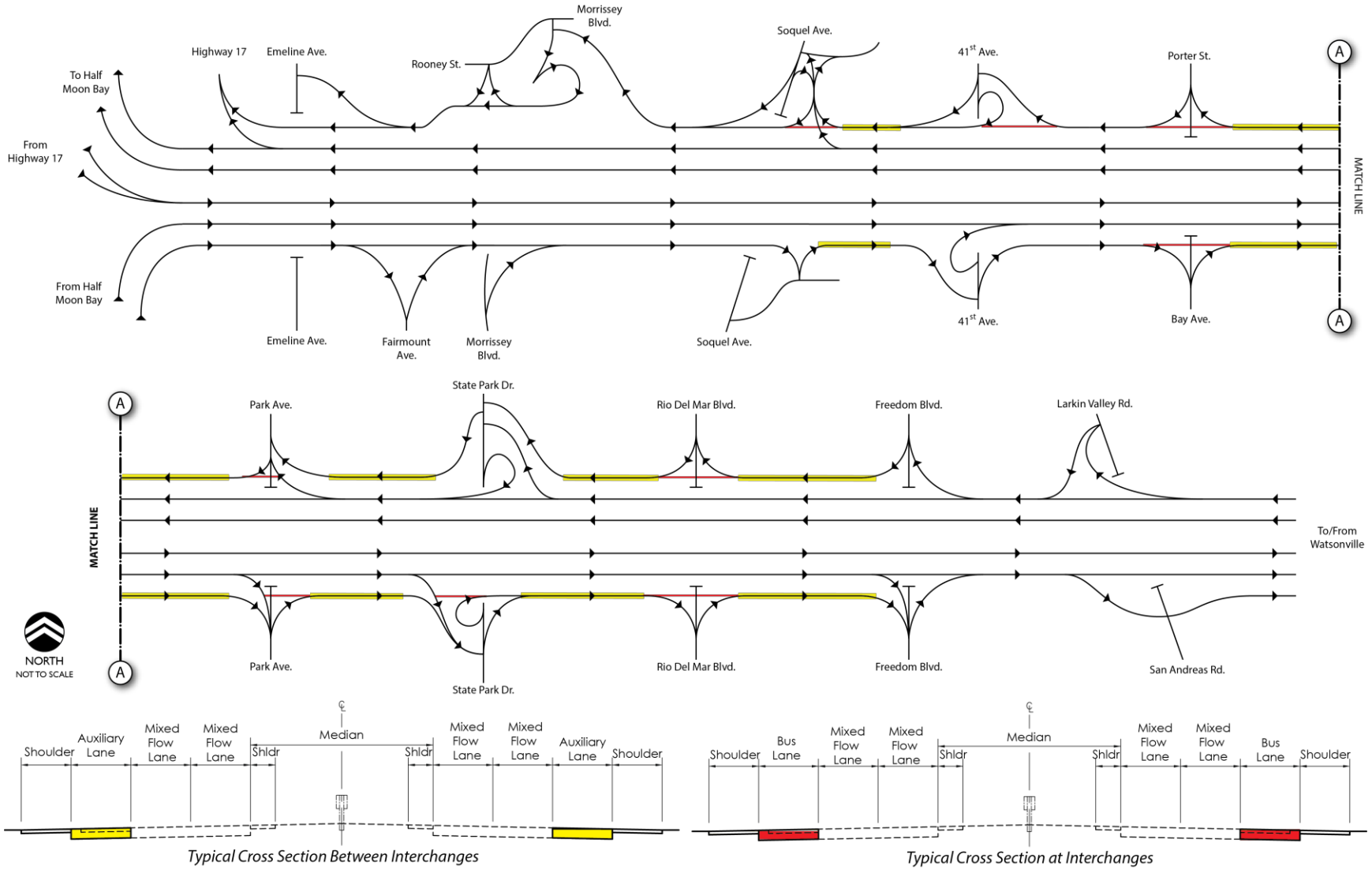
- *Higher Bus Speeds:* For most part, buses will travel on auxiliary lanes, where traffic speeds are typically higher compared to those on the remaining travel lanes. Also, auxiliary lanes do not have speed restrictions like those for bus-on-shoulder operations.
- *Moderately Cost-Effective:* Option A is moderately cost-effective – it involves no construction between interchanges and minimal construction across interchanges.
- *Open Shoulders:* Shoulders will be available for the exclusive use of emergency vehicles, especially between interchanges.

Disadvantages and Potential Issues

- *Queue Spillovers:* Traffic spilling back from a congested off-ramp onto an auxiliary lane would reduce bus speeds.

- *Two-Lane Off-Ramps:* At locations with two-lane off-ramps, a bus-only lane cannot be provided immediately after the auxiliary lane terminates to avoid conflict with exiting traffic. At such locations, buses would have to shift over from the auxiliary lane to the outermost non-exit-only lane to travel across the off-ramp junction. It is expected that with the construction of all of the planned auxiliary lanes, there will be six two-lane off-ramps in the study corridor. It is not practical to consider reducing these ramps to a single lane, as forecast traffic volumes dictate the lane requirement and removing one lane would likely cause queuing onto the freeway, which is also bad for bus-on-shoulder.
- *Structures/Obstacles:* Buses will need to bypass areas where shoulders are inadequate. This requires weaving out of the shoulder lane and entering the right most traffic lane until the obstacle is bypassed. This is a normal aspect of bus-on-shoulder operations, however, too many of these obstacles will degrade the benefits of bus-on-shoulder operations

Figure 4-7: Santa Cruz Alternative 2 – Option A



- *On-Ramp Merge Issues:* Merge-related issues could occur at bus-only lane/on-ramp junctions. These issues would be critical with loop on-ramps and could require Caltrans design exceptions. However, it is expected that these issues could be fully or partially resolved with the implementation of ramp metering that SCCRTC is planning as part of its Highway 1 Corridor Investment Program.
- *Restricted Access to Bus-Only Lanes:* Prohibiting access of general traffic to bus-only lanes will be challenging.
- *Dependent on Construction of Auxiliary Lanes:* The successful implementation of Option A is dependent on the construction of all or some of the 10 auxiliary lanes (five in each direction) planned by SCCRTC. Stages 1-3 of the auxiliary lane program will start construction by 2025, the final 2 stages will be much more long term, however it is practical to state the implementation of bus-on-shoulder to coincide with the implementation of each stage of the auxiliary lanes.

Option B: Bus-on-Shoulder

Option B will provide continuous bus on right shoulder operations between Morrissey Boulevard and Freedom Boulevard interchanges, except at the following locations:

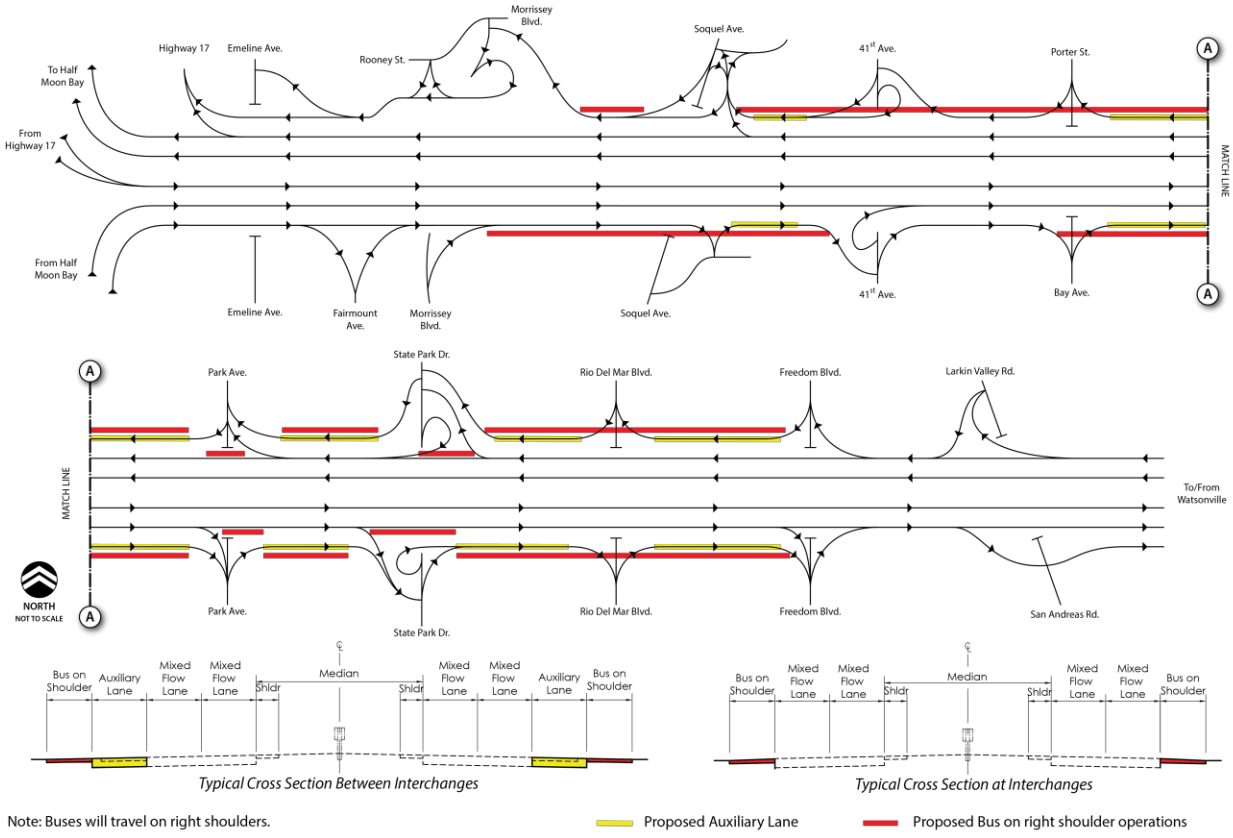
- Along southbound SR 1 between 41st Avenue and Bay Avenue/Porter Street interchanges – This location has narrow right shoulders; as such, buses will operate on auxiliary lanes.
- At two-lane off-ramps – To avoid conflicting with traffic exiting the highway, buses cannot continue on right shoulders at two-lane off-ramps; buses would have to shift over from the auxiliary lane to the outermost non-exit-only lane to travel across the off-ramp junction and enter right shoulder immediately after the off-ramp. It is not practical to consider reducing these ramps to a single lane, as forecast traffic volumes dictate the lane requirement and removing one lane would likely cause queuing onto the freeway, which is also bad for bus-on-shoulder.

The schematic layout of Alternative 2: Option B is provided in **Figure 4-8**.

Advantages:

- *Simple Design:* The design of Option B is not complicated like that of Option A. It is simple – the right shoulders will be open for bus use under certain conditions and can be easily communicated to general traffic using signage and striping.
- *Cost-Effective:* Option B involves no or minimal construction and is cost-effective. The majority of the construction would be related to shoulder widening, signage and striping.
- *Independent of Off-Ramp Queue Spillovers:* Traffic spilling back from a congested off-ramp onto freeway would not affect bus speeds, except at the off-ramp junction where buses would go across the off-ramp.
- *Improved Right Shoulder:* Freeway widening conducted as part of the auxiliary lanes' construction would provide improved right shoulders.

Figure 4-8: Santa Cruz Alternative 2 – Option B



Note: Buses will travel on right shoulders.

Proposed Auxiliary Lane

Proposed Bus on right shoulder operations

Disadvantages and Potential Issues:

- *Dependent on the Construction of Auxiliary Lanes:* Currently, the right-of-way is tight at the Capitola Avenue overpass and the two railroad bridges located south of State Park Drive. Without the construction of auxiliary lanes, buses cannot be operated on the right shoulder at these locations.
- *Structures/Obstacles:* Buses will need to bypass areas where shoulders are inadequate. This requires weaving out of the shoulder lane and entering the right most traffic lane until the obstacle is bypassed. This is a normal aspect of bus-on-shoulder operations, however, too many of these obstacles will degrade the benefits of bus-on-shoulder operations
- *Shared Shoulders:* Shoulders will not be available for the exclusive use of emergency vehicles.
- *Speed Limits:* Bus speeds are not fixed and are determined by the speed of congested traffic in the right-most travel lane.

Left-Side Alternative

Alternative 3: HOV Lane Project

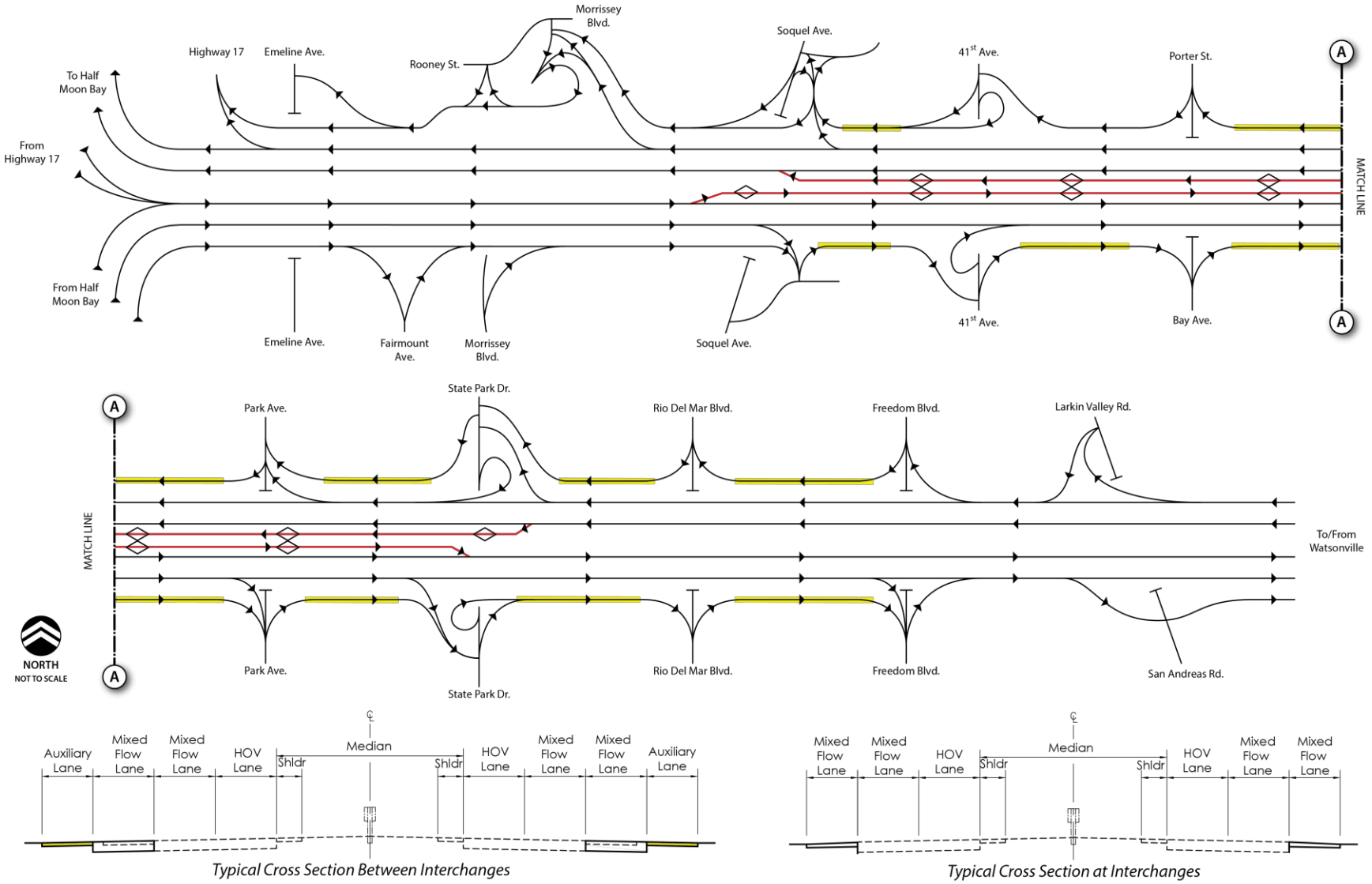
Operating buses on left shoulders in Santa Cruz County is challenging due to the following reasons:

- The study area has narrow left shoulders and requires substantial construction and widening, including widening of interchanges and other structures,
- Greater difficulty is encountered for buses while weaving to enter and exit the left shoulder,
- The merge sight lines on the right side of buses are not as good as on the left side where the driver sits resulting in bus remerges to finesse pinch-points to be less practical, and
- Access to/from left side shoulders would require weaving across two or more traffic lanes resulting in longer merge and diverge areas for buses.

As such, instead of operating buses on left shoulders, Alternative 3 will provide continuous northbound and southbound HOV lanes in the median of SR 1 between Soquel Avenue and State Park Drive interchanges. This alternative is a cost-effective, value-engineered version of the HOV Lane Alternative evaluated by SCCRTC as part of the Highway 1 Corridor Investment Program, wherein HOV lanes will be provided in either direction in the highway median between Morrissey Boulevard and San Andreas Road/Larkin Valley Road interchanges. Provision of HOV lanes would result in higher travel speeds for buses on the highway.

Alternative 3 would involve substantial construction, including widening of interchange structures between Soquel Avenue and State Park Drive, and Capitola Avenue overpass to accommodate HOV lanes in the median and auxiliary lanes on the outside. The schematic layout of Alternative 3 is provided in **Figure 4-9**.

Figure 4-9: Santa Cruz Alternative 3



Advantages:

- *High Bus Speeds:* Due to travel on exclusive bus lanes, buses will travel at or near speed limits, improving their travel time and reliability.
- *Promotes Express Service:* This alternative will aid in the operation of express bus service(s) between Santa Cruz and Watsonville.
- *Open Shoulders:* Freeway shoulders will be available for the exclusive use of emergency vehicles.

Disadvantages and Potential Issues:

- *Expensive:* This alternative involves freeway widening and construction of an exclusive lane, which will be very expensive.
- *Coordination with the Construction of Auxiliary Lanes:* Design and construction of this alternative has to be coordinated with the construction of the planned auxiliary lanes.

Cost Estimates

Methodology

Conceptual cost estimates were prepared for all alternatives and segments. The cost estimate assumes that no existing structures would be widened as part of any of the alternatives (except Santa Cruz Alternative 3 and the Monterey HOV lane alternative discussed in Chapter 5) and that no right-of-way would be acquired (except Santa Cruz Alternative 3). Unit costs were obtained from the 2016 Caltrans Cost Data Book and escalated to 2018 dollars at a rate of 3.5 percent per year.

Allowances based on the quantified bid items were included in all alternatives for storm water pollution prevention plan (3 percent), traffic handling (10 percent), miscellaneous construction costs (15 percent), and maintenance of traffic (3 percent). An allowance for mobilization (10 percent) and a contingency (35 percent) were also added to arrive at the total construction costs. Soft costs were calculated for engineering studies (3 percent), environmental (3 percent), design engineering and construction support (17 percent for alternatives within Caltrans right-of-way and 15 percent for alternatives outside of Caltrans right-of-way), and construction management (13 percent).

Bus-on-Shoulder Alternatives

Cost estimates for bus-on-shoulder alternatives were generated on a per linear foot basis. It was assumed that the existing shoulder would be excavated and replaced with a new 10-foot shoulder. The structural section for the shoulder pavement was based on the structural section proposed for travel lanes for the HOV Lane Alternative evaluated by SCCRTC as part of the Highway 1 Corridor Investment Program between Larkin Valley Road and Morrissey Boulevard interchanges. Units per linear foot for hot mix asphalt, aggregate subbase, lean concrete base, roadway excavation, imported borrow, hydroseed, clearing and grubbing, traffic stripes, roadside signs, and relocated roadway signs were calculated using typical cross sections that were exhibited in **Figures 4-1 through 4-8**. Relocation of overhead, roadside call boxes, catch basins, light poles, and guardrail

were assumed via a Google Earth assessment. Average length and height of new retailing walls were assumed via a Google Earth assessment.

For Santa Cruz Alternative 2 (Option B), it was assumed that the bus-on-shoulder lanes would be constructed in conjunction with the auxiliary lane project on SR 1, and the cost estimates represent the additional costs to add the bus-on-shoulder elements. The auxiliary lane project includes new shoulders of at least 10 feet in width. Construction is mainly limited to signage and striping. Accordingly, all required sound walls and retaining walls were assumed to be included in the auxiliary lane project.

HOV Alternative

The HOV Lane Project assumed the same design and construction of the HOV Lane Alternative that was evaluated by SCCRTC as part of the Highway 1 Corridor Investment Program. The 2010 construction cost estimates for the HOV project was escalated from 2010 dollars to 2017 dollars using the Caltrans Construction Cost Index. The costs were then escalated to 2018 dollars using the escalation rate of 3.5 percent.

Monterey Branch Line Alternatives

Cost estimates for the Monterey Branch Line alternatives were generated on a per linear foot basis. It was assumed that a new 12-foot busway with 4-foot shoulders on each side would be constructed adjacent to the existing rails. It was assumed that no rail would be removed as part of the project.

For Monterey Segment 2, a new 2,200-square-foot cut-and-cover tunnel was assumed to cross under Monterey Road near the junction of SR 1 and Fremont Boulevard. The roadway grade for the approaches to the tunnel was assumed to be 8 percent. New traffic signals were assumed at the intersections of the busway with Playa and Tioga Avenues. It was assumed that all land in the right-of-way that is currently leased will be returned to TAMC with all improvements removed.

Caltrans Bike/Pedestrian Trail Alternative

Cost estimates for the Caltrans Bike/Pedestrian Trail alternative were generated on a per linear foot basis. It was assumed that a new 12-foot busway with 4-foot shoulders on each side would be constructed in place of the existing 10-foot bike/pedestrian trail. The structural section for the busway and busway shoulder pavement was based on the structural section proposed for the HOV Lane Alternative that was evaluated by SCCRTC as part of the Highway 1 Corridor Investment Program between Larkin Valley Road and Morrissey Boulevard interchanges. Units per linear foot for hot mix asphalt, aggregate base, aggregate subbase, lean concrete base, imported borrow, hydroseed, clearing and grubbing, and traffic stripes were calculated using typical cross sections that can be found in **Figures 4-1 through 4-8**. Drainage costs were assumed to be 3 percent of the costs of the quantified bid items.

BRT Alternative

Cost estimates for the BRT alternative assumed bus operations in mixed-flow lanes with a queue-jump lane at SR 218.

Monterey County Cost Estimates

A summary of cost estimates for the project options in Monterey County is provided in **Table 4-1**, while detailed costs estimates are included in **Appendix A**.

Table 4-1: Project Options' Cost Estimates – Monterey County

Segment	Option Description		Cost Estimates (2018 $ in millions)			
			Construction Costs	Right-of-Way Costs	Soft Costs[1]	Total Costs
Reservation Road/SR 1 to Fremont Boulevard/SR 1	I-A	Southbound Bus-on-Shoulder	$13.76	$0	$4.96	$18.72
	I-B	Monterey Branch Line Busway	$14.89	$0	$5.06	$19.96
	I-C	Caltrans Bike/Pedestrian Trail	$14.35	$0	$4.88	$19.23
Fremont Boulevard/SR 1 Highway 218	II-A	Southbound Bus-on-Shoulder	$3.89	$0	$1.40	$5.30
	II-B	Monterey Branch Line Busway	$6.62	$0	$2.25	$8.86
Highway 218-Del Monte Avenue	III-A	BRT to English Avenue	$0.38	$0	$0.20	$0.58
	III-B	Southbound Bus-on-Shoulder	$5.22	$0	$1.78	$6.99
Casa Verde Way/SR 1 to Fremont Boulevard/SR 1	IV-A	Northbound Bus-on-Shoulder	$4.80	$0	$1.73	$6.52

Note:

1. *Soft costs include engineering studies, environmental documentation preparation, design engineering and construction support, and construction management costs.*

The total costs for the project alternatives in Segment 1 are expected to be the highest, between $19 and $20 million. The remaining alternatives are expected to cost between $5 and $9 million, except for Alternative 3A, which is expected to cost $580,000.

Santa Cruz County Cost Estimates

A summary of cost estimates for the project alternatives in Santa Cruz County is provided in **Table 4-2**, while detailed costs estimates are included in **Appendix A**.

The total cost estimates are about $12.2 million for Alternative 1, $1.96 million for Alternative 2 (Option A), $2.23 million for Alternative 2 (Option B), and $350.7 million for Alternative 3. The cost estimate for Alternative 3 was derived from the most recent version provided in the draft Regional Transportation Plan,

Table 4-2: Project Alternatives' Cost Estimates – Santa Cruz County

Alternative		Cost Estimates (2018 $ in millions)			
		Construction Costs	Right-of-Way Costs	Soft Costs[1]	Total Costs
1	Interim Southbound Bus-on-Shoulder	$8.97	$0	$3.23	$12.20
	Segment A: Soquel Avenue – 41st Avenue	*$1.97*	*$0*	*$0.71*	*$2.68*
	Segment B: Capitola Avenue – State Park Drive	*$4.06*	*$0*	*$1.46*	*$5.52*
	Segment C: South Railroad Bridge – Freedom Boulevard	*$2.94*	*$0*	*$1.06*	*$4.00*
2	Option A: Hybrid-Auxiliary Lanes – Morrissey Boulevard to State Park Drive	$1.44	$0	$0.52	$1.96
2	Option B: Bus-on-Shoulder– Morrissey Boulevard to State Park Drive	$1.64	$0	$0.59	$2.23
3	HOV Lane Project – Soquel Avenue to State Park Drive	$257.93	NA[2]	$92.80	$350.7

Note:

1. *Soft costs include engineering studies, environmental documentation preparation, design engineering and construction support, and construction management costs.*
2. *Right-of-way costs for this alternative are included in the construction costs estimate.*

Chapter 5
Evaluation of Alternatives

This chapter provides an evaluation of the bus-on-shoulder and the bus on the Monterey Branch Line alternatives that were identified and defined in the previous chapter.

Evaluation Criteria and Methodology

The project team collaborated to develop the specific criteria to be used to provide for a comparative evaluation of the alternatives.

Criteria

The following evaluation criteria were identified:

- Constructability – consideration of the degree of complexity in constructing the project including construction requirements (such as roadway widening, new or modified structures), displacement of existing infrastructure environmental impacts or operational issues
- Transit operations – including consideration of additional service to be provided with the future project as well as:
  - Travel time savings
  - Operating cost savings
  - Transit reliability
  - Fleet requirements – including consideration of autonomous buses and vehicle to infrastructure technology such as ramp metering with bus detection
- Potential ridership – including consideration of additional service to be provided with the future project
- Traffic operations and safety – including consideration of potential conflicts between buses and general traffic as well as pedestrians and bicyclists
- Vehicle miles of travel reductions – related to diversion of auto drivers and passengers to transit due to improved transit service quality
- Potential environmental impacts/mitigations required – review of possible areas of impact caused by construction of the transit improvements or operation of the transit services
- Consistency with current plans and policies – review of current plans and policies to determine the degree to which the potential transit improvements are supportive of adopted local and regional goals

- Funding potential – identification of funding sources which could support implementation of the potential transit improvements
- Institutional considerations – identification of the agencies responsible for funding, implementing, monitoring and operating the potential transit improvements
- Cost (capital and operations and maintenance) – including all softs costs of project development such as design and environmental studies, permitting, and construction management
- Cost-effectiveness and cost-benefit assessment – quantification of the costs and benefits associated with each improvement option and alternative

Methodology Overview

The methodology used to conduct the evaluation utilizes sketch planning techniques which are typically used at this early stage of project planning and feasibility assessment. Sketch planning techniques, sometimes also called "quick-response" methods, use relatively simple and transparent approaches to estimating travel behavior changes. The benefit is that they are well suited to evaluating large numbers of alternatives and variations of alternatives, which is the case in this study. Typically, spreadsheet-based models are used instead of relying on more complex regional travel models which may not be fully sensitive to smaller scale changes to the transportation network such as bus-on-shoulder operations.

Because the alternatives have been defined at a very conceptual level the estimates of costs and ridership should be considered as order of magnitude assessments, which are primarily suitable for comparing the alternatives. More details on the methodologies used to assess the implications of the alternatives are provided below.

Alternatives and Timeframes

Another aspect of the methodology is the process for comparing the alternatives. To have a benchmark to compare alternatives, a No-Build Alternative was postulated. The No-Build Alternative consists of the existing transportation network plus any transportation improvements that are currently programed in the corridor and likely to occur within the timeframe of the project evaluation.

Monterey County

In Monterey County, the most significant improvements that will impact the project are:

1. **Marina-Salinas Multimodal Corridor Project** – As noted in the planning document for the corridor: "The Marina-Salinas Multimodal Corridor Plan was developed in response to the need for a regional route through the former Fort Ord area that will increase roadway capacity by prioritizing high quality transit, bicycling and walking as viable alternatives to driving." The corridor extends between Salinas and Marina. The western terminus of the corridor is in Fort Ord adjacent to SR 1 near the 8th Street crossing of SR 1. Once the corridor is in place there will be high quality transit services operating on the Marina-Salinas Multimodal Corridor which could connect to the transit alternatives being considered in this study.

2. **Intermodal Center** – The Fort Ord Reuse Plan calls for an Intermodal Center at the west end of the Marina-Salinas Multimodal Corridor at or near the roundabout that links 8th and 9th Streets. The center would serve as an important transit node where services in the Marina-Salinas Multimodal Corridor could interface with local transit lines and the MST lines that would be using the SR 1 Corridor.

3. **SR 1 Widening** – There are no specific plans to widen SR 1 in Monterey County at this time. The *Transportation Concept Report - State Route 1* prepared by Caltrans District 5 in 2017 does not call for adding additional lanes, although it does cite shoulder widening and auxiliary lanes as potential future projects. The mitigations for the Fort Ord Reuse plan do include an element for widening/improvements to SR 1, but it is not clear how or when this would occur.

The analysis also included consideration of an HOV Lane alternative which would involve adding median HOV lanes on SR 1 from Del Monte Boulevard in Marina to Del Monte Avenue in Monterey. This hypothetical alternative was included for purposes of comparison and is not currently part of any local, regional or state plans.

Santa Cruz County

For Santa Cruz County the No-Build Project will include the planned SR 1 Auxiliary Lanes being implemented by the Santa Cruz County Regional Transportation Commission as part of the Measure D funding program. Auxiliary lanes are short lane segments which extend along the right side of the freeway between the on and off-ramps. They are very effective at increasing the efficiency of the traffic weaving that occurs between ramps. The auxiliary lanes include new shoulder areas which could be suitable for bus-on-shoulder operations.

The first phase of this project will be auxiliary lanes between 41st Avenue and Soquel Drive with ultimate plans to extend the auxiliary lanes to Freedom Boulevard in Aptos. For this project the No-Build Project includes new auxiliary lanes from Morrissey Boulevard to State Park Drive with the understanding that the segment from State Park Drive to Freedom Boulevard is a long-range, unfunded project. The Santa Cruz County Regional Transportation Commission estimates that the auxiliary lanes between State Park Drive and Freedom Boulevard will cost $124.6 million. These funds would have to found before any bus-on-shoulder operations could be implemented in this segment of the corridor.

Timeframes

Year 2025 was selected as the evaluation timeframe for the alternatives. It is assumed that the completion and opening of the alternatives could feasibly occur by year 2025. It might be possible to implement some of the bus-on-shoulder proposals before this timeframe, however, it is still an appropriate year for comparing the alternatives. In Santa Cruz County the auxiliary lanes from Morrissey Boulevard to Freedom Boulevard will not be completed until well after 2025, however they are still included as part of the No-Build Project because the bus-on-shoulder options 2A and 2B would not be implemented in this segment until the auxiliary lanes are in place.

Evaluation Results

The criteria identified above were used to evaluate all the alternatives identified for the SR 1 corridors in both Monterey and Santa Cruz counties.

Monterey County

The alternatives for Monterey County include bus-on-shoulder operations on SR 1, a bi-directional busway on the Monterey Branch Line or the Caltrans Pedestrian/Bicycle Trail, and various hybrid combinations of these options. To facilitate the review of the alternatives the corridor has been divided into segments and the functional options are defined for each of these segments as discussed in Chapter 4.

Constructability

The constructability assessment looks at potential challenges or obstacles which may create difficulties in constructing each of the options. Examples could be conflicts with existing structures, or a need to avoid sensitive habitats such as bird nesting areas or the presence of hazardous materials. At this early conceptualization phase, it is difficult to identify all the potential constructability issues, but areas of potential concern have been identified. The matrix below,

Table 5-1, summarizes these issues for each corridor segment and options. In general, no fatal flaws were found that would prevent any of the options from being constructed. The bus-on-shoulder options do require widening of the shoulder. Widening the shoulder across a bridge is particularly costly and difficult and is not assumed as part of the bus-on-shoulder options.

In these cases, this cost can be avoided if the buses bypass the critical section of the shoulder by re-entering the regular traffic lane until the bridge area is cleared. The section of SR 1 between the Fremont and Del Monte Avenue interchanges has three critical crossings in each direction, and this may be too many instances where the buses must merge in and out of traffic in a two-mile distance. The use of the Monterey Branch Line in Sand City and Seaside requires the busway to cross three busy streets with nearby signalized intersections. Adding a traffic signal for the busway will create a complex traffic operation problem and reduce the capacity of these intersections which are critical for traffic circulation and transit operations (Playa Avenue). A busway underpass of the Monterey Road crossing is included as a mitigation at that location, but it would be a costly solution, approximately $2.1 million for a simple cut-and-cover underpass. The City of Seaside is exploring improvements to this intersection which could offer a lower cost solution. Roundabouts may be an alternative solution at the Playa and Tioga Avenue locations where the Monterey Branch Line and the local streets intersect.

Table 5-1: Constructability Issues – Monterey County

Options by Segment		Constructability Issues
Segment I	**Reservation Road/SR 1 to Fremont Boulevard/SR 1 (Sand City)**	
Option I-A	Southbound Bus-on-Shoulder	▪ Shoulder widening would be necessary in some areas ▪ Shoulder strength is unknown ▪ Retaining walls may be necessary to accommodate widening ▪ Old rail spur overcrossing may need widening or buses will need to bypass ▪ Sensitive environmental habitat
Option I-B	Monterey Branch Line Busway	▪ Narrow overcrossing of unknown condition at Divarty Street ▪ May have underground utilities in right-of-way ▪ Sensitive environmental habitat ▪ Potential for hazardous materials
Option I-C	Caltrans Bike/Pedestrian Trail Busway	▪ Pavement is likely not suitable strength for buses ▪ Retaining walls may be necessary to accommodate busway ▪ Displacement of existing recreational trail (nearby parallel alternative exists) ▪ Sensitive environmental habitat
Segment II	**Fremont Boulevard/SR 1 to SR 218**	
Option II-A	Southbound Bus-on-Shoulder – (continues south to the Del Monte Avenue off-ramp)	▪ Shoulder widening would be necessary in some areas ▪ Shoulder strength is unknown ▪ Retaining walls may be necessary to accommodate widening ▪ Overcrossing of Fremont Boulevard off-ramp and rail branch line may need widening or buses will need to bypass ▪ Overcrossing of Coastal Trail may need widening or buses will need to bypass ▪ Overcrossing of SR 218 may need widening or buses will need to bypass ▪ Sensitive environmental habitat
Option II-B	Monterey Branch Line Busway	▪ Street crossings at Playa Avenue and Tioga Avenue would require new signals and will create complex traffic operations issues due to nearby adjacent intersections. An undercrossing is assumed at Monterey Road. ▪ Potential for hazardous materials ▪ May have underground utilities in right-of-way ▪ Between Tioga Avenue and Contra Costa Street tenant leases for using right of way for parking and storage would need to be terminated
Segment III	**SR 218 to City of Monterey**	
Option III-A	BRT to English Avenue	▪ Potential minor operational impacts due to operating in mixed flow traffic
Option III-B	Southbound Bus-on-Shoulder – SR 218 to Del Monte Avenue	▪ Shoulder widening would be necessary in some areas ▪ Shoulder strength is unknown ▪ Retaining walls may be necessary to accommodate widening ▪ Sensitive environmental habitat
Segment IV	**Casa Verde Way/SR 1 to Fremont Boulevard/SR 1**	
Option IV-A	Northbound Bus-on-Shoulder	▪ Narrow overcrossing of De Monte Avenue would need to be widened or buses will need to bypass ▪ Overcrossing of SR 218 may need widening or buses will need to bypass ▪ Overcrossing of Coastal Trail may need widening or buses will need to bypass ▪ Sensitive environmental habitat

Transit Operations

As discussed in Chapter 3, MST operates many bus lines which use the SR 1 Corridor. MST Line 20 which operates from Salinas to Monterey via Marina is the most frequent service, operating on-average about every 30 minutes during the weekday morning and afternoon peak periods. Combined, all of the MST lines operating on SR 1 provide 7 to 8 trips during the peak hour in the peak direction on SR 1 under the current schedule, or about one bus every 8 minutes.

In terms of future service, the No-Build Alternative in year 2025 was assumed to include:

- Reducing the peak hour headway on MST Line 20 to 20 minutes
- Implementing quality transit service in the Marina-Salinas Multimodal Corridor was considered, however, this project is longer term beyond the year 2025 time frame

For all of the other options it is assumed Line 20 headways would be further reduced to 15 minutes and four additional trips per hour would be to the most productive of the other MST lines using the corridor. This would be service added to take advantage of the travel time and reliability benefits offered by the project.

Travel time savings

One of the key benefits of bus-on-shoulder or the busway alternatives would be travel time savings. Reduced travel times benefit the transit rider and they also benefit the transit operator in the form of reduced costs of operations due to fewer labor hours required to operate the service.

- **Year 2016 Travel Times** – The travel time analysis for each of the study segments and alternatives in Monterey County based on the conditions observed in year 2016 is shown in **Table 5-2**. INRIX cellular data was used to determine peak hour average speeds. The current transit speed assumes the buses are operating in general freeway traffic. For bus-on-shoulder operations to occur the traffic speeds must be 35 miles per hour or less. Currently in the southbound direction in the morning peak hour from Reservation Road to Fremont Boulevard, this occurs 38 percent of the time on weekdays. Thus, buses would experience a travel time saving only during these times. It was assumed when the speeds drop below 35 miles per hour the buses would use the shoulder at speeds 10 miles per hour faster than the traffic speed in the adjacent lanes.

  For Segment 1 between Reservation Road and Fremont Boulevard, the average time savings per trip for bus-on-shoulder operations would be 1.7 minutes after adjusting for the fact that a time savings would occur only 38 percent of the weekdays. Bus speeds when using the shoulder would average 28.4 miles per hour. In contrast, bus speed on a busway parallel to the freeway would be 65 miles per hour and the average time savings per trip over the same segment would be 4.7 minutes.

Table 5-2: 2016 Travel Time Analysis – Monterey County

Option			Peak Hour Travel Speeds and Times per Trip (2016)						
		Length (mi)	Current Average Traffic Speed (mph)[1]	Current Average Transit Speed (mph)	Percent of Time Speed is less than 35 mph	Average Transit Minutes of Travel	New Average Transit Speed (mph)	New Average Transit Minutes of Travel	Adjusted Average Time Savings[2] (min)
Segment I	**Reservation Road/SR 1 to Fremont Boulevard/SR 1 (Sand City)**								
I-A	Southbound Bus-on-Shoulder	3.9	18.4	18.4	38%	12.7	28.4	8.2	1.7
I-B	Monterey Branch Line Busway[3]	4.9	42.5	42.5	NA	7.5	65.0	4.5	4.7
I-C	Caltrans Bike/ Ped Trail Busway[3]	4.9	42.5	42.5	NA	7.5	65.0	4.5	4.7
Segment II	**Fremont Boulevard/SR 1 to SR 218**								
II-A	Southbound Bus-on-Shoulder (continues to Del Monte Blvd.)	1.1	26.3	26.3	31%	2.2	36.3	1.7	0.2
II-B	Monterey Branch Line Busway[4]	1.1	25.0	11.0	NA	6.0	25.0	2.6	3.4
Segment III	**SR 218 to City of Monterey**								
III-A	BRT to English Ave.[5]	0.6	20.0	9.0	NA	4.0	28.6	3.5	0.5
III-B	Bus-on-Shoulder Southbound – SR 218 to English Avenue	0.6	26.3	26.3	62%	1.2	37.3	0.9	0.1
Segment IV	**Casa Verde Way/SR 1 to Fremont Boulevard/SR 1**								
IV-A	Northbound Bus-on-Shoulder	2.5	24.2	24.2	100%	6.5	34.2	4.3	2.2

Notes:

1. *Freeway speeds based on Peak Hour 50th percentile INRIX Data on SR 1. For bus-on-shoulder this is the average speed for the time when traffic speeds drop below 35 mph. Surface street speeds are estimates.*
2. *The average freeway travel time is weighted to account for the distribution of speeds for each 10-percentile grouping. This is necessary because the average speed is lower than the 50th percentile or median speed.*
3. *For the one-mile segment paralleling Del Monte Boulevard in Marina, existing traffic speeds and transit speeds are assumed to be 30 mph.*
4. *Existing traffic speeds are estimated to be 25 mph, and existing transit speeds are from the MST peak hour schedule for Line 20.*
5. *Bus operates in mixed traffic with queue jump at SR 218 intersection and transitions to recreational trail ROW at English Avenue intersection.*

In terms of speeds and time savings a busway would have a considerable savings over bus-on-shoulder operations.

- **Year 2025 Travel Times** – Travel time analysis for year 2025 is shown in **Table 5-3**. The traffic forecasts presented in Chapter 3 indicate that traffic volumes in the corridor will increase by 42.1 percent by year 2040, which interpolates to a growth of 16.8 percent by year 2025. Increases in traffic volumes result in lower traffic speeds. This relationship is often defined by what is called a speed-flow diagram as shown in **Figure 5-1**. Generally, as traffic volumes increase and approach the capacity of the freeway, a small percentage increase in traffic can result in a relatively large decline in traffic speed. For example, as shown in the diagram, a 10 percent increase in traffic would result in a decline of 18 miles per hour in the average speed. This speed-flow relationship was used to calculate the future average speeds for year 2025.

  The increase in traffic results in southbound AM peak hour average speeds on the freeway decreasing from 18.4 miles per hour currently to 17.9 miles per hour, however, unlike conditions in year 2016, this speed would represent the average of 100 percent of the weekdays in year 2025. So, for Segment I, the average time savings per trip for bus-on-shoulder operations would be 4.7 minutes as compared to 1.7 minutes in year 2016. However, busway time savings would also benefit from the lower freeway traffic speeds with a 10.6-minute time savings per trip in year 2025 for Segment I, as compared with the estimated 4.7 minutes in year 2016. Busway time savings per trip would be significantly higher than those experienced with bus-on-shoulder.

Figure 5-1: Freeway Speed versus Flow Relationship

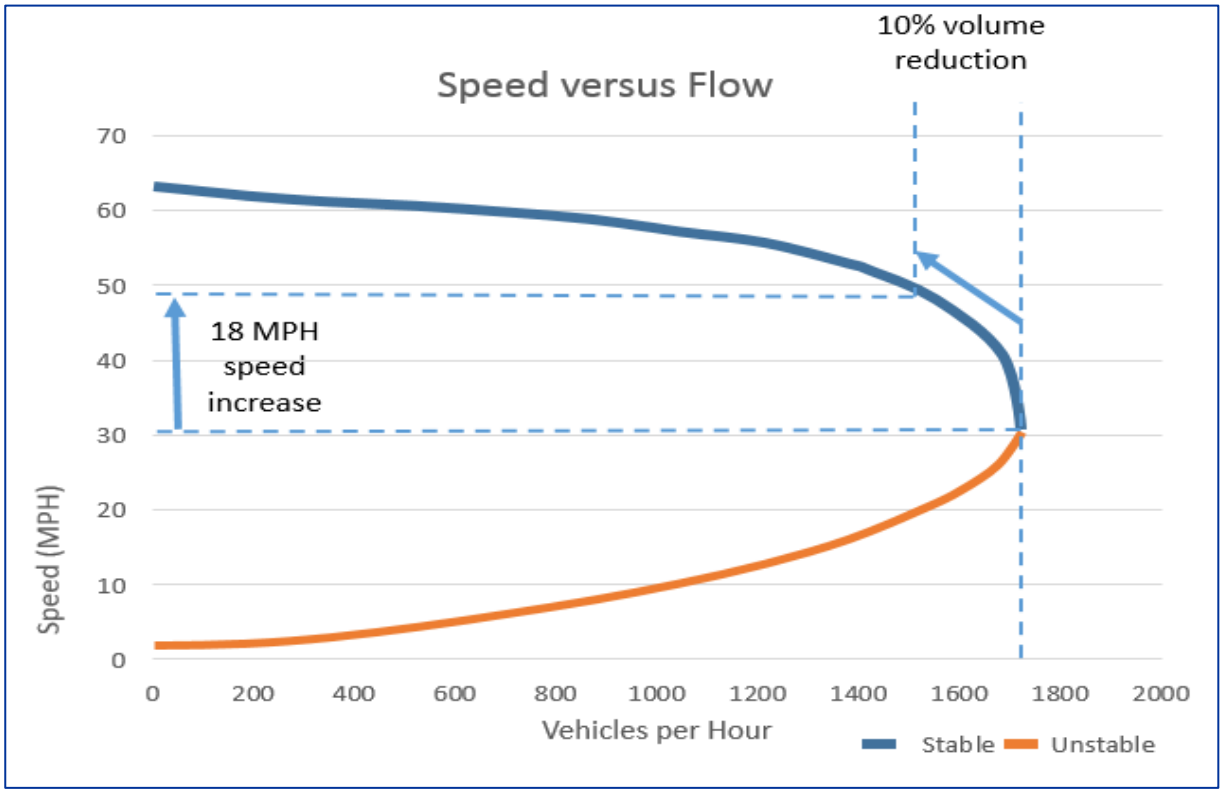


Table 5-3: 2025 Travel Time Analysis – Monterey County

Option		Length (mi)	Peak Hour Travel Speeds and Times per Trip (2025)						
			Average Traffic Speed (mph)[1]	Average Transit Speed (mph)	Percent of Time Speed is less than 35 mph	Average Transit Minutes of Travel	New Average Transit Speed	New Average Transit Minutes of Travel	Average Time Savings
Segment I	**Reservation Road/SR 1 to Fremont Boulevard/SR 1 (Sand City)**								
I-A	Southbound Bus-on-Shoulder	3.9	17.9	17.9	100%	13.1	27.9	8.4	4.7
I-B	Monterey Branch Line Busway[2]	4.9	17.9	17.9	N/A	15.1	65.0	4.5	10.6
I-C	Caltrans Bike/Ped Trail Busway[2]	4.9	17.9	17.9	N/A	15.1	65.0	4.5	10.6
Segment II	**Fremont Boulevard/SR 1 to SR 218**								
II-A	Southbound Bus-on-Shoulder (continues to Del Monte Blvd.)	1.1	26.3	26.3	100%	3.9	36.3	2.4	1.4
II-B	Monterey Branch Line Busway[3]	1.1	23.0	9.4	N/A	7.0	25.0	2.6	4.4
Segment III	**SR 218 to City of Monterey**								
III-A	BRT to English Avenue[4]	0.6	18.0	8.0	N/A	4.5	28.6	3.5	1.0
III-B	Southbound Bus-on-Shoulder – SR 218 to English Avenue	0.6	17.0	17.0	100%	1.4	27.0	0.9	0.5
Segment IV	**Casa Verde Way/SR 1 to Fremont Boulevard/SR 1**								
IV-A	Northbound Bus-on-Shoulder – Casa Verde Way to Fremont Blvd.	2.5	13.5	13.5	100%	11.1	23.5	6.3	4.8

Notes:

1. *Freeway speeds based on Peak Hour 50th percentile INRIX Data on SR 1, plus consideration of the projected growth in traffic*
2. *For the one-mile segment paralleling Del Monte Boulevard, traffic speeds and transit speeds are assumed to be 30 mph.*
3. *Traffic speeds are estimated to be 23 mph, and transit speeds are from the MST schedule for Line 20 plus a minute added for traffic growth*
4. *Bus operates in mixed traffic with queue jump at SR 218 intersection and transitions to recreational trail ROW at English Avenue intersection.*

Estimated Travel Time Savings

The options for the various corridor segments can be mixed and matched in many ways to make up complete alternatives for the full length of the corridor. The range of the alternative available that would appear to offer the greatest time saving benefits is as follows:

1. **Southbound Bus-on-Shoulder** – This alternative would involve AM peak period bus-on-shoulder operations on southbound SR 1 all the way from the Del Monte Boulevard on-ramp in Marina to the Del Monte Avenue off-ramp in Monterey, a distance of 5.4 miles.

2. **Southbound Bus-on-Shoulder plus Branch Line** – This alternative would involve AM peak period operations on southbound SR 1 all the way from the Del Monte Boulevard on-ramp in Marina to the Fremont Boulevard off-ramp in Sand City. The buses would then transition to the Monterey Branch Line right-of-way at the Monterey Road/California Avenue/Fremont Boulevard intersection. The buses would then use a bi-directional busway on the branch line to Contra Costa Street and transition to Del Monte Boulevard, continuing all the way to English Avenue in Monterey, for a total distance of 5.4 miles.

3. **Branch Line** – This alternative, a bi-directional busway, would use the Monterey Branch Line right-of-way from Reservation Road in Marina to Contra Costa Street in Sand City. Buses would then transition to Del Monte Boulevard, continuing all the way to English Avenue in Monterey, for a total distance of 5.6 miles.

4. **Pedestrian/Bike Trail plus Branch Line** – This alternative, a bi-directional busway, would use the Monterey Branch Line right-of-way from Reservation Road in Marina to Beach Range Road and then transition to the Monterey Peninsula Recreational Trail continuing south to the Monterey Road/California Avenue/Fremont Boulevard intersection in Sand City. The alignment would then then transition to the Monterey Branch Line right-of-way at the Monterey Road/California Avenue/Fremont Boulevard intersection, passing under the intersection. The buses would then use a bi-directional busway on the branch line to Contra Costa Street and transition to Del Monte Boulevard, continuing all the way to English Avenue in Monterey, for a total distance of 5.6 miles

5. **Northbound Bus-on-Shoulder** – This is not truly an alternative to the above options but represents an additional potential project. Buses would operate in the PM peak period on the northbound SR 1 shoulder from Casa Verde Way in Monterey to Fremont Boulevard in Sand City, a total distance of 2.5 miles.

Table 5-4 shows the travel times savings per trip that were calculated for each of these alternatives using the results from Table 5-2 and Table 5-3 as compared to the No- Build and HOV Lanes alternatives.

Table 5-4: Estimated Travel Time Savings by Alternative – Monterey County

Alternatives				Estimated Travel Time Savings per Trip (Peak Hour/Peak Direction)					
#	Options included	Name	Description	Existing Transit Travel Time (minutes)	Average 2016 Transit Time Savings (minutes)	Percent Travel Time Improvement	2025 Transit Travel Time (minutes)	Average 2025 Transit Time Savings (minutes)	Percent Travel Time Improvement
1	I-A, II-A, III-B	Southbound Bus-on-Shoulder	Del Monte Blvd to English Avenue via SR 1	18.9	2.4	13%	21.5	7.1	33%
2	I-A, II-B, III-A	Southbound Bus-on-Shoulder Plus Branch Line	Del Monte Blvd to English Avenue via SR 1 and Branch Line	22.7	5.6	25%	24.6	10.1	41%
3	I-B, II-B, III-A	Branch Line	Reservation Road to English Avenue via Branch Line	17.5	8.5	49%	26.6	15.9	60%
4	I-C, II-B, III-A	Pedestrian/Bike Trail Plus Branch Line	Reservation Road to English Avenue via Caltrans Ped/Bike Path and Branch Line	17.5	8.5	49%	26.6	15.9	60%
5	IV-A	Northbound Bus-on-Shoulder	Casa Verde Way to Fremont Boulevard via SR 1	6.5	2.2	34%	11.1	4.8	43%
6	N/A	No-Build	SR 1 from Del Monte Boulevard in Marina to Del Monte Avenue in Monterey	18.9	0.0	0%	21.5	0.0	0%
7	N/A	HOV Lanes	SR 1 from Del Monte Boulevard in Marina to Del Monte Avenue in Monterey	18.9	6.7	35%	21.5	14.2	66%

The greatest travel time savings for transit would result from the provision of HOV lanes in the corridor, with a 66 percent savings in peak hour, peak direction travel times as compared with the No-Build Alternative. The busway Alternatives 3 and 4 would be competitive with a 60 percent travel time savings. The Bus-on-Shoulder Alternative 1 would provide a 33 percent time savings compared to the No-Build Alternative. As operations are limited to 10 miles per hour greater than the freeway traffic speed, the travel time benefits are also limited as compared to a busway where speeds of 65 miles per hour are practical.

Operating Costs

MST Line 20 is the primary service in the corridor today. **Table 5-5** provides current operating statistics for this line. The operating costs per hour were estimated from the MST 2017 Financial Report.

Table 5-5: Line 20 Operating Statistics – Monterey County

Trips	Days per Year	Daily Trips		Annual Trips		
		Northbound to Salinas	Southbound to Monterey	Northbound to Salinas	Southbound to Monterey	Total
Weekday	258	38	35	9,804	9,030	18,834
Saturday	52	27	24	1,404	1,248	2,652
Sunday	52	18	18	936	936	1,872
Holiday	3	12	12	36	36	72
Total	**365**	**95**	**89**	**12,180**	**11,250**	**23,430**
Average Run Time (min.)		58	60	58	60	
Operating Costs (@ $173 per hour plus 20 percent to account for layover/deadhead time)		$ 19,100	$ 18,500	$ 2,442,500	$ 2,333,800	$ 4,776,300

The alternatives would increase transit speeds during periods of congestion and result in reduced running time for the services. This in turn will result in reduced costs of operation as the required hours of service will decrease. For year 2025 it was estimated that approximately 30 percent of the MST Line 20 transit trips in the corridor will be during periods of congestion on SR 1. For the busway Alternatives 3 and 4, this would result in an annual operating cost savings of $327,000 or a reduction of 6.8 percent over current cost levels (see **Table 5-6**). For the bus-on-shoulder Alternative 1, an annual savings of 3.1 percent was estimated. The other MST lines serving the corridor would experience similar cost savings on a percentage basis.

Table 5-7 shows the estimated annual operating costs for the transit services related to each alternative in year 2025 (in 2018 dollars) as compared to the No-Build Alternative. These savings are for the entire corridor as served by each of the alternatives. The costs include all of the MST lines using the corridor as noted in column 4 of the table. The next column to the right shows the added cost related to the assumed service increases by the year 2025.

Table 5-6: Line 20 Operating Cost Savings - Monterey County

	Alternative	Location	Annual Line 20 Operating Costs Savings			
			Peak Hour Time Savings Per Trip (min.)	Total Minutes Saved	Annual Cost Savings	Percent Savings
1	Southbound Bus-on-Shoulder	Del Monte Boulevard to English Avenue via SR 1	7	33,925	$146,619	3.1%
2	Southbound Bus-on-Shoulder Plus Branch Line	Del Monte Boulevard to English Avenue via SR 1 and Branch Line	10	47,811	$206,631	4.3%
3	Branch Line	Reservation Road to English Avenue via Branch Line	16	75,700	$327,165	6.8%
4	Pedestrian/Bike Trail Plus Branch Line	Reservation Road to English Avenue via Caltrans Ped/Bike Path and Branch Line	16	75,700	$327,165	6.8%
5	Northbound Bus-on-Shoulder	Casa Verde Way to Fremont Boulevard via SR 1	5	22,720	$98,194	2.1%
6	No-Build	SR 1 from Del Monte Boulevard in Marina to Del Monte Avenue in Monterey	0	0	$0.0	0.0%
7	HOV Lanes	SR 1 from Del Monte Boulevard in Marina to Del Monte Avenue in Monterey	14	67,478	$291,631	6.1%

Table 5-7: Incremental Annual Operating and Maintenance Costs – Monterey County

Alternative		Year 2025 Operating and Maintenance Costs (millions of 2018 dollars)						
		Line 20 Costs	Cost of other Corridor Services[1]	Cost of Added Service	Total Annual Transit Operating Costs	Annual Facilities Maintenance Costs	Total Annual Maintenance and Operating Costs	Incremental Costs Compared to No-Build
1	Southbound Bus-on-Shoulder	$4.63	$5.97	$10.4	$21.0	$1.14	$22.2	$5.8
2	Southbound Bus-on-Shoulder Plus Branch Line	$4.57	$5.89	$10.3	$20.7	$1.04	$21.8	$5.5
3	Branch Line	$4.45	$5.74	$10.0	$20.2	$1.09	$21.3	$5.0
4	Pedestrian/Bike Trail Plus Branch Line	$4.45	$5.74	$10.0	$20.2	$1.07	$21.3	$5.0
5	Northbound Bus-on-Shoulder	$4.68	$6.03	$10.5	$21.2	$0.24	$21.5	$5.2
6	No-Build	$4.78	$6.16	$5.4	$16.3	$0.0	$16.3	$0.0
7	HOV Lanes	$4.48	$5.78	$10.1	$20.3	$21.66	$42.0	$25.7

[1] Includes MST Lines 12, 18, 19, 21, 55, 67, 72, 74, 75, 76, and 78

Transit Reliability

Currently, as documented in Chapter 3, congestion in the SR 1 corridor creates variations in transit speeds and travel times, affecting service reliability. For example, service of the MST Line 20 was observed to vary from the printed schedule by as much as 10 minutes faster or slower over a section of highway where the schedule transit time was 19 minutes. Thus, daily transit trip times on SR 1 varied by as much as 50 percent of the scheduled time. Reliability of transit services, as compared to the schedule, impacts the riders and the transit operator in several ways. When riders learn that a line has poor reliability, they are less likely to ride, and if they do ride, they must add extra time into their schedule to protect against any potential delays. The transit operator will typically do the same thing, add time into the transit schedule to account for the travel time variations. The result is reduced ridership and increased operating costs. Drivers must also hold at timepoints if they are running early, frustrating passengers who want to get to their destination.

Bus-on-shoulder operations do improve reliability, as buses bypass traffic congestion. However, there is still a degree of unreliability, as bus speeds can only be about 10 miles per hour faster than traffic speeds in the general-purpose lanes. As traffic conditions vary daily, so will transit speeds, even when the shoulders are utilized. In contrast, an exclusive busway would offer better reliability as it would not be dependent on traffic conditions in terms of its performance.

Fleet Requirements

The estimated bus fleet requirements were calculated for each alternative as shown in **Table 5-8**. A total of eight additional buses would be required for each of the alternatives as compared with the No-Build Alternative.

Table 5-8: Year 2025 Fleet Requirements – Monterey County

Alternative		Year 2025 Transit Buses Required for New Corridor Services			
		Buses Required	Spare Buses @ 20%	Total Buses Required	Incremental Increase over No-Build
1	Southbound Bus-on-Shoulder	14	3	17	8
2	Southbound Bus-on-Shoulder Plus Branch Line	14	3	17	8
3	Branch Line	14	3	17	8
4	Pedestrian/Bike Trail Plus Branch Line	14	3	17	8
5	Northbound Bus-on-Shoulder	14	3	17	8
6	No-Build	7	1	8	0
7	HOV Lanes	14	3	17	8

Potential Ridership

A quick response, sketch planning technique has been used to assess ridership potential for the alternatives. This approach uses the existing corridor ridership as a basis and then calculates potential ridership increases based on the quality of the proposed future service. The model is

sensitive to regional growth in the corridor, travel time savings, improvements in reliability and increases in service frequency. Elasticity factors were identified to be applied to end of the service quality indicators. Elasticity refers to the observed response in ridership to a change in a service quality factor such as travel time. For example, an elasticity factor of -0.6 is often used to relate travel time savings to potential ridership growth. This means that a 50 percent reduction in travel time would translate to a 30 percent increase in ridership (50 percent times -0.6 = 30 percent). **Table 5-9** shows the results of the ridership analysis. Population and employment growth typically translates directly into increased transit ridership, so an elasticity of 1.0 was used. In this case, transit reliability is a major factor so an elasticity of one was also used. The two busway Alternatives 3 and 4 and the HOV Lane Alternative would have the greatest ridership increases.

Table 5-9: Forecast Future Daily Ridership – Monterey County

Alternative		Existing Corridor Ridership		Daily Ridership Growth Factors				Estimated Year 2025 Corridor Daily Ridership	
		Southbound AM Peak (6-10 AM)	Northbound PM Peak (3-7 PM)	Population/ Employment Growth Factor (Elasticity = 1.0)	Travel Time Savings Factor (Elasticity = -0.6)	Service Frequency Increase Factor (Elasticity = -0.5)	Service Reliability Factor (Elasticity = 1.0)	Southbound AM Peak (6-10 AM)	Northbound PM Peak (3-7 PM)
1	Southbound Bus-on-Shoulder	270	455	17%	33%	180%	10%	640	850
2	Southbound Bus-on-Shoulder Plus Branch Line	270	455	17%	41%	180%	16%	670	1,060
3	Branch Line	270	455	17%	60%	180%	20%	710	1,200
4	Pedestrian/Bike Trail Plus Branch Line	270	455	17%	60%	180%	20%	710	1,200
5	Northbound Bus-on-Shoulder	270	455	17%	43%	180%	20%	500	1,150
6	No-Build	270	455	17%	0%	140%	0%	500	850
7	HOV Lanes	270	455	17%	66%	180%	20%	720	1,210

Notes:

1. *Highlighted cells indicate that the alternative does provide travel time savings in that travel direction or that the alternative provides more travel time savings in that travel direction than in the other direction.*
2. *See text for explanation of ridership growth factors and elasticity values.*

Traffic Operations and Safety

As noted in Chapter 2, the safety record of bus-on-shoulder operations around the county is excellent. With busway operations, there have been some safety issues involving collisions with traffic where the busway would cross local streets. This would occur with Alternatives 2, 3 and 4. Traffic operations at these locations in Sand City are also an issue because the crossings would be so close to the adjacent intersections, particularly at Playa Avenue. A special traffic control strategy would be needed at these locations to prevent traffic from queuing across the busway crossing area, while at the same time preserving traffic flow during times when the buses are not present. The concept of roundabouts should be explored at these locations as a possible mitigation.

HOV lanes also have their operational issues. It is particularly difficult for buses to maneuver in and out of the left side lanes to and from the freeway ramps where stops are desirable. For this reason, in many urban areas transit operators opt not to use HOV lanes. In the case of this corridor it would be unlikely that HOV lanes would serve a useful transit function due to the issues of weaving and transit safety.

Vehicle Miles of Travel Reductions

One benefit of bus-on-shoulder operations, busways, or HOV lanes is that the transit services that use them are fast enough to attract new riders to transit. **Table 5-10** shows the vehicle miles of travel reductions associated with each of the alternatives based on the new transit riders attracted as compared with the No-Build Alternative. A vehicle occupancy of 1.1 persons (equivalent transit riders) per vehicle (automobiles) was assumed and the average trip length was estimated to be 6 miles, so every new transit trip would represent 5.45 vehicle miles of travel saved.

Table 5-10: Vehicle Miles of Travel Reduction – Monterey County

Alternative		Annual Vehicle Miles of Travel (2025)		
		Estimated Annual Transit Ridership	Estimated Vehicle Miles of Travel Eliminated	Incremental Vehicle Miles of Travel Reduction over No-Build
1	Southbound Bus-on-shoulder	1,195,600	6,521,500	613,100
2	Southbound Bus-on-shoulder Plus Branch Line	1,388,100	7,571,500	1,663,100
3	Branch Line	1,532,600	8,359,600	2,451,200
4	Pedestrian/Bike Trail Plus Branch Line	1,532,600	8,359,600	2,451,200
5	Northbound Bus-on-shoulder	1,324,000	7,221,800	1,313,400
6	No-Build	1,083,200	5,908,400	-
7	HOV Lanes	1,548,600	8,446,900	2,538,500

Potential Environmental Impacts and Mitigations Required

This portion of the study relies heavily on the environmental research conducted as part of the *Alternatives Analysis for the Monterey Peninsula Fixed Guideway Corridor Study, March 2012* and the *Monterey Peninsula Light Rail Project First Administrative Draft Environmental Assessment, September 2011.* Both of these documents were prepared by the Transportation Agency for Monterey County to examine the possibility of a light-rail or busway on the Monterey Branch Line. Extensive environmental research was conducted as part of this effort. **Table 5-11** provides a summary of the environmental review that was conducted for each of the alternatives. The key issues related to each of the alternatives are as follows:

1. **Southbound Bus-on-Shoulder** – The SR 1 shoulder widening required for this alternative could impact the adjacent sensitive biological habitat although the impacted area would be small and is within the existing right-of-way.

2. **Southbound Bus-on-Shoulder plus Branch Line** – The SR 1 shoulder widening could impact the adjacent sensitive habitat although the impacted area would be small and is within the existing right-of-way. The Monterey Branch Line right-of-way may contain hazardous materials. There would be impacts to the Monterey Peninsula Recreational Trail. Traffic impacts will occur at the locations where the busway crosses city streets. Existing tenants will be displaced from the Monterey Branch Line right-of-way. There may be some noise and vibration impacts.

3. **Branch Line** – The development of a busway on the Monterey Branch Line right-of-way would impact sensitive biological habitat. The Monterey Branch Line right-of-way may contain hazardous materials. There would be impacts to the Monterey Peninsula Recreational Trail. Traffic impacts will occur at the locations where the busway crosses city streets. Existing tenants would be displaced from the Monterey Branch Line right-of-way. There may be some noise and vibration impacts.

4. **Bike and Pedestrian Trail Plus Branch Line** – The development of a busway on the Monterey Peninsula Recreational Trail would impact sensitive biological habitat. The Monterey Branch Line right-of-way may contain hazardous materials. A major portion of the Monterey Peninsula Recreational Trail would be displaced. Traffic impacts will occur at the locations where the busway crosses city streets. Existing tenants would be displaced from the Monterey Branch Line right-of-way. There may be some noise and vibration impacts.

5. **Northbound Bus-on-Shoulder** – The SR 1 shoulder widenings required for this alternative could impact the adjacent sensitive biological habitat, although the impacted area would be small and is within the existing right-of-way.

6. **No-Build** – The no build alternative involves an increase in bus traffic on SR 1 which is not expected to have any significant impacts and should actually have some environmental benefits. However, traffic congestion would continue to increase, and desired emissions reductions would not occur with this alternative.

7. **HOV Lanes** – This alternative involves a significant widening and reconstruction of SR 1. The development of HOV lanes would impact sensitive biological habitat as additional right-of-way may be required. There would be impacts to the Monterey Peninsula Recreational Trail at some locations where the trail is close to the freeway. There may be some noise and vibration impacts. It is not consistent with the adopted plans and policies of MST, as it would not be usable by transit vehicles due to weaving problems and safety concerns.

It is important to note that all of the build alternatives would provide environmental benefits in terms of diversion of existing auto trips to transit and the resulting reduction in vehicle miles traveled, greenhouse gas emissions, and traffic related noise.

Table 5-11: Environmental Impact Review Summary – Monterey County

Impact	Alternative						
	1	2	3	4	5	6	7
	South-bound Bus-on-Shoulder	South-bound Bus-on-Shoulder plus Branch Line	Branch Line	Pedestrian/ Bike Trail Plus Branch Line	Northbound Bus-on-Shoulder	No-Build	HOV Lanes
Water Quality	○	○	○	○	○	○	○
Coastal Zone	◒	◒	◒	◒	◒	○	◒
Floodplain	○	○	○	○	○	○	○
Biology	◒	◒	●	●	◒	○	●
Wetlands	○	○	◒	◒	◒	○	◒
Hazardous Materials	○	◒	◒	◒	○	○	◒
Parklands (4f)	○	◒	◒	●	○	○	◒
Visual Impacts	○	○	○	○	○	○	●
Relocations	○	◒	◒	◒	○	○	○
Traffic	○	◒	◒	◒	○	●	○
Cultural Resources	○	○	○	○	○	○	○
Noise and Vibration	○	◒	◒	◒	○	○	◒
Air Quality	○	○	○	○	○	●	○
Consistency with Community Plans	○	○	○	○	○	○	●
○ Not Significant		◒ Possibly Significant			● Significant		

Consistency with Current Plans and Policies

Development of either bus-on-shoulder operations or bus use of the Monterey Branch Line is fully consistent with statewide, regional and local land use and transportation plans and policies.

California Assembly Bill No. 946 which was passed in 2013 authorizes the Monterey-Salinas Transit District and the Santa Cruz Metropolitan Transit District to conduct a transit bus-only program using the shoulders of certain state highways as transit bus-only traffic corridors, subject to approval by the department (Caltrans) and the Department of the California Highway Patrol. *California Assembly Bill No. 1746,* which is currently under consideration, states that Monterey-Salinas Transit, the Santa Cruz Metropolitan Transit District and a number of other transit operators:

> … may conduct a transit bus-only program using the shoulders of certain highways in the state highway system within the areas served by the transit services of each entity, with the approval of the department and the Department of the California Highway Patrol. The department, the Department of the California Highway Patrol, and each participating transit entity shall jointly determine the segments of each highway where it is appropriate to designate the shoulders as transit bus-only traffic corridors, based upon factors that shall include, but are not limited to, right-of-way availability and capacity, peak congestion hours, and the most heavily congested areas. Under the program, the participating transit entities shall actively work with the department and the Department of the California Highway Patrol to develop guidelines that ensure driver and vehicle safety and the integrity of the infrastructure.

Caltrans is preparing updated guidelines for bus operations on highways and use of shoulder areas. Bus-on-shoulder operations were successfully tested as part of a pilot program on SR-52 and I-805 in San Diego County, so there is precedent for bus-on-shoulder operations on state highways.

The Metropolitan Transportation Plan (MTP) and its Sustainable Communities Strategy (SCS) will be released by the Association of Monterey Bay Area Governments in 2018. It identifies Bus Rapid Transit in the SR 1 corridor as part of the year 2040 transit network plan, it also references this bus-on-shoulder and branch line study as an ongoing effort. This plan will replace the current Metropolitan Transportation Plan (MTP) and its Sustainable Communities Strategy (SCS) which was adopted in 2014.

The Transportation Agency for Monterey County's Measure X expenditure program includes the Highway 1 Traffic Relief – Busway project which is described as follows: "Create a new rapid bus corridor along Highway 1 between Monterey and Marina, with possible extensions to Castroville, utilizing the shoulder of the highway and/or portions of the parallel rail right-of-way, to provide a way for buses to travel more rapidly than cars so that commuters spend less time in traffic."

During the course of this project, meetings were held with the Fort Ord Reuse Authority and with the cities of Monterey, Sand City, Seaside, and Marina. In each case, the bus-on-shoulder concept or use of the Monterey Branch Line for a busway was not in conflict with existing plans and policies and in general would support sustainability goals in terms of transportation and the environment. The City of Monterey has studied the feasibility of a bus rapid transit alignment

paralleling Del Monte Avenue, which would provide for an extension of this project into the heart of Monterey.

Funding Potential

As mentioned above the Transportation Agency of Monterey County's Measure X expenditure program includes the Highway 1 Traffic Relief – Busway project. A budget of $15.0 million is designated for this project.

The Fort Ord Reuse Authority's Capital Improvement Plan 2017 includes $123 million for transportation and transit improvements. $22 million is earmarked for SR 1 widening between Fremont and Del Monte Boulevard/Avenue (Sand City to Monterey).

The Measure X funds and any funding available from the Fort Ord Reuse Authority Capital Improvement Plan could be used to leverage other state and federal funds. The Federal Transit Administration under its Small Starts program can fund busway improvements. So far, however, they have not allowed these funds to be used for bus on freeway projects.

There are several funding opportunities at the state level. Examples include the Transit and Intercity Rail Capital Program (TIRCP) which was created by Senate Bill (SB) 862 (Chapter 36, Statutes of 2014) and modified by Senate Bill 9 (Chapter 710, Statutes of 2015) to provide grants from the Greenhouse Gas Reduction Fund to fund transformative capital improvements that will modernize California's intercity, commuter, and urban rail systems, and bus and ferry transit systems to reduce emissions of greenhouse gases by reducing congestion and vehicle miles traveled throughout California. Senate Bill 1, the Road Repair and Accountability Act of 2017, was signed into law on April 28, 2017. This legislative package invests $54 billion over the next decade to fix roads, freeways and bridges in communities across California and puts more dollars toward transit and safety. These funds will be split equally between state and local investments. While there is no specific earmark for projects on SR 1, there are discretionary funds available.

In general, the projects that qualify for funding are those that have broad local support, are in an advanced state of readiness, and provide tangible benefits.

Institutional Considerations

Any bus-on-shoulder project will have to be approved by both Caltrans and the California Highway Patrol. Caltrans is in the process of developing guidelines for bus-on-shoulder applications. These guidelines are likely to be very similar to those laid out in the Transit Cooperative Research Program Report 151, which was the basis of the conceptual planning used in this study.

The Transportation Agency for Monterey County is owner of the Monterey Branch Line right-of-way (except in the City of Monterey) and City of Seaside south of Contra Costa Street. MST would need approval from the Transportation Agency for Monterey County as well as an easement to construct a busway on the branch line. Desirably, each of the cities along the corridor would also allow the use of the right-of-way.

Capital Costs

The costs of construction and project development have been prepared for each of the alternatives. These costs are incremental or in excess of the costs of the No-Build Alternative. The assumptions which were used to develop these costs are presented in Chapter 4. **Table 5-12** presents the results of the cost analysis. It is assumed that there will be no right-of-way costs for use of either the Caltrans' right-of-way or the Monterey Branch Line right-of-way. Soft costs include the costs of environmental clearance, project planning and design, and construction management and oversight. The HOV Lane alternative is by far the most expensive, as it would require the widening or lengthening of eight bridges and two full lanes of pavement plus new shoulders for the length of the corridor (approximately 5.8 miles). The other alternatives, except Alternative 5 (northbound PM peak period only), are similar in cost, though it is important to note that Alternative 1 - Southbound Bus-on-Shoulder provides benefit in one direction only during the AM peak period. The other alternatives provide service in both travel directions, southbound in the AM peak period and northbound in the PM peak period, although for Alternative 2, this is only for the southern portion of the corridor.

Alternatives 3 and 4 provide a connection to the Intermodal Center and the Marina-Salinas Multimodal Corridor in Fort Ord. This is not included in the other alternatives because of the difficulty of creating new on and off ramps to SR 1.

Table 5-12: Incremental Capital Costs – Monterey County

Alternative			Year 2025 Capital Costs (millions of 2018 dollars)				
		Segments	Construction Costs	Right-of-Way Costs	Soft Costs	Vehicle Costs	Total
1	Southbound Bus-on-Shoulder	I-A, II-A, III-B	$22.9	$0	$8.1	$4.0	$35.0
2	Southbound Bus-on-Shoulder Plus Branch Line	I-A, II-B, III-A	$20.8	$0	$7.4	$4.0	$32.1
3	Branch Line	I-B, II-B, III-A	$21.9	$0	$7.5	$4.0	$33.4
4	Pedestrian/Bike Trail Plus Branch Line	I-C, II-B, III-A	$21.3	$0	$7.3	$4.0	$32.6
5	Northbound Bus-on-Shoulder	IV-A	$4.8	$0	$1.7	$4.0	$10.5
6	No-Build	N/A	$0	$0	$0	$0	$0
7	HOV Lanes	N/A	$327.7	$0	$118.0	$4.0	$449.7

Cost-Effectiveness and Benefit-Cost Assessment

A benefit-cost analysis for the project alternatives in Monterey County was conducted. The purpose of a benefit-cost assessment is to provide a quantitative comparison of the benefits of an alternative which would include time savings to transit riders, transit operating cost savings, savings due to reduced vehicle miles of travel and related reductions in vehicular emissions; compared to the costs of the alternative which include project development and construction costs, as well as annual operating/maintenance costs. The analysis was based on the following assumptions:

- Life cycle of an alternative is 30 years;

- The project alternative will be constructed by year 2025;
- Value of time in Monterey County is $13.65 per hour per person (Source: Cal-B/C Model);
- Discount rate is 4 percent (Source: Cal-B/C Model);
- Annualization factor is 321 days per year; and
- Ratio of travel distance of a bus line on SR 1 to the overall route length is 50 percent. This factor was used to estimate the operations and maintenance costs that would be applicable to a project alternative.

A summary of cost-benefit analyses conducted for the project alternatives in Monterey County is provided in **Table 5-13**. The benefit-to-cost ratio of the project alternatives would vary between 0.07 and 0.67. Alternatives 1, 2, and 7 are expected to have a benefit-to-cost ratio of 0.25 or lower, while Alternatives 3 and 4 that would provide benefits in both the directions would have a benefit-to-cost ratio of 0.66 and 0.67, respectively.

Detailed calculations showing cost-benefit estimates are included in **Appendix B**.

Table 5-13: Cost-Benefit Summary – Monterey County

Alternative			Present Value of Costs (2018 $ in millions)			Present Value of Benefits (2018 $ in millions)				Benefit-to-Cost Ratio
		Segments	Capital Costs	Operating Costs	Total Costs	Travel Time Benefits	Operating Cost Benefits	CO_2 Emissions Benefits	Total Benefits	
1	Southbound Bus-on-Shoulder	I-A, II-A, III-B	$35.00	$60.35	$95.35	$5.22	$11.41	$0.19	$16.82	0.18
2	Southbound Bus-on-Shoulder Plus Branch Line	I-A, II-B, III-A	$32.20	$56.03	$88.23	$5.24	$16.08	$0.52	$21.84	0.25
3	Branch Line	I-B, II-B, III-A	$33.40	$52.57	$85.97	$30.55	$25.45	$0.77	$56.77	0.66
4	Pedestrian/Bike Trail Plus Branch Line	I-C, II-B, III-A	$32.60	$46.52	$84.82	$30.55	$25.46	$0.77	$56.78	0.67
5	Northbound Bus-on-Shoulder	IV-A	$10.50	$33.30	$57.02	$6.97	$7.64	$0.41	$15.02	0.26
7	HOV Lanes	N/A	$449.70	$426.42	$876.12	$34.60	$22.69	$0.80	$58.10	0.07

Santa Cruz County

The alternatives for Santa Cruz County are strictly bus-on-shoulder applications using SR 1. The same criteria as were used in the Monterey County assessment were applied to the assessment for Santa Cruz County.

Constructability

With the exception of the Interim Southbound Bus-on-Shoulder Alternative, the remainder of the alternatives are dependent on the planned implementation of the SR 1 Auxiliary Lanes project (see **Table 5-14**). The first phase of this project will be auxiliary lanes between 41st Avenue and Soquel Drive with ultimate plans to extend the auxiliary lanes to Freedom Boulevard in Aptos. For this project the No-Build Alternative includes new auxiliary lanes from Morrissey Boulevard to State Park Drive, with the understanding that there is no identified funding source for the segment between State Park Drive and Freedom Boulevard which should be considered a long-range project. The auxiliary lanes include new shoulder areas which could be suitable for bus-on-shoulder operations. No fatal flaws were found that would render any of the alternatives infeasible. The HOV Lane Alternative 3, however, does require the widening or lengthening of five structures beyond that which is already required for the Auxiliary Lane project, which is very costly and would have other significant impacts such as the need for retaining walls and added right-of-way. Unlike the bus-on-shoulder alternatives, the HOV alternative requires new, fully functional lanes that can be used by buses and carpools.

For the Interim Southbound Bus-on-Shoulder Alternative, widening the shoulder across a bridge is particularly costly and difficult. In these cases, this cost can be avoided if the buses bypass the critical section of the shoulder by re-entering the regular traffic lane until the bridge area is cleared and then returning to the shoulder. The same is true of the Bus-on-Shoulder Options 2A and 2B. Widening at interchanges and structures is not essential as the buses can rejoin the general purpose lanes to bypass these locations, which is a lot more cost effective than spending the funds to remove the obstacle. It is very common in the bus-on-shoulder practice throughout the country for the buses to make such bypass maneuvers.

Table 5-14: Constructability Issues – Santa Cruz County

Alternatives		Constructability Issues
1	**Interim Southbound Bus-on-Shoulder**	
Segment A	Soquel Avenue to 41st Avenue	▪ Shoulder widening will be necessary in some areas ▪ Shoulder strength is unknown ▪ Retaining walls may be necessary to accommodate widening ▪ Sensitive environmental habitat
Segment B	Capitola Avenue to State Park Drive	▪ Shoulder widening will be necessary in some areas ▪ Shoulder strength is unknown ▪ Retaining walls may be necessary to accommodate widening ▪ Overcrossing at Park Avenue may need widening or buses will need merge out of the shoulder and bypass the bridge using the regular traffic lane. ▪ Sensitive environmental habitat
Segment C	South Railroad Bridge to Freedom Boulevard	▪ Shoulder widening will be necessary in some areas ▪ Shoulder strength is unknown ▪ Retaining walls may be necessary to accommodate widening ▪ Sensitive environmental habitat
2	**Bus on Right Shoulder with Auxiliary Lanes**	
Option A	Hybrid-Auxiliary Lanes – Morrissey Boulevard to State Park Drive	▪ Auxiliary lane project involves roadway widening and new 10-foot shoulders. Bus-on-shoulder requires minor shoulder widening in some areas. ▪ Six structures will need to be widened or lengthened, as part of the auxiliary lane project, this is not part of the bus-on-shoulder project ▪ Sensitive environmental habitat
Option B	Bus-on-Shoulder – Morrissey Boulevard to State Park Drive	▪ Auxiliary lane project involves roadway widening and new 10-foot shoulders. Bus-on-shoulder requires minor shoulder widening in some areas. ▪ Six structures will need to be widened or lengthened, as part of the auxiliary lane project, this is not part of the bus-on-shoulder project ▪ Sensitive environmental habitat
3	**HOV Lane Project**	
	Soquel Avenue to State Park Drive	▪ Major freeway reconstruction to create median HOV lanes, add auxiliary lanes and shoulders ▪ Five structures will need to be widened or lengthened, as part of the HOV lane and auxiliary lane project (fewer structures than Alternative 2 because of the shorter distance with a southern terminus at State Park Drive) ▪ Sensitive environmental habitat

Transit Operations

METRO currently does not operate any through bus service on SR 1 in this corridor. One reason for that is that SR 1 is so congested that any transit service would be very slow and unreliable. METRO Route 91X is the route that comes closest to serving the freeway corridor. It does use the freeway for portions of its trip between Santa Cruz and Watsonville. Its average peak hour speed

is 11.8 miles per hour. If bus-on-shoulder or HOV lanes were developed on SR 1, METRO plans to enhance its service including direct non-stop express service between Santa Cruz and Watsonville.

Travel time savings

Travel time savings were calculated using the INRIX speed data from year 2016 as a base and then forecasting traffic growth to year 2025 using the traffic projections from the traffic operations report for the Auxiliary Lane project. Time savings per trip were calculated using the METRO Route 91X travel times as the baseline as shown in **Table 5-15**. The Interim Bus-on-Shoulder options under Alternative 1 would provide the least travel time savings, however, the time savings for all but Segment A are significant. The bus-on-shoulder Options A & B under Alternative 2 would provide the greatest time savings as these options span a 5.3-mile distance as compared to 4.0 miles for Alternative 3 – HOV Lanes. Buses would operate faster in the HOV lanes but over a shorter distance than in Alternative 2.

Table 5-15: Estimated Travel Time Savings – Santa Cruz County

Alternatives		Travel Direction & Shoulder	Length (mi)	Peak Hour Travel Speeds and Time Savings per Trip: Current Average Speed on Freeway (mph)	Current Average Transit Speed (Route 91X)	Opening Year 2025 Speed, without Aux-iliary Lanes	Opening Year 2025 Speed, with Auxiliary Lanes	Percent of Time Speed is less than 35 mph	Average Transit Minutes of Travel on Freeway	New Average Transit Speed on Freeway	New Average Transit Minutes of Travel	Average Time Savings on Freeway	Average Time Savings over Existing Transit (91X)
1	**Interim Southbound Bus-on-Shoulder**												
Segment A	Soquel Avenue to 41st Avenue	SB/Right	0.9	10.6	11.8	N/A	N/A	100%	5.1	20.6	2.6	2.5	2.0
Segment B	Capitola Avenue to State Park Drive	SB/Right	2.1	22.5	11.8	N/A	N/A	100%	5.6	32.5	3.9	1.7	6.8
Segment C	South Railroad Bridge to Freedom Blvd.	SB/Right	1.4	35.9	11.8	N/A	N/A	97%	2.3	45.9	1.8	0.5	5.3
2	**Bus on Right-Shoulder with Auxiliary Lanes**												
Option A	Morrissey Blvd. to State Park Drive	NB/Right	5.3	29.0	11.8	20.5	37.0	NA	8.6	42.0	7.6	1.0	17.1
		SB/Right	5.3	15.0	11.8	13.0	25.5	NA	12.5	30.5	10.4	2.0	7.9
Option B	Morrissey Blvd. to State Park Drive	NB/Right	5.3	29.0	11.8	20.5	37.0	NA	8.6	47.0	6.8	1.8	17.9
		SB/Right	5.3	15.0	11.8	13.0	25.5	NA	12.5	35.5	9.0	3.5	9.4
3	**HOV Lane Project**												
	Soquel Avenue to State Park Drive	NB/Left	4.0	20.0	11.8	20.5	37.0	N/A	6.5	65.0	3.7	2.8	11.2
		SB/Left	4.0	20.0	11.8	13.0	25.5	N/A	9.4	65.0	3.7	5.7	14.1

Operating Costs

METRO provided the following cost information (see **Table 5-16**) for the amount and type of transit services that would be operated on SR 1 in the study corridor if either bus-on-shoulder operations or HOV lanes were available. In both cases the headways on the 91X would be reduced to 15 minutes during peak periods and 30 minutes in the off peak and the other routes shown represent new services using the freeway corridor, essentially extensions of METRO's successful Highway 17 Express Service to San Jose that would serve the mid-county and south-county areas along SR 1.

Table 5-16: Operating Costs for Planned METRO Bus Services– Santa Cruz County

Route	Span (in hours)	Frequency	Trips per Day	Hours per Trip	Operating Cost per Hour	Annual Operating Cost	Frequency w/ Existing and Proposed Service
Bus-on-Shoulder							
91x	11.5	30min	42	0.75	$200	$1,606,500	N/A
91x Santa Cruz-Watsonville	6	30min	24	0.75	$200	$918,000	15 min
91x Santa Cruz-Watsonville	15	30min	60	0.75	$200	$990,000	30 min
Hwy 17 Mid County	6	30min	12	1.25	$200	$765,000	30 min
					Total Existing Service Operating Costs	**$1,606,500**	
					Total New Service Operating Costs	**$2,673,000**	
HOV Lanes							
91x	11.5	30min	42	0.75	$200	$1,606,500	N/A
91x Santa Cruz-Watsonville	6	30min	24	0.75	$200	$918,000	15 min
91x Santa Cruz-Watsonville	15	30min	60	0.75	$200	$990,000	30 min
Hwy 17 South County	6	30min	12	1.5	$200	$918,000	30 min
Hwy 17 South County	13	1.5hrs	18	1.5	$200	$594,000	1.5hrs
Hwy 17 Mid County	6	30min	12	1.25	$200	$765,000	30min
					Total Existing Service Operating Costs	**$1,606,500**	
					Total New Service Operating Costs	**$4,185,000**	

The operating cost savings that could expected with each of the alternatives for existing METRO Route 91x are shown in **Table 5-17**. Savings as high as 20-22 percent of the current operating costs could be experienced with the bus-on-shoulder alternatives 2A and 2B.

Table 5-17: Transit Operating Cost Savings – Santa Cruz County

Alternatives		Annual Route 91X Operating Costs Savings			
		Peak Hour Time Savings Per Trip (min.)	Total Minutes Saved	Annual Cost Savings	Percent Savings
1	**Interim Southbound Bus-on-Shoulder**				
Segment A	Soquel Avenue to 41st Avenue	2.0	7,688	$38,439	2%
Segment B	Capitola Avenue to State Park Drive	6.8	26,645	$133,223	8%
Segment C	South Railroad Bridge to Freedom Boulevard	5.3	20,713	$103,563	6%
2	**Bus on Right-Shoulder with Auxiliary Lanes**				
Option A	Hybrid-Auxiliary Lanes – Morrissey Blvd. to State Park Drive	12.5	48,718	$243,590	15%
Option B	Bus-on-Shoulder – Morrissey Blvd. to State Park Drive	13.6	53,152	$265,762	17%
3	**HOV Lane Project**				
	Soquel Avenue to State Park Drive	7.1	27,549	$137,744	9%

Table 5-18 shows the incremental transit operating costs for each alternative as compared with the No-Build (existing METRO Route 91X). The costs are similar for all the alternatives except for Alternative 3 – HOV Lanes which had much more added service because of the higher investment in infrastructure. The annual cost of facilities maintenance included the cost to maintain the physical elements of new construction that are required to implement each alternative.

Table 5-18: Incremental Annual Operating Costs – Santa Cruz County

Alternative		Incremental Year 2025 Operating and Maintenance Costs (millions $2018)					
		Route 91x Operating Costs	Cost of Added Service	Total Transit Operating Costs	Annual Facilities Main-tenance Costs	Total Annual Main-tenance and Operating Costs	Incre-mental Costs Compared to No-Build
1	**Interim Southbound Bus-on-Shoulder**						
Segment A	Soquel Avenue to 41st Avenue	$1.6	$2.7	$4.2	$0.1	$4.3	$2.7
Segment B	Capitola Avenue to State Park Drive	$1.5	$2.7	$4.1	$0.2	$4.3	$2.7
Segment C	South Railroad Bridge to Freedom Boulevard	$1.5	$2.7	$4.2	$0.1	$4.3	$2.7
2	**Bus on Right-Shoulder with Auxiliary Lanes**						
Option A	Hybrid-Auxiliary Lanes – Morrissey Blvd. to State Park Drive	$1.3	$2.7	$4.0	$0.1	$4.1	$2.5

Alternative		Incremental Year 2025 Operating and Maintenance Costs (millions $2018)					
		Route 91x Operating Costs	Cost of Added Service	Total Transit Operating Costs	Annual Facilities Main-tenance Costs	Total Annual Main-tenance and Operating Costs	Incre-mental Costs Compared to No-Build
Option B	Bus-on-Shoulder – Morrissey Blvd. to State Park Drive	$1.3	$2.7	$3.9	$0.1	$4.0	$2.4
3	**HOV Lane Project**						
	Soquel Avenue to State Park Drive	$1.5	$4.2	$5.7	$15.0	$20.7	$19.1

Transit Reliability

METRO was not able to provide any information on the reliability of the existing Route 91X service, however, given the known day-to-day variability in traffic speeds and travel times on SR 1 it is likely that there are significant changes in transit running times which either require slack to be built into the schedule or an acceptance of poor on-time performance.

Fleet Requirements

Table 5-19 shows the fleet requirements for each alternative as compared to the No-Build Alternative (existing Route 91X service). Twelve new buses would be required for the bus-on-shoulder Alternatives 1 and 2, and 27 new buses would be required to operate the service planned for Alternative 3 – HOV Lanes.

Table 5-19: Incremental Fleet Requirements – Santa Cruz County

Alternative		Incremental Year 2025 Fleet Requirements			
		Buses Required	Spares @ 15%	Total	Incremental Increase over No-Build
1	**Interim Southbound Bus-on-Shoulder**				
Segment A	Soquel Avenue to 41st Avenue	13	2	15	12
Segment B	Capitola Avenue to State Park Drive	13	2	15	12
Segment C	South Railroad Bridge to Freedom Boulevard	13	2	15	12
2	**Bus on Right-Shoulder with Auxiliary Lanes**				
Option A	Morrissey Blvd. to State Park Drive	13	2	15	12
Option B	Morrissey Blvd. to State Park Drive	13	2	15	12
3	**HOV Lane Project**				
	Soquel Avenue to State Park Drive	26	4	30	27

Potential Ridership

A quick response, sketch planning technique has been used to assess ridership potential for the alternatives. This approach uses the existing corridor ridership as a basis and calculates potential ridership increases based on the quality of the proposed future service. The model is sensitive to regional growth in the corridor, travel time savings, improvements in reliability and increases in service frequency. Elasticity factors were identified and applied. Elasticity refers to the observed response in ridership to a change in a service quality factor such as travel time. For example, an elasticity factor of -0.6 is often used to relate travel time savings to potential ridership growth. This means that a 50 percent reduction in travel time would translate to a 30 percent increase in ridership (50 percent times -0.6 = 30 percent). **Table 5-20** shows the results of the ridership analysis. Population and employment growth typically translate directly into increased transit ridership, so an elasticity of 1.0 was used. In this case transit reliability and transit frequency increase are major factors so an elasticity of one was also used. For Alternative 1 – Interim Bus-on-Shoulder, Segments A & B were combined. These two segments are where the primary congestion occurs and would likely generate the greatest ridership gains. The adjustment factors are then multiplied times the existing ridership.

Table 5-20: Forecast Year 2025 Daily Ridership – Santa Cruz County

Alternatives					Ridership Growth Factors*					
			Existing Corridor Daily Ridership		Population/ Employment Growth Factor (Elasticity = 1.0)[1]	Travel Time Savings Factor (Elasticity = -0.6)[1]	Service Frequency Increase Factor (Elasticity = -0.5)[1]	Service Reliability Factor (Elasticity = 1.0)[1]	Estimated Year 2025 Corridor Daily Ridership	
Alternative	Limits	Segments	Northbound AM Peak (6-10 AM)	Southbound PM Peak (3-7 PM)					Northbound AM Peak (6-10 AM)	Southbound PM Peak (3-7 PM)
Alternative 1	Soquel Avenue to State Park Drive	1A+1B	77	55	8%	35%	400%	50%	390	690
Alternative 2 (Option A)	Morrissey Blvd. to State Park Drive	N/A	77	55	8%	50%	400%	50%	1,100	1,050
Alternative 2 (Option B)	Morrissey Blvd. to State Park Drive	N/A	77	55	8%	55%	400%	50%	1,110	1,050
Alternative 3	Soquel Avenue to State Park Drive	N/A	77	55	8%	51%	650%	50%	1,490	1,470
No-Build Alternative[2]	Morrissey Blvd. to State Park Drive	N/A	77	55	8%	34%	0%	0%	220	120

Notes:

Highlighted cells indicate that the alternative does provide travel time savings in that travel direction or that the alternative provides more travel time savings in that travel direction than in the other direction.

[1]See text for explanation of ridership growth factors and elasticity values.

[2]Represents existing highway with auxiliary lanes.

Alternative 3, the HOV Lane project, would yield the greatest ridership; however, Alternatives 2A and 2B would also yield high levels of ridership. Alternative 1 – Interim Bus-on-Shoulder yields less ridership than the other alternatives, but still substantially more than the No-Build Alternative.

Traffic Operations/Safety

As noted in Chapter 2, the safety record of bus-on-shoulder operations around the county is excellent. Alternative 2A which involves buses transitioning from the auxiliary lane to a bus-on-shoulder lane through the interchanges is a variation of bus-on-shoulder operations that has not been tested. A pilot project at a single interchange might be a reasonable way to test the operation of this concept when Phase I of the auxiliary lane program is implemented.

Vehicle Miles of Travel Reduction

One benefit of bus-on-shoulder operations or HOV lanes is that the transit services that use them are fast enough to attract new riders to transit. **Table 5-21** shows the vehicle miles of travel reductions associated with each of the alternatives based on the new transit riders attracted as compared with the No-Build Alternative. A vehicle occupancy of 1.1 persons per vehicle was assumed and the average trip length was estimated to be 7 miles, the length of the corridor, as most transit vehicle trips will be non-stop. All of the alternatives show a significant reduction in vehicle miles of travel with the greatest reduction associated with the HOV Lanes - Alternative 3.

Table 5-21: Incremental Vehicle Miles of Travel Reduction – Santa Cruz County

Alternative		Annual Vehicle Miles of Travel (2025)		
Alternative	Limits	Estimated Annual Transit Ridership	Estimated Vehicle Miles of Travel Eliminated	Incremental Vehicle Miles of Travel Reduction over No-Build
Alternative 1	Soquel Avenue to State Park Drive	810,000	5,154,500	3,531,800
Alternative 2 (Option A)	Morrissey Boulevard to State Park Drive	1,612,500	10,261,400	8,638,700
Alternative 2 (Option B)	Morrissey Boulevard to State Park Drive	1,620,000	10,309,100	8,686,400
Alternative 3	Soquel Avenue to State Park Drive	2,220,000	14,127,300	12,504,600
No-Build Alternative	Morrissey Boulevard to State Park Drive	255,000	1,622,700	- -

Potential Environmental Impacts/Mitigations Required

This portion of the study relies heavily on the environmental research conducted as part of the *Santa Cruz Route 1 Tier I and Tier II Environmental Impact Report/ Environmental Assessment Draft - November 2015*. This document was prepared by the Santa Cruz County Regional Transportation to examine the possibility of auxiliary lanes or HOV lanes on SR 1. Extensive environmental research was conducted as part of this effort. **Table 5-22** provides a summary of the environmental review that was conducted for each of the alternatives. The key issues related to each of the alternatives are as follows:

1. **Interim Bus-on-Shoulder Southbound** – This alternative involves minor widening of the existing shoulder areas which could impact some sensitive biological habitat, waterways and wetlands along the corridor. It would also alter the visual landscape.

2. **Bus on Right-Shoulder with Auxiliary Lanes** – The auxiliary lanes and new shoulders that are essential for both Options A and B, are actually part of the No-Build Project. As such, the impacts of these two variations of bus-on-shoulder are expected to be not-significant.

3. **HOV Lane Project –** This alternative involves major widening of the freeway in order to create the median HOV Lanes and provide the auxiliary lanes with adequate right-side shoulders and could impact some sensitive biological habitat, waterways and wetlands along the corridor. The need for new sound walls and/or retaining walls could have visual impacts. Significant displacement of businesses and residential units is involved. As the HOV lane would be open to carpools and other qualifying vehicles, noise and vibration increases are likely.

4. **No-Build –** The No-Build Alternative does not directly address the lack of convenient transit alternative to drive-alone auto travel in this corridor and is inconsistent with plans and policies at the state and local level which call for increased transit use to improve mobility and reduce greenhouse gas emissions.

It is important to note that all of the build alternatives will provide environmental benefits in terms of diversion of existing auto trips to transit and the resulting reduction in vehicle miles traveled, greenhouse gas emissions, and traffic related noise.

Table 5-22: Environmental Impact Review Summary – Santa Cruz County

	Alternatives				
	1. Interim Bus-on-Shoulder Southbound	2. Bus on Right-Shoulder with Auxiliary Lanes		3. HOV Lane Project	4. No-Build Project
Impact	Soquel Avenue to State Park Drive	A. Hybrid-Auxiliary Lanes - Morrissey Blvd. to State Park Drive	B. Bus-on-Shoulder - Morrissey Blvd. to State Park Drive	Soquel Avenue to State Park Drive	Existing Highway with Auxiliary Lanes - Morrissey Blvd. to State Park Drive
Water Quality	◒	○	○	◒	◒
Coastal Zone	◒	○	○	◒	◒
Floodplain	◒	○	○	●	◒
Biology	◒	○	○	●	◒
Wetlands	◒	○	○	●	◒
Hazardous Materials	◒	○	○	◒	◒
Parklands (4f)	○	○	○	○	○
Visual Impacts	◒	○	○	●	◒
Relocations	○	○	○	●	○
Traffic	○	○	○	◒	○
Cultural Resources	◒	○	○	◒	◒
Noise and Vibration	○	○	○	●	○
Air Quality	○	○	○	◒	○
Consistency with Community Plans	○	○	○	○	◒
○ Not Significant		◒ Possibly Significant		● Significant	

Consistency with Current Plans and Policies

It was found that development of either bus-on-shoulder operations or HOV lanes on SR 1 in Santa Cruz County is fully consistent with statewide, regional and local land use and transportation plans and policies.

California Assembly Bill No. 946 which was passed in year 2013 authorizes the Monterey-Salinas Transit District and the Santa Cruz Metropolitan Transit District to conduct a transit bus-only program using the shoulders of certain state highways as transit bus-only traffic corridors, subject to approval by the department (Caltrans) and the Department of the California Highway Patrol. California Assembly Bill No. 1746, which is currently under consideration, states that Monterey-Salinas Transit, the Santa Cruz Metropolitan Transit District and a number of other transit operators:

> *…may conduct a transit bus-only program using the shoulders of certain highways in the state highway system within the areas served by the transit services of each entity, with the approval of the department and the Department of the California Highway Patrol. The*

> *department, the Department of the California Highway Patrol, and each participating transit entity shall jointly determine the segments of each highway where it is appropriate to designate the shoulders as transit bus-only traffic corridors, based upon factors that shall include, but are not limited to, right-of-way availability and capacity, peak congestion hours, and the most heavily congested areas. Under the program, the participating transit entities shall actively work with the department and the Department of the California Highway Patrol to develop guidelines that ensure driver and vehicle safety and the integrity of the infrastructure.*

Caltrans is preparing updated guidelines for bus operations on highways and use of shoulder areas. Bus-on-shoulder operations were successfully tested as part of a pilot program on SR 152 and I-805, so there is precedent for bus-on-shoulder operations on state highways.

The Metropolitan Transportation Plan (MTP) and its Sustainable Communities Strategy (SCS) will be released by the Association of Monterey Bay Area Governments in 2018. It identifies Bus Rapid Transit in the SR 1 corridor as part of the year 2040 transit network plan, it also references this bus-on-shoulder and branch line study as an ongoing effort. This plan will replace the current Metropolitan Transportation Plan (MTP) and its Sustainable Communities Strategy (SCS) which was adopted in 2014.

The Santa Cruz County Regional Transportation Commission is conducting the *Unified Corridor Investment Study.* The *Unified Corridor Investment Study* will examine which transportation improvements work together to make the most effective use of the community's north/south transportation corridor including three parallel routes: Highway 1, Soquel/Freedom, and the Santa Cruz Branch Rail Line right-of-way. The study is including both HOV Lanes and bus-on-shoulder alternatives for the SR 1 corridor.

Funding Potential

Phase I of the Auxiliary Lanes project on SR 1 is funded under the Santa Cruz County Regional Transportation Commission's Measure D. It will complete the segment between 41st Avenue and Soquel Drive. This does not include funding for a bus-on-shoulder or HOV lanes project. The Unified Corridor Investment Study will identify possible sources of funding for projects but not a detailed strategy for funding these projects.

Institutional Considerations

Any bus-on-shoulder project will need to be approved by both Caltrans and the California Highway Patrol. Caltrans is in the process of developing guidelines for bus-on-shoulder applications. These guidelines are likely to be very similar to those laid out in the Transit Cooperative Research Program Report 151, which was the basis of the conceptual planning used in this study.

Phasing of bus-on-shoulder improvements on SR 1 is an important consideration. While the Interim Bus-on-Shoulder Alternative could yield near term benefits, it is critical that it not interfere with the implementation of the auxiliary lane project. For example, a logical phasing strategy would be to complete Phase 1 of the auxiliary lane project including either the Alternative 2 Option A or B approach to bus-on-shoulder and the Segment B of the Interim Bus-on-Shoulder Alternative. This would provide bus-on-shoulder southbound all the way to

State Park Drive. Then as subsequent phases of the auxiliary lane project proceed the Alternative 2 Option A or B approach to bus-on-shoulder could be implemented at the same time for each new segment.

Cost (Capital and Operations/Maintenance)

The costs of construction and project development have been prepared for each of the alternatives. These costs are incremental or in excess of the costs of the No-Build Alternative. The assumptions which were used to develop these costs are presented in Chapter 4. **Table 5-23** presents the results of the cost analysis. It is assumed there would be no cost for use of the Caltrans' right-of-way. Soft costs include all the costs of environmental clearance, project planning and design and construction management and oversight. Note that the costs for Alternatives 1, 2A, and 2B do not include any costs for structure widening or replacement. It is assumed that buses will bypass these locations using the general purpose freeway lanes.

Table 5-23: Incremental Capital Costs – Santa Cruz County

Alternatives			Year 2025 Capital Costs (millions of 2018 dollars)				
Alternative	Limits	Segments	Construction Costs	Right-of-Way	Vehicle Costs	Soft Costs	Total
Alternative 1	Soquel Avenue to State Park Drive	1A+1B	$6.0	$0.0	$5.9	$2.2	$14.1
Alternative 2 (Option A)	Morrissey Boulevard to State Park Drive	N/A	$1.5	$0.0	$5.9	$0.5	$7.9
Alternative 2 (Option B)	Morrissey Boulevard to State Park Drive	N/A	$1.7	$0.0	$5.9	$0.6	$8.2
Alternative 3	Soquel Avenue to State Park Drive	N/A	$257.9	$0.0	$13.4	$92.8	$453.9
No-Build Alternative[2]	Morrissey Boulevard to State Park Drive	N/A	$0.0	$0.0	$0.0	$0.0	$0.0

Cost-Effectiveness and Benefit-Cost Assessment

Benefit-cost analysis for project alternatives in Santa Cruz County was conducted based on the same assumptions used for project alternatives in Monterey County. Results of the benefit-cost analysis for the Santa Cruz County alternatives are provided in **Table 5-24**. The benefit-to-cost ratio of the project alternatives would vary between 0.06 and 1.69. Due to the high construction costs involved, Alternative 3 (HOV Project from Soquel Avenue to State Park Drive) is expected to have the least benefit-to-cost ratio of 0.06, while Alternative 2 - Option A (Bus-on-Shoulder - Auxiliary Lanes between Morrissey and Freedom Boulevards) would have the highest benefit-to-cost ratio of about 1.69. This is because the costs of the auxiliary lane project which is actually part of the No-Build Alternative, do not have to be included in the costs of Alternative 2 (either Options A or B), but the full benefits of being able to use the widened shoulder which is part of the auxiliary lane project will accrue to Alternative 2 – Options A & B.

Detailed calculations showing benefit-cost estimates are included in **Appendix B**.

Table 5-24: Benefit-Cost Summary – Santa Cruz County

Alternative			Present Value of Costs (2018 $ in millions)			Present Value of Benefits (2018 $ in millions)				Benefit-to-Cost Ratio
		Segments	Capital Costs	Operating Costs	Total Costs	Travel Time Benefits	Operating Cost Benefits	GHG Emissions' Benefits	Total Benefits	
1	Alternative 1 (Soquel Avenue to State Park Drive)	1A+1B	$14.10	$8.10	$22.20	$1.38	$2.70	$0.39	$4.47	0.20
2	Alternative 2 - Option A (Morrissey Boulevard to Freedom Boulevard)	2A	$7.86	$23.34	$31.94	$25.84	$14.60	$2.74	$43.18	1.38
3	Alternative 2 - Option B (Morrissey Boulevard to Freedom Boulevard)	2B	$8.13	$20.75	$28.88	$30.03	$15.93	$2.75	$48.71	1.69
4	Alternative 3 (Morrissey Boulevard to State Park Drive)	3	$364.10	$293.96	$658.06	$29.63	$6.01	$3.94	$39.58	0.06

APPENDIX

APPENDIX A

COST ESTIMATES

MONTEREY BAY FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Comparison of Alternatives
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Santa Cruz	
Alternative 1 - Interim Bus on Shoulder Southbound	
Segment A: Soquel Avenue to 41st Avenue	**$2,700,000**
Segment B: Capitola Avenue to State Park Drive	**$5,600,000**
Segment C: South Railroad Bridge to Freedom Boulevard	**$4,100,000**
Alternative 2 - Bus on Right Shoulder with Auxilary Lanes	
Option A: Hybrid-Auxiliary Lanes (Morrissey to State Park Drive)	**$2,000,000**
Option B: Bus on Shoulder (Morrissey to State Park Dirve)	**$2,300,000**
Alternative 3 - HOV Lane Project	
HOV Lane Project from STA 98+70 to STA 168+25	**$350,800,000**
Monterey	
Segment I: Reservation Road to Del Monte Aenue (Sand City)	
Option I-A - Southbound Bus on Shoulder	**$18,800,000**
Option I-B - Monterey Branch Line Busway	**$20,000,000**
Option I-C - Caltrans Bike/Pedestrian Trail	**$19,300,000**
Segment II: Del Monte Avenue (Sand City) to SR 218	
Option II-A - Southbound Bus on Shoulder	**$5,300,000**
Option II-B - Monterey Branch Line Busway	**$8,900,000**
Segment III: SR 218 to Monterey	
Option III-A - BRT to English	**$600,000**
Option III-B - Southbound Bus on Shoulder	**$7,000,000**
Segment IV: Casa Verde to Fremont/Del Monte	
Option IV-A - Bus on Shoulder Northbound (PM Peak)	**$6,600,000**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Santa Cruz Alternative 1 - Interim Southbound Bus-on-Shoulder
Segment A: Soquel Avenue to 41st Avenue
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Segment Details

Segment Length:	4,500'
Average Existing Shoulder Width:	8'
Overhead Signs:	2
Call Boxes:	1
Catch Basins:	1
Retaining Wall Length	0'
Average Retaining Wall Height:	0'
Sound Wall Length:	0'
Light Pole:	0

Item #	Code	Description	Unit	Quantity	Unit Price	Cost
1.0	150662	REMOVE METAL BEAM GUARD RAILING	LF	75	$6.50	$488
2.0	150668	REMOVE FLARED END SECTION	EA	2	$510	$1,020
3.0	150827	REMOVE CATCH BASIN	EA	1	$1,750	$1,750
4.0	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	9	$535	$4,815
5.0	160103	CLEARING AND GRUBBING (ACRE)	ACRE	1	$85,400	$85,400
6.0	190101	ROADWAY EXCAVATION	CY	4,806	$11.50	$55,269
7.0	198010	IMPORTED BORROW (CY)	CY	234	$3.70	$866
8.0	210430	HYDROSEED	SQFT	51,840	$0.07	$3,629
9.0	250201	CLASS 2 AGGREGATE SUBBASE	CY	1,832	$175	$320,600
10.0	280000	LEAN CONCRETE BASE	CY	1,071	$165	$176,715
11.0	390132	HOT MIX ASPHALT (TYPE A)	TON	3,533	$87	$307,371
12.0	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$400	$0
13.0	498052	60" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	36	$1,250	$45,000
14.0	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	0	$560	$0
15.0	510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	4	$1,950	$7,800
16.0	566012	ROADSIDE SIGN - TWO POST	EA	18	$445	$8,010
17.0	568056	RELOCATE SIGN STRUCTURE	EA	2	$6,750	$13,500
18.0	582001	SOUND WALL (MASONRY BLOCK)	SF	0	$26	$0
19.0	705001	STEEL FLARED END SECTION	EA	2	$220	$440
20.0	832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	75	$30	$2,250
21.0	839701	CONCRETE BARRIER (TYPE 60)	LF	0	$100	$0
22.0	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	4,500	$0.14	$630
23.0	900001	RELOCATE CALL BOX	EA	1	$500	$500
24.0	900002	RELOCATE LIGHT POLE	EA	0	$5,000	$0
25.0	900003	CUT AND COVER STRUCTURE	EA	0	$600,000	$0
26.0	900004	SIGNAL AND LIGHTING	EA	0	$350,000	$0
27.0	900005	MODIFY SIGNAL AND LIGHTING	EA	0	$200,000	$0
					SUBTOTAL I (ALL OF ABOVE)	**$1,036,052**
				SW3P (3% OF SUBTOTAL I)	$31,080	$31,080
				TRAFFIC HANDLING (10% OF SUBTOTAL I)	$103,610	$103,610
				MISC. CONSTRUCTION COSTS (15% OF SUBTOTAL I)	$155,410	$155,410
				MAINTENANCE OF UTILITIES (3% OF SUBTOTAL I)	$31,080	$31,080
					SUBTOTAL II (MISCELLANOUS)	**$321,180**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

MOBILIZATION (10% OF SUBTOTAL I & II)	$135,720	$135,720
CONTINGENCIES (35% OF SUBTOTAL I & II)	$476,000	$476,000
SUBTOTAL III (CONSTRUCTION)		**$1,969,000**
LAND ACQUISITION	$0	$0
SUBTOTAL IV (RIGHT-OF-WAY)		**$0**
ENGINEERING STUDIES (3% OF SUBTOTAL III)	$59,000	$59,000
ENVIRONMENTAL (3% OF SUBTOTAL III)	$59,000	$59,000
DESIGN ENGINEERING AND CONSTRUCTION SUPPORT (17% OF SUBTOTAL III)	$335,000	$335,000
CONSTRUCTION MANAGEMENT (13% OF SUBTOTAL III)	$256,000	$256,000
SUBTOTAL V (SOFT COSTS)		**$709,000**
PROJECT TOTAL		**$2,678,000**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Santa Cruz Alternative 1 - Interim Southbound Bus-on-Shoulder
Segment B: Capitola Avenue to State Park Drive
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Segment Details

Segment Length:	11,000'
Average Existing Shoulder Width:	10'
Overhead Signs:	0
Call Boxes:	0
Catch Basins:	0
Retaining Wall Length	0'
Average Retaining Wall Height:	0'
Sound Wall Length:	0'
Light Pole:	0

Item #	Code	Description	Unit	Quantity	Unit Price	Cost
1.0	150662	REMOVE METAL BEAM GUARD RAILING	LF	0	$6.50	$0
2.0	150668	REMOVE FLARED END SECTION	EA	0	$510	$0
3.0	150827	REMOVE CATCH BASIN	EA	0	$1,750	$0
4.0	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	22	$535	$11,770
5.0	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0	$85,400	$0
6.0	190101	ROADWAY EXCAVATION	CY	11,946	$11.50	$137,379
7.0	198010	IMPORTED BORROW (CY)	CY	0	$3.70	$0
8.0	210430	HYDROSEED	SQFT	0	$0.07	$0
9.0	250201	CLASS 2 AGGREGATE SUBBASE	CY	4,477	$175	$783,475
10.0	280000	LEAN CONCRETE BASE	CY	2,618	$165	$431,970
11.0	390132	HOT MIX ASPHALT (TYPE A)	TON	8,635	$87	$751,245
12.0	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$400	$0
13.0	498052	60" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$1,250	$0
14.0	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	0	$560	$0
15.0	510061	STRUCTURAL CONCRETE, SOUND WALL	CY	0	$620	$0
16.0	510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	0	$1,950	$0
17.0	566012	ROADSIDE SIGN - TWO POST	EA	44	$445	$19,580
18.0	568056	RELOCATE SIGN STRUCTURE	EA	0	$6,750	$0
19.0	705001	STEEL FLARED END SECTION	EA	0	$220	$0
20.0	832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	0	$30	$0
21.0	839701	CONCRETE BARRIER (TYPE 60)	LF	0	$100	$0
22.0	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	11,000	$0.14	$1,540
23.0	900001	RELOCATE CALL BOX	EA	0	$500	$0
24.0	900002	RELOCATE LIGHT POLE	EA	0	$5,000	$0
25.0	900003	CUT AND COVER STRUCTURE	EA	0	$600,000	$0
26.0	900004	SIGNAL AND LIGHTING	EA	0	$350,000	$0
27.0	900005	MODIFY SIGNAL AND LIGHTING	EA	0	$200,000	$0
					SUBTOTAL I (ALL OF ABOVE)	**$2,136,959**
					SW3P (3% OF SUBTOTAL I) $64,110	$64,110
					TRAFFIC HANDLING (10% OF SUBTOTAL I) $213,700	$213,700
					MISC. CONSTRUCTION COSTS (15% OF SUBTOTAL I) $320,540	$320,540
					MAINTENANCE OF UTILITIES (3% OF SUBTOTAL I) $64,110	$64,110
					SUBTOTAL II (MISCELLANOUS)	**$662,460**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

MOBILIZATION (10% OF SUBTOTAL I & II)	$279,940	$279,940
CONTINGENCIES (35% OF SUBTOTAL I & II)	$980,000	$980,000
SUBTOTAL III (CONSTRUCTION)		**$4,059,400**
LAND ACQUISITION	$0	$0
SUBTOTAL IV (RIGHT-OF-WAY)		**$0**
ENGINEERING STUDIES (3% OF SUBTOTAL III)	$122,000	$122,000
ENVIRONMENTAL (3% OF SUBTOTAL III)	$122,000	$122,000
DESIGN ENGINEERING AND CONSTRUCTION SUPPORT (17% OF SUBTOTAL III)	$690,000	$690,000
CONSTRUCTION MANAGEMENT (13% OF SUBTOTAL III)	$528,000	$528,000
SUBTOTAL V (SOFT COSTS)		**$1,462,000**
PROJECT TOTAL		**$5,522,000**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Santa Cruz Alternative 1 - Interim Southbound Bus-on-Shoulder
Segment C: South Railroad Bridge to Freedom Boulevard
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Segment Details

Segment Length:	6,000'
Average Existing Shoulder Width:	8'
Overhead Signs:	0
Call Boxes:	0
Catch Basins:	0
Retaining Wall Length	1250'
Average Retaining Wall Height:	8'
Sound Wall Length:	0'
Light Pole:	0

Item #	Code	Description	Unit	Quantity	Unit Price	Cost
1.0	150662	REMOVE METAL BEAM GUARD RAILING	LF	0	$6.50	$0
2.0	150668	REMOVE FLARED END SECTION	EA	0	$510	$0
3.0	150827	REMOVE CATCH BASIN	EA	0	$1,750	$0
4.0	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	12	$535	$6,420
5.0	160103	CLEARING AND GRUBBING (ACRE)	ACRE	2	$85,400	$170,800
6.0	190101	ROADWAY EXCAVATION	CY	6,408	$11.50	$73,692
7.0	198010	IMPORTED BORROW (CY)	CY	312	$3.70	$1,154
8.0	210430	HYDROSEED	SQFT	69,120	$0.07	$4,838
9.0	250201	CLASS 2 AGGREGATE SUBBASE	CY	2,442	$175	$427,350
10.0	280000	LEAN CONCRETE BASE	CY	1,428	$165	$235,620
11.0	390132	HOT MIX ASPHALT (TYPE A)	TON	4,710	$87	$409,770
12.0	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$400	$0
13.0	498052	60" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$1,250	$0
14.0	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	371	$560	$207,760
15.0	510061	STRUCTURAL CONCRETE, SOUND WALL	CY	0	$620	$0
16.0	510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	0	$1,950	$0
17.0	566012	ROADSIDE SIGN - TWO POST	EA	24	$445	$10,680
18.0	568056	RELOCATE SIGN STRUCTURE	EA	0	$6,750	$0
19.0	705001	STEEL FLARED END SECTION	EA	0	$220	$0
20.0	832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	0	$30	$0
21.0	839701	CONCRETE BARRIER (TYPE 60)	LF	0	$100	$0
22.0	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	6,000	$0.14	$840
23.0	900001	RELOCATE CALL BOX	EA	0	$500	$0
24.0	900002	RELOCATE LIGHT POLE	EA	0	$5,000	$0
25.0	900003	CUT AND COVER STRUCTURE	EA	0	$600,000	$0
26.0	900004	SIGNAL AND LIGHTING	EA	0	$350,000	$0
27.0	900005	MODIFY SIGNAL AND LIGHTING	EA	0	$200,000	$0
					SUBTOTAL I (ALL OF ABOVE)	**$1,548,925**
					SW3P (3% OF SUBTOTAL I) $46,470	$46,470
					TRAFFIC HANDLING (10% OF SUBTOTAL I) $154,890	$154,890
					MISC. CONSTRUCTION COSTS (15% OF SUBTOTAL I) $232,340	$232,340
					MAINTENANCE OF UTILITIES (3% OF SUBTOTAL I) $46,470	$46,470
					SUBTOTAL II (MISCELLANOUS)	**$480,170**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

MOBILIZATION (10% OF SUBTOTAL I & II)	$202,910	$202,910
CONTINGENCIES (35% OF SUBTOTAL I & II)	$711,000	$711,000
SUBTOTAL III (CONSTRUCTION)		**$2,943,100**
LAND ACQUISITION	$0	$0
SUBTOTAL IV (RIGHT-OF-WAY)		**$0**
ENGINEERING STUDIES (3% OF SUBTOTAL III)	$88,000	$88,000
ENVIRONMENTAL (3% OF SUBTOTAL III)	$88,000	$88,000
DESIGN ENGINEERING AND CONSTRUCTION SUPPORT (17% OF SUBTOTAL III)	$500,000	$500,000
CONSTRUCTION MANAGEMENT (13% OF SUBTOTAL III)	$383,000	$383,000
SUBTOTAL V (SOFT COSTS)		**$1,059,000**
PROJECT TOTAL		**$4,003,000**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Santa Cruz Alternative 2 - Bus-on-Shoulder with Auxiliary Lanes
Option A: Hybrid-Auxiliary Lanes (Morrissey to State Park Drive)
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Segment Details

Segment Length:	10,150'
Average Existing Shoulder Width:	8'
Overhead Signs:	0
Call Boxes:	0
Catch Basins:	0
Retaining Wall Length	0'
Average Retaining Wall Height:	0'
Sound Wall Length:	0'
Light Pole:	0

Item #	Code	Description	Unit	Quantity	Unit Price	Cost
1.0	150662	REMOVE METAL BEAM GUARD RAILING	LF	0	$6.50	$0
2.0	150668	REMOVE FLARED END SECTION	EA	0	$510	$0
3.0	150827	REMOVE CATCH BASIN	EA	0	$1,750	$0
4.0	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	21	$535	$11,235
5.0	160103	CLEARING AND GRUBBING (ACRE)	ACRE	1	$85,400	$85,400
6.0	190101	ROADWAY EXCAVATION	CY	3,578	$11.50	$41,142
7.0	198010	IMPORTED BORROW (CY)	CY	174	$3.70	$645
8.0	210430	HYDROSEED	SQFT	38,586	$0.07	$2,701
9.0	250201	CLASS 2 AGGREGATE SUBBASE	CY	1,364	$175	$238,623
10.0	280000	LEAN CONCRETE BASE	CY	797	$165	$131,551
11.0	390132	HOT MIX ASPHALT (TYPE A)	TON	2,629	$87	$228,761
12.0	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$400	$0
13.0	498052	60" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$1,250	$0
14.0	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	0	$560	$0
15.0	510061	STRUCTURAL CONCRETE, SOUND WALL	CY	0	$620	$0
16.0	510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	0	$1,950	$0
17.0	566012	ROADSIDE SIGN - TWO POST	EA	41	$445	$18,245
18.0	568056	RELOCATE SIGN STRUCTURE	EA	0	$6,750	$0
19.0	705001	STEEL FLARED END SECTION	EA	0	$220	$0
20.0	832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	0	$30	$0
21.0	839701	CONCRETE BARRIER (TYPE 60)	LF	0	$100	$0
22.0	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	10,150	$0.14	$1,421
23.0	900001	RELOCATE CALL BOX	EA	0	$500	$0
24.0	900002	RELOCATE LIGHT POLE	EA	0	$5,000	$0
25.0	900003	CUT AND COVER STRUCTURE	EA	0	$600,000	$0
26.0	900004	SIGNAL AND LIGHTING	EA	0	$350,000	$0
27.0	900005	MODIFY SIGNAL AND LIGHTING	EA	0	$200,000	$0
					SUBTOTAL I (ALL OF ABOVE)	**$759,724**
				SW3P (3% OF SUBTOTAL I)	$22,790	$22,790
				TRAFFIC HANDLING (10% OF SUBTOTAL I)	$75,970	$75,970
				MISC. CONSTRUCTION COSTS (15% OF SUBTOTAL I)	$113,960	$113,960
				MAINTENANCE OF UTILITIES (3% OF SUBTOTAL I)	$22,790	$22,790
					SUBTOTAL II (MISCELLANOUS)	**$235,510**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

MOBILIZATION (10% OF SUBTOTAL I & II)	$99,520	$99,520
CONTINGENCIES (35% OF SUBTOTAL I & II)	$349,000	$349,000
SUBTOTAL III (CONSTRUCTION)		**$1,443,800**
LAND ACQUISITION	$0	$0
SUBTOTAL IV (RIGHT-OF-WAY)		**$0**
ENGINEERING STUDIES (3% OF SUBTOTAL III)	$43,000	$43,000
ENVIRONMENTAL (3% OF SUBTOTAL III)	$43,000	$43,000
DESIGN ENGINEERING AND CONSTRUCTION SUPPORT (17% OF SUBTOTAL III)	$245,000	$245,000
CONSTRUCTION MANAGEMENT (13% OF SUBTOTAL III)	$188,000	$188,000
SUBTOTAL V (SOFT COSTS)		**$519,000**
PROJECT TOTAL		**$1,963,000**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Santa Cruz Alternative 2 - Bus-on-Shoulder with Auxiliary Lanes
Option B: Bus on Shoulder (Morrissey to State Park Drive)
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Segment Details

Segment Length:	42,700'
Average Existing Shoulder Width:	7'
Overhead Signs:	0
Call Boxes:	0
Catch Basins:	0
Retaining Wall Length	200'
Average Retaining Wall Height:	2'
Sound Wall Length:	0'
Light Pole:	0

Item #	Code	Description	Unit	Quantity	Unit Price	Cost
1.0	150662	REMOVE METAL BEAM GUARD RAILING	LF	0	$6.50	$0
2.0	150668	REMOVE FLARED END SECTION	EA	0	$510	$0
3.0	150827	REMOVE CATCH BASIN	EA	0	$1,750	$0
4.0	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	86	$535	$46,010
5.0	160103	CLEARING AND GRUBBING (ACRE)	ACRE	1	$85,400	$85,400
6.0	190101	ROADWAY EXCAVATION	CY	3,578	$11.50	$41,142
7.0	198010	IMPORTED BORROW (CY)	CY	174	$3.70	$645
8.0	210430	HYDROSEED	SQFT	38,586	$0.07	$2,701
9.0	250201	CLASS 2 AGGREGATE SUBBASE	CY	1,364	$175	$238,623
10.0	280000	LEAN CONCRETE BASE	CY	797	$165	$131,551
11.0	390132	HOT MIX ASPHALT (TYPE A)	TON	2,629	$87	$228,761
12.0	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$400	$0
13.0	498052	60" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$1,250	$0
14.0	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	15	$560	$8,400
15.0	510061	STRUCTURAL CONCRETE, SOUND WALL	CY	0	$620	$0
16.0	510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	0	$1,950	$0
17.0	566012	ROADSIDE SIGN - TWO POST	EA	171	$445	$76,095
18.0	568056	RELOCATE SIGN STRUCTURE	EA	0	$6,750	$0
19.0	705001	STEEL FLARED END SECTION	EA	0	$220	$0
20.0	832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	0	$30	$0
21.0	839701	CONCRETE BARRIER (TYPE 60)	LF	0	$100	$0
22.0	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	42,700	$0.14	$5,978
23.0	900001	RELOCATE CALL BOX	EA	0	$500	$0
24.0	900002	RELOCATE LIGHT POLE	EA	0	$5,000	$0
25.0	900003	CUT AND COVER STRUCTURE	EA	0	$600,000	$0
26.0	900004	SIGNAL AND LIGHTING	EA	0	$350,000	$0
27.0	900005	MODIFY SIGNAL AND LIGHTING	EA	0	$200,000	$0
					SUBTOTAL I (ALL OF ABOVE)	**$865,306**
				SW3P (3% OF SUBTOTAL I)	$25,960	$25,960
				TRAFFIC HANDLING (10% OF SUBTOTAL I)	$86,530	$86,530
				MISC. CONSTRUCTION COSTS (15% OF SUBTOTAL I)	$129,800	$129,800
				MAINTENANCE OF UTILITIES (3% OF SUBTOTAL I)	$25,960	$25,960
					SUBTOTAL II (MISCELLANOUS)	**$268,250**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

MOBILIZATION (10% OF SUBTOTAL I & II)	$113,360	$113,360
CONTINGENCIES (35% OF SUBTOTAL I & II)	$397,000	$397,000
SUBTOTAL III (CONSTRUCTION)		**$1,644,000**
LAND ACQUISITION	$0	$0
SUBTOTAL IV (RIGHT-OF-WAY)		**$0**
ENGINEERING STUDIES (3% OF SUBTOTAL III)	$49,000	$49,000
ENVIRONMENTAL (3% OF SUBTOTAL III)	$49,000	$49,000
DESIGN ENGINEERING AND CONSTRUCTION SUPPORT (17% OF SUBTOTAL III)	$279,000	$279,000
CONSTRUCTION MANAGEMENT (13% OF SUBTOTAL III)	$214,000	$214,000
SUBTOTAL V (SOFT COSTS)		**$591,000**
PROJECT TOTAL		**$2,235,000**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Segment I: Reservation Road to Fremont Boulevard (Sand City)
Monterey Option I-A - Southbound Bus-on-Shoulder
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Segment Details

Segment Length:	29,500'
Average Existing Shoulder Width:	8'
Overhead Signs:	0
Call Boxes:	2
Catch Basins:	0
Retaining Wall Length	6000'
Average Retaining Wall Height:	2'
Sound Wall Length:	0'
Light Pole:	0

Item #	Code	Description	Unit	Quantity	Unit Price	Cost
1.0	150662	REMOVE METAL BEAM GUARD RAILING	LF	8,600	$6.50	$55,900
2.0	150668	REMOVE FLARED END SECTION	EA	2	$510	$1,020
3.0	150827	REMOVE CATCH BASIN	EA	0	$1,750	$0
4.0	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	59	$535	$31,565
5.0	160103	CLEARING AND GRUBBING (ACRE)	ACRE	6	$85,400	$512,400
6.0	190101	ROADWAY EXCAVATION	CY	31,506	$11.50	$362,319
7.0	198010	IMPORTED BORROW (CY)	CY	1,534	$3.70	$5,676
8.0	210430	HYDROSEED	SQFT	339,840	$0.07	$23,789
9.0	250201	CLASS 2 AGGREGATE SUBBASE	CY	12,007	$175	$2,101,225
10.0	280000	LEAN CONCRETE BASE	CY	7,021	$165	$1,158,465
11.0	390132	HOT MIX ASPHALT (TYPE A)	TON	23,158	$87	$2,014,746
12.0	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$400	$0
13.0	498052	60" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$1,250	$0
14.0	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	445	$560	$249,200
15.0	510061	STRUCTURAL CONCRETE, SOUND WALL	CY	0	$620	$0
16.0	510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	0	$1,950	$0
17.0	566012	ROADSIDE SIGN - TWO POST	EA	118	$445	$52,510
18.0	568056	RELOCATE SIGN STRUCTURE	EA	0	$6,750	$0
19.0	705001	STEEL FLARED END SECTION	EA	1	$220	$220
20.0	832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	2,400	$30	$72,000
21.0	839701	CONCRETE BARRIER (TYPE 60)	LF	6,000	$100	$600,000
22.0	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	29,500	$0.14	$4,130
23.0	900001	RELOCATE CALL BOX	EA	2	$500	$1,000
24.0	900002	RELOCATE LIGHT POLE	EA	0	$5,000	$0
25.0	900003	CUT AND COVER STRUCTURE	EA	0	$600,000	$0
26.0	900004	SIGNAL AND LIGHTING	EA	0	$350,000	$0
27.0	900005	MODIFY SIGNAL AND LIGHTING	EA	0	$200,000	$0
					SUBTOTAL I (ALL OF ABOVE)	**$7,246,165**
				SW3P (3% OF SUBTOTAL I)	$217,380	$217,380
				TRAFFIC HANDLING (10% OF SUBTOTAL I)	$724,620	$724,620
				MISC. CONSTRUCTION COSTS (15% OF SUBTOTAL I)	$1,086,920	$1,086,920
				MAINTENANCE OF UTILITIES (3% OF SUBTOTAL I)	$217,380	$217,380
					SUBTOTAL II (MISCELLANOUS)	**$2,246,300**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

MOBILIZATION (10% OF SUBTOTAL I & II)	$949,250	$949,250
CONTINGENCIES (35% OF SUBTOTAL I & II)	$3,323,000	$3,323,000
SUBTOTAL III (CONSTRUCTION)		**$13,764,800**
LAND ACQUISITION	$0	$0
SUBTOTAL IV (RIGHT-OF-WAY)		**$0**
ENGINEERING STUDIES (3% OF SUBTOTAL III)	$413,000	$413,000
ENVIRONMENTAL (3% OF SUBTOTAL III)	$413,000	$413,000
DESIGN ENGINEERING AND CONSTRUCTION SUPPORT (17% OF SUBTOTAL III)	$2,340,000	$2,340,000
CONSTRUCTION MANAGEMENT (13% OF SUBTOTAL III)	$1,789,000	$1,789,000
SUBTOTAL V (SOFT COSTS)		**$4,955,000**
PROJECT TOTAL		**$18,720,000**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Segment I: Reservation Road to Fremont Boulevard (Sand City)
Monterey Option I-B - Monterey Branch Line Busway
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Segment Details

Segment Length:	27,000'
Configuration:	MBL
Overhead Signs:	0
Call Boxes:	0
Catch Basins:	0
Retaining Wall Length	0'
Average Retaining Wall Height:	0'
Sound Wall Length:	0'
Light Pole:	0

Item #	Code	Description	Unit	Quantity	Unit Price	Cost
1.0	150662	REMOVE METAL BEAM GUARD RAILING	LF	0	$6.50	$0
2.0	150668	REMOVE FLARED END SECTION	EA	0	$510	$0
3.0	150827	REMOVE CATCH BASIN	EA	0	$1,750	$0
4.0	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0	$535	$0
5.0	160103	CLEARING AND GRUBBING (ACRE)	ACRE	21	$85,400	$1,793,400
6.0	190101	ROADWAY EXCAVATION	CY	11,610	$11.50	$133,515
7.0	198010	IMPORTED BORROW (CY)	CY	15,795	$3.70	$58,442
8.0	210430	HYDROSEED	SQFT	368,658	$0.07	$25,806
9.0	250201	CLASS 2 AGGREGATE SUBBASE	CY	13,176	$175	$2,305,800
10.0	280000	LEAN CONCRETE BASE	CY	7,695	$165	$1,269,675
11.0	390132	HOT MIX ASPHALT (TYPE A)	TON	29,376	$87	$2,555,712
12.0	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$400	$0
13.0	498052	60" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$1,250	$0
14.0	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	0	$560	$0
15.0	510061	STRUCTURAL CONCRETE, SOUND WALL	CY	0	$620	$0
16.0	510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	0	$1,950	$0
17.0	566012	ROADSIDE SIGN - TWO POST	EA	0	$445	$0
18.0	568056	RELOCATE SIGN STRUCTURE	EA	0	$6,750	$0
19.0	705001	STEEL FLARED END SECTION	EA	0	$220	$0
20.0	832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	0	$30	$0
21.0	839701	CONCRETE BARRIER (TYPE 60)	LF	0	$100	$0
22.0	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	54,000	$0.14	$7,560
23.0	900001	RELOCATE CALL BOX	EA	0	$500	$0
24.0	900002	RELOCATE LIGHT POLE	EA	0	$5,000	$0
25.0	900003	CUT AND COVER STRUCTURE	EA	0	$600,000	$0
26.0	900004	SIGNAL AND LIGHTING	EA	0	$350,000	$0
27.0	900005	MODIFY SIGNAL AND LIGHTING	EA	0	$200,000	$0
					SUBTOTAL I (ALL OF ABOVE)	**$8,149,910**
					SW3P (3% OF SUBTOTAL I) $244,500	$244,500
					DRAINAGE (5% OF SUBTOTAL I) $407,500	$407,500
					MISC. CONSTRUCTION COSTS (15% OF SUBTOTAL I) $1,222,490	$1,222,490
					MAINTENANCE OF UTILITIES (3% OF SUBTOTAL I) $244,500	$244,500
					SUBTOTAL II (MISCELLANOUS)	**$2,118,990**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

MOBILIZATION (10% OF SUBTOTAL I & II)	$1,026,890	$1,026,890
CONTINGENCIES (35% OF SUBTOTAL I & II)	$3,595,000	$3,595,000
SUBTOTAL III (CONSTRUCTION)		**$14,890,800**
LAND ACQUISITION	$0	$0
SUBTOTAL IV (RIGHT-OF-WAY)		**$0**
ENGINEERING STUDIES(3% OF SUBTOTAL III)	$447,000	$447,000
ENVIRONMENTAL (3% OF SUBTOTAL III)	$447,000	$447,000
DESIGN ENGINEERING AND CONSTRUCTION SUPPORT (15% OF SUBTOTAL III)	$2,234,000	$2,234,000
CONSTRUCTION MANAGEMENT (13% OF SUBTOTAL III)	$1,936,000	$1,936,000
SUBTOTAL V (SOFT COSTS)		**$5,064,000**
PROJECT TOTAL		**$19,955,000**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Segment I: Reservation Road to Fremont Boulevard (Sand City)
Monterey Option I-C - Caltrans Bike/Pedestrian Trail
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Segment Details

Segment Length:	27,000'
Configuration:	CBP
Overhead Signs:	0
Call Boxes:	0
Catch Basins:	0
Retaining Wall Length	0'
Average Retaining Wall Height:	0'
Sound Wall Length:	0'
Light Pole:	0

Item #	Code	Description	Unit	Quantity	Unit Price	Cost
1.0	150662	REMOVE METAL BEAM GUARD RAILING	LF	0	$6.50	$0
2.0	150668	REMOVE FLARED END SECTION	EA	0	$510	$0
3.0	150827	REMOVE CATCH BASIN	EA	0	$1,750	$0
4.0	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0	$535	$0
5.0	160103	CLEARING AND GRUBBING (ACRE)	ACRE	15	$85,400	$1,281,000
6.0	190101	ROADWAY EXCAVATION	CY	32,616	$11.50	$375,084
7.0	198010	IMPORTED BORROW (CY)	CY	7,722	$3.70	$28,571
8.0	210430	HYDROSEED	SQFT	367,200	$0.07	$25,704
9.0	250201	CLASS 2 AGGREGATE SUBBASE	CY	13,203	$175	$2,310,525
10.0	280000	LEAN CONCRETE BASE	CY	7,695	$165	$1,269,675
11.0	390132	HOT MIX ASPHALT (TYPE A)	TON	29,376	$87	$2,555,712
12.0	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$400	$0
13.0	498052	60" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$1,250	$0
14.0	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	0	$560	$0
15.0	510061	STRUCTURAL CONCRETE, SOUND WALL	CY	0	$620	$0
16.0	510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	0	$1,950	$0
17.0	566012	ROADSIDE SIGN - TWO POST	EA	0	$445	$0
18.0	568056	RELOCATE SIGN STRUCTURE	EA	0	$6,750	$0
19.0	705001	STEEL FLARED END SECTION	EA	0	$220	$0
20.0	832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	0	$30	$0
21.0	839701	CONCRETE BARRIER (TYPE 60)	LF	0	$100	$0
22.0	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	54,000	$0.14	$7,560
23.0	900001	RELOCATE CALL BOX	EA	0	$500	$0
24.0	900002	RELOCATE LIGHT POLE	EA	0	$5,000	$0
25.0	900003	CUT AND COVER STRUCTURE	EA	0	$600,000	$0
26.0	900004	SIGNAL AND LIGHTING	EA	0	$350,000	$0
27.0	900005	MODIFY SIGNAL AND LIGHTING	EA	0	$200,000	$0
					SUBTOTAL I (ALL OF ABOVE)	**$7,853,831**
					SW3P (3% OF SUBTOTAL I) $235,610	$235,610
					DRAINAGE (5% OF SUBTOTAL I) $392,690	$392,690
					MISC. CONSTRUCTION COSTS (15% OF SUBTOTAL I) $1,178,070	$1,178,070
					MAINTENANCE OF UTILITIES (3% OF SUBTOTAL I) $235,610	$235,610
					SUBTOTAL II (MISCELLANOUS)	**$2,041,980**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

MOBILIZATION (10% OF SUBTOTAL I & II)	$989,580	$989,580
CONTINGENCIES (35% OF SUBTOTAL I & II)	$3,464,000	$3,464,000
SUBTOTAL III (CONSTRUCTION)		**$14,349,400**
LAND ACQUISITION	$0	$0
SUBTOTAL IV (RIGHT-OF-WAY)		**$0**
ENGINEERING STUDIES(3% OF SUBTOTAL III)	$430,000	$430,000
ENVIRONMENTAL (3% OF SUBTOTAL III)	$430,000	$430,000
DESIGN ENGINEERING AND CONSTRUCTION SUPPORT (15% OF SUBTOTAL III)	$2,152,000	$2,152,000
CONSTRUCTION MANAGEMENT (13% OF SUBTOTAL III)	$1,865,000	$1,865,000
SUBTOTAL V (SOFT COSTS)		**$4,877,000**
PROJECT TOTAL		**$19,227,000**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Segment II: Fremont Boulevard (Sand City) to SR-218
Monterey Option II-A - Southbound Bus-on-Shoulder
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Segment Details

Segment Length:	7,000'
Average Existing Shoulder Width:	8'
Overhead Signs:	0
Call Boxes:	1
Catch Basins:	2
Retaining Wall Length	2600'
Average Retaining Wall Height:	8'
Sound Wall Length:	0'
Light Pole:	0

Item #	Code	Description	Unit	Quantity	Unit Price	Cost
1.0	150662	REMOVE METAL BEAM GUARD RAILING	LF	275	$6.50	$1,788
2.0	150668	REMOVE FLARED END SECTION	EA	1	$510	$510
3.0	150827	REMOVE CATCH BASIN	EA	2	$1,750	$3,500
4.0	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	14	$535	$7,490
5.0	160103	CLEARING AND GRUBBING (ACRE)	ACRE	2	$85,400	$170,800
6.0	190101	ROADWAY EXCAVATION	CY	7,476	$11.50	$85,974
7.0	198010	IMPORTED BORROW (CY)	CY	364	$3.70	$1,347
8.0	210430	HYDROSEED	SQFT	80,640	$0.07	$5,645
9.0	250201	CLASS 2 AGGREGATE SUBBASE	CY	2,849	$175	$498,575
10.0	280000	LEAN CONCRETE BASE	CY	1,666	$165	$274,890
11.0	390132	HOT MIX ASPHALT (TYPE A)	TON	5,495	$87	$478,065
12.0	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$400	$0
13.0	498052	60" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$1,250	$0
14.0	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	771	$560	$431,760
15.0	510061	STRUCTURAL CONCRETE, SOUND WALL	CY	0	$620	$0
16.0	510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	7	$1,950	$13,650
17.0	566012	ROADSIDE SIGN - TWO POST	EA	28	$445	$12,460
18.0	568056	RELOCATE SIGN STRUCTURE	EA	0	$6,750	$0
19.0	705001	STEEL FLARED END SECTION	EA	0	$220	$0
20.0	832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	0	$30	$0
21.0	839701	CONCRETE BARRIER (TYPE 60)	LF	300	$100	$30,000
22.0	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	7,000	$0.14	$980
23.0	900001	RELOCATE CALL BOX	EA	1	$500	$500
24.0	900002	RELOCATE LIGHT POLE	EA	0	$5,000	$0
25.0	900003	CUT AND COVER STRUCTURE	EA	0	$600,000	$0
26.0	900004	SIGNAL AND LIGHTING	EA	0	$350,000	$0
27.0	900005	MODIFY SIGNAL AND LIGHTING	EA	0	$200,000	$0
					SUBTOTAL I (ALL OF ABOVE)	**$2,017,933**
				SW3P (3% OF SUBTOTAL I)	$60,540	$60,540
				TRAFFIC HANDLING (10% OF SUBTOTAL I)	$201,790	$201,790
				MISC. CONSTRUCTION COSTS (17% OF SUBTOTAL I)	$343,050	$343,050
				MAINTENANCE OF UTILITIES (3% OF SUBTOTAL I)	$60,540	$60,540
					SUBTOTAL II (MISCELLANOUS)	**$665,920**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

MOBILIZATION (10% OF SUBTOTAL I & II)	$268,390	$268,390
CONTINGENCIES (35% OF SUBTOTAL I & II)	$940,000	$940,000
SUBTOTAL III (CONSTRUCTION)		**$3,892,300**
LAND ACQUISITION	$0	$0
SUBTOTAL IV (RIGHT-OF-WAY)		**$0**
ENGINEERING STUDIES (3% OF SUBTOTAL III)	$117,000	$117,000
ENVIRONMENTAL (3% OF SUBTOTAL III)	$117,000	$117,000
DESIGN ENGINEERING AND CONSTRUCTION SUPPORT (17% OF SUBTOTAL III)	$662,000	$662,000
CONSTRUCTION MANAGEMENT (13% OF SUBTOTAL III)	$506,000	$506,000
SUBTOTAL V (SOFT COSTS)		**$1,402,000**
PROJECT TOTAL		**$5,295,000**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Segment II: Fremont Boulevard (Sand City) to SR-218
Monterey Option II-B - Monterey Branch Line Busway
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Segment Details

Segment Length:	6,500'
Configuration:	MBL
Overhead Signs:	0
Call Boxes:	0
Catch Basins:	0
Retaining Wall Length	1340'
Average Retaining Wall Height:	10'
Sound Wall Length:	0'
Light Pole:	0

Item #	Code	Description	Unit	Quantity	Unit Price	Cost
1.0	150662	REMOVE METAL BEAM GUARD RAILING	LF	0	$6.50	$0
2.0	150668	REMOVE FLARED END SECTION	EA	0	$510	$0
3.0	150827	REMOVE CATCH BASIN	EA	0	$1,750	$0
4.0	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0	$535	$0
5.0	160103	CLEARING AND GRUBBING (ACRE)	ACRE	6	$85,400	$512,400
6.0	190101	ROADWAY EXCAVATION	CY	2,795	$11.50	$32,143
7.0	198010	IMPORTED BORROW (CY)	CY	3,803	$3.70	$14,071
8.0	210430	HYDROSEED	SQFT	88,751	$0.07	$6,213
9.0	250201	CLASS 2 AGGREGATE SUBBASE	CY	3,172	$175	$555,100
10.0	280000	LEAN CONCRETE BASE	CY	1,853	$165	$305,745
11.0	390132	HOT MIX ASPHALT (TYPE A)	TON	7,072	$87	$615,264
12.0	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$400	$0
13.0	498052	60" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$1,250	$0
14.0	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	497	$560	$278,320
15.0	510061	STRUCTURAL CONCRETE, SOUND WALL	CY	0	$620	$0
16.0	510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	0	$1,950	$0
17.0	566012	ROADSIDE SIGN - TWO POST	EA	0	$445	$0
18.0	568056	RELOCATE SIGN STRUCTURE	EA	0	$6,750	$0
19.0	705001	STEEL FLARED END SECTION	EA	0	$220	$0
20.0	832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	0	$30	$0
21.0	839701	CONCRETE BARRIER (TYPE 60)	LF	0	$100	$0
22.0	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	13,000	$0.14	$1,820
23.0	900001	RELOCATE CALL BOX	EA	0	$500	$0
24.0	900002	RELOCATE LIGHT POLE	EA	0	$5,000	$0
25.0	900003	CUT AND COVER STRUCTURE	EA	1	$600,000	$600,000
26.0	900004	SIGNAL AND LIGHTING	EA	2	$350,000	$700,000
27.0	900005	MODIFY SIGNAL AND LIGHTING	EA	0	$200,000	$0
					SUBTOTAL I (ALL OF ABOVE)	**$3,621,075**
				SW3P (3% OF SUBTOTAL I)	$108,630	$108,630
				DRAINAGE (5% OF SUBTOTAL I)	$181,050	$181,050
				MISC. CONSTRUCTION COSTS (15% OF SUBTOTAL I)	$543,160	$543,160
				MAINTENANCE OF UTILITIES (3% OF SUBTOTAL I)	$108,630	$108,630
					SUBTOTAL II (MISCELLANOUS)	**$941,470**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

MOBILIZATION (10% OF SUBTOTAL I & II)	$456,250	$456,250
CONTINGENCIES (35% OF SUBTOTAL I & II)	$1,597,000	$1,597,000
SUBTOTAL III (CONSTRUCTION)		**$6,615,800**
LAND ACQUISITION	$0	$0
SUBTOTAL IV (RIGHT-OF-WAY)		**$0**
ENGINEERING STUDIES (3% OF SUBTOTAL III)	$198,000	$198,000
ENVIRONMENTAL (3% OF SUBTOTAL III)	$198,000	$198,000
DESIGN ENGINEERING AND CONSTRUCTION SUPPORT (15% OF SUBTOTAL III)	$992,000	$992,000
CONSTRUCTION MANAGEMENT (13% OF SUBTOTAL III)	$860,000	$860,000
SUBTOTAL V (SOFT COSTS)		**$2,248,000**
PROJECT TOTAL		**$8,864,000**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Segment III: SR-218 to Monterey
Monterey Option III-A - BRT to English Avenue
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Segment Details

Segment Length:	'
Average Existing Shoulder Width:	0'
Overhead Signs:	0
Call Boxes:	0
Catch Basins:	0
Retaining Wall Length	0'
Average Retaining Wall Height:	0'
Sound Wall Length:	0'
Light Pole:	0

Item #	Code	Description	Unit	Quantity	Unit Price	Cost
1.0	566011	ROADSIDE SIGN - ONE POST	EA	5	$340	$1,700
2.0	900005	MODIFY SIGNAL AND LIGHTING	EA	1	$200,000	$200,000
					SUBTOTAL I (ALL OF ABOVE)	**$201,700**
					SW3P (3% OF SUBTOTAL I) $6,050.00	$6,050
					TRAFFIC HANDLING (10% OF SUBTOTAL I) $20,170.00	$20,170
					MISC. CONSTRUCTION COSTS (15% OF SUBTOTAL I) $30,260.00	$30,260
					MAINTENANCE OF UTILITIES (3% OF SUBTOTAL I) $6,050	$6,050
					SUBTOTAL II (MISCELLANOUS)	**$62,530**
					MOBILIZATION (10% OF SUBTOTAL I & II) $26,420	$26,420
					CONTINGENCIES (35% OF SUBTOTAL I & II) $93,000	$93,000
					SUBTOTAL III (CONSTRUCTION)	**$383,700**
					LAND ACQUISITION $0	$0
					SUBTOTAL IV (RIGHT-OF-WAY)	**$0**
					ENVIRONMENTAL (3% OF SUBTOTAL III OR $40k MIN.) $40,000	$40,000
					ENVIRONMENTAL (3% OF SUBTOTAL III OR $40k MIN.) $40,000	$40,000
					DESIGN ENGINEERING AND CONSTRUCTION SUPPORT (17% OF SUBTOTAL III) $65,000	$65,000
					CONSTRUCTION MANAGEMENT (13% OF SUBTOTAL III) $50,000	$50,000
					SUBTOTAL V (SOFT COSTS)	**$195,000**
					PROJECT TOTAL	**$579,000**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Segment III: SR-218 to Monterey
Monterey Alternative 3B - Southbound Bus-on-Shoulder
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Segment Details

Segment Length:	11,000'
Average Existing Shoulder Width:	3'
Overhead Signs:	0
Call Boxes:	0
Catch Basins:	0
Retaining Wall Length	0'
Average Retaining Wall Height:	0'
Sound Wall Length:	0'
Light Pole:	0

Item #	Code	Description	Unit	Quantity	Unit Price	Cost
1.0	150662	REMOVE METAL BEAM GUARD RAILING	LF	0	$6.50	$0
2.0	150668	REMOVE FLARED END SECTION	EA	0	$510	$0
3.0	150827	REMOVE CATCH BASIN	EA	0	$1,750	$0
4.0	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	22	$535	$11,770
5.0	160103	CLEARING AND GRUBBING (ACRE)	ACRE	7	$85,400	$597,800
6.0	190101	ROADWAY EXCAVATION	CY	9,427	$11.50	$108,411
7.0	198010	IMPORTED BORROW (CY)	CY	6,974	$3.70	$25,804
8.0	210430	HYDROSEED	SQFT	212,509	$0.07	$14,876
9.0	250201	CLASS 2 AGGREGATE SUBBASE	CY	4,477	$175	$783,475
10.0	280000	LEAN CONCRETE BASE	CY	2,618	$165	$431,970
11.0	390132	HOT MIX ASPHALT (TYPE A)	TON	8,635	$87	$751,245
12.0	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$400	$0
13.0	498052	60" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$1,250	$0
14.0	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	0	$560	$0
15.0	510061	STRUCTURAL CONCRETE, SOUND WALL	CY	0	$620	$0
16.0	510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	0	$1,950	$0
17.0	566012	ROADSIDE SIGN - TWO POST	EA	44	$445	$19,580
18.0	568056	RELOCATE SIGN STRUCTURE	EA	0	$6,750	$0
19.0	705001	STEEL FLARED END SECTION	EA	0	$220	$0
20.0	832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	0	$30	$0
21.0	839701	CONCRETE BARRIER (TYPE 60)	LF	0	$100	$0
22.0	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	11,000	$0.14	$1,540
23.0	900001	RELOCATE CALL BOX	EA	0	$500	$0
24.0	900002	RELOCATE LIGHT POLE	EA	0	$5,000	$0
25.0	900003	CUT AND COVER STRUCTURE	EA	0	$600,000	$0
26.0	900004	SIGNAL AND LIGHTING	EA	0	$350,000	$0
27.0	900005	MODIFY SIGNAL AND LIGHTING	EA	0	$200,000	$0
					SUBTOTAL I (ALL OF ABOVE)	**$2,746,470**
					SW3P (3% OF SUBTOTAL I) $82,390	$82,390
					TRAFFIC HANDLING (10% OF SUBTOTAL I) $274,650	$274,650
					MISC. CONSTRUCTION COSTS (15% OF SUBTOTAL I) $411,970	$411,970
					MAINTENANCE OF UTILITIES (3% OF SUBTOTAL I) $82,390	$82,390
					SUBTOTAL II (MISCELLANOUS)	**$851,400**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

MOBILIZATION (10% OF SUBTOTAL I & II)	$359,790	$359,790
CONTINGENCIES (35% OF SUBTOTAL I & II)	$1,260,000	$1,260,000
SUBTOTAL III (CONSTRUCTION)		**$5,217,700**
LAND ACQUISITION	$0	$0
SUBTOTAL IV (RIGHT-OF-WAY)		**$0**
ENGINEERING STUDIES (3% OF SUBTOTAL III)	$157,000	$157,000
ENVIRONMENTAL (3% OF SUBTOTAL III)	$157,000	$157,000
DESIGN ENGINEERING AND CONSTRUCTION SUPPORT (15% OF SUBTOTAL III)	$783,000	$783,000
CONSTRUCTION MANAGEMENT (13% OF SUBTOTAL III)	$678,000	$678,000
SUBTOTAL V (SOFT COSTS)		**$1,775,000**
PROJECT TOTAL		**$6,993,000**

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Opinion of Probable Construction Costs
Project Name:
Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Segment IV: Casa Verde Way to Fremont Boulevard
Monterey Option IV-A - Northbound Bus-on-Shoulder
Date of Preparation:
June 26, 2018
Submittal:
DRAFT

Segment Details

Segment Length:	10,000'
Average Existing Shoulder Width:	5'
Overhead Signs:	0
Call Boxes:	1
Catch Basins:	1
Retaining Wall Length	1100'
Average Retaining Wall Height:	6'
Sound Wall Length:	0'
Light Pole:	0

Item #	Code	Description	Unit	Quantity	Unit Price	Cost
1.0	150662	REMOVE METAL BEAM GUARD RAILING	LF	0	$6.50	$0
2.0	150668	REMOVE FLARED END SECTION	EA	0	$510	$0
3.0	150827	REMOVE CATCH BASIN	EA	1	$1,750	$1,750
4.0	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	20	$535	$10,700
5.0	160103	CLEARING AND GRUBBING (ACRE)	ACRE	5	$85,400	$427,000
6.0	190101	ROADWAY EXCAVATION	CY	9,690	$11.50	$111,435
7.0	198010	IMPORTED BORROW (CY)	CY	3,230	$3.70	$11,951
8.0	210430	HYDROSEED	SQFT	138,000	$0.07	$9,660
9.0	250201	CLASS 2 AGGREGATE SUBBASE	CY	4,070	$175	$712,250
10.0	280000	LEAN CONCRETE BASE	CY	2,380	$165	$392,700
11.0	390132	HOT MIX ASPHALT (TYPE A)	TON	7,850	$87	$682,950
12.0	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$400	$0
13.0	498052	60" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	0	$1,250	$0
14.0	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	245	$560	$137,200
15.0	510061	STRUCTURAL CONCRETE, SOUND WALL	CY	0	$620	$0
16.0	510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	4	$1,950	$7,800
17.0	566012	ROADSIDE SIGN - TWO POST	EA	40	$445	$17,800
18.0	568056	RELOCATE SIGN STRUCTURE	EA	0	$6,750	$0
19.0	705001	STEEL FLARED END SECTION	EA	0	$220	$0
20.0	832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	0	$30	$0
21.0	839701	CONCRETE BARRIER (TYPE 60)	LF	0	$100	$0
22.0	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	10,000	$0.14	$1,400
23.0	900001	RELOCATE CALL BOX	EA	1	$500	$500
24.0	900002	RELOCATE LIGHT POLE	EA	0	$5,000	$0
25.0	900003	CUT AND COVER STRUCTURE	EA	0	$600,000	$0
26.0	900004	SIGNAL AND LIGHTING	EA	0	$350,000	$0
27.0	900005	MODIFY SIGNAL AND LIGHTING	EA	0	$200,000	$0
					SUBTOTAL I (ALL OF ABOVE)	**$2,525,096**
					SW3P (3% OF SUBTOTAL I) $75,750	$75,750
					TRAFFIC HANDLING (10% OF SUBTOTAL I) $252,510	$252,510
					MISC. CONSTRUCTION COSTS (15% OF SUBTOTAL I) $378,760	$378,760
					MAINTENANCE OF UTILITIES (3% OF SUBTOTAL I) $75,750	$75,750
					SUBTOTAL II (MISCELLANOUS)	**$782,770**

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Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

MOBILIZATION (10% OF SUBTOTAL I & II)	$330,790	$330,790
CONTINGENCIES (35% OF SUBTOTAL I & II)	$1,158,000	$1,158,000
SUBTOTAL III (CONSTRUCTION)		**$4,796,700**
LAND ACQUISITION	$0	$0
SUBTOTAL IV (RIGHT-OF-WAY)		**$0**
ENGINEERING STUDIES (3% OF SUBTOTAL III)	$144,000	$144,000
ENVIRONMENTAL (3% OF SUBTOTAL III)	$144,000	$144,000
DESIGN ENGINEERING AND CONSTRUCTION SUPPORT (17% OF SUBTOTAL III)	$815,000	$815,000
CONSTRUCTION MANAGEMENT (13% OF SUBTOTAL III)	$624,000	$624,000
SUBTOTAL V (SOFT COSTS)		**$1,727,000**
PROJECT TOTAL		**$6,524,000**

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MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Bid Item Code	Bid Item Description	Unit	Price
150662	REMOVE METAL BEAM GUARD RAILING	LF	$6.50
150668	REMOVE FLARED END SECTION	EA	$510.00
150827	REMOVE CATCH BASIN	EA	$1,750.00
150833	REMOVE RETAINING WALL	LF	$16.00
152386	RELOCATE ROADSIDE SIGN-ONE POST	EA	$270.00
152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	$535.00
153252	REMOVE SOUND WALL	LF	$30.00
160103	CLEARING AND GRUBBING (ACRE)	ACRE	$85,400.00
190101	ROADWAY EXCAVATION	CY	$11.50
198010	IMPORTED BORROW (CY)	CY	$3.70
205035	WOOD MULCH	CY	$66.00
210220	EROSION CONTROL (DRILL SEED) (SQYD)	SQYD	$0.50
210430	HYDROSEED	SQFT	$0.07
250201	CLASS 2 AGGREGATE SUBBASE	CY	$175.00
260203	CLASS 2 AGGREGATE BASE (CY)	CY	$53.00
280000	LEAN CONCRETE BASE	CY	$165.00
390132	HOT MIX ASPHALT (TYPE A)	TON	$87.00
401050	JOINTED PLAIN CONCRETE PAVEMENT	CY	$320.00
490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	$400.00
498052	60" CAST-IN-DRILLED-HOLE CONCRETE PILE	LF	$1,250.00
510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	$560.00
510061	STRUCTURAL CONCRETE, SOUND WALL	CY	$620.00
510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	$1,950.00
520101	BAR REINFORCING STEEL	LB	$1.10
566011	ROADSIDE SIGN - ONE POST	EA	$340.00
566012	ROADSIDE SIGN - TWO POST	EA	$445.00
568056	RELOCATE SIGN STRUCTURE	EA	$6,750.00
582001	SOUND WALL (MASONRY BLOCK)	SF	$26.00
705001	STEEL FLARED END SECTION	EA	$220.00
731504	MINOR CONCRETE (CURB AND GUTTER)	CY	$500.00
731521	MINOR CONCRETE (SIDEWALK)	CY	$460.00
731623	MINOR CONCRETE (CURB RAMP)	CY	$580.00
750049	INLET GRATE (TYPE 36R)	EA	$540.00
832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	$30.00
839701	CONCRETE BARRIER (TYPE 60)	LF	$100.00
840655	PAINT TRAFFIC STRIPE (1-COAT)	LF	$1.00
840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	$0.14
840666	PAINT PAVEMENT MARKING (2-COAT)	SQFT	$4.00
900001	RELOCATE CALL BOX	EA	$500.00
900002	RELOCATE LIGHT POLE	EA	$5,000.00
900003	CUT AND COVER STRUCTURE	EA	$600,000.00
900004	SIGNAL AND LIGHTING	EA	$350,000.00
900005	MODIFY SIGNAL AND LIGHTING	EA	$200,000.00

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MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Existing Shoulder Width	Bid Item Code	Bid Item Description	Unit	Quantity
0	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0.002
0	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0.000863
0	190101	ROADWAY EXCAVATION	CY	0.618
0	198010	IMPORTED BORROW (CY)	CY	1.293
0	210430	HYDROSEED	SQFT	27.6
0	250201	CLASS 2 AGGREGATE SUBBASE	CY	0.407
0	280000	LEAN CONCRETE BASE	CY	0.238
0	390132	HOT MIX ASPHALT (TYPE A)	TON	0.785
0	566012	ROADSIDE SIGN - TWO POST	EA	0.004
0	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	1
3	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0.002
3	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0.000604
3	190101	ROADWAY EXCAVATION	CY	0.857
3	198010	IMPORTED BORROW (CY)	CY	0.634
3	210430	HYDROSEED	SQFT	19.319
3	250201	CLASS 2 AGGREGATE SUBBASE	CY	0.407
3	280000	LEAN CONCRETE BASE	CY	0.238
3	390132	HOT MIX ASPHALT (TYPE A)	TON	0.785
3	566012	ROADSIDE SIGN - TWO POST	EA	0.004
3	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	1
5	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0.002
5	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0.000432
5	190101	ROADWAY EXCAVATION	CY	0.969
5	198010	IMPORTED BORROW (CY)	CY	0.323
5	210430	HYDROSEED	SQFT	13.8
5	250201	CLASS 2 AGGREGATE SUBBASE	CY	0.407
5	280000	LEAN CONCRETE BASE	CY	0.238
5	390132	HOT MIX ASPHALT (TYPE A)	TON	0.785
5	566011	ROADSIDE SIGN - ONE POST	EA	0.004
5	566012	ROADSIDE SIGN - TWO POST	EA	0.004
5	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	1
6	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0.002
6	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0.000345
6	190101	ROADWAY EXCAVATION	CY	1.011
6	198010	IMPORTED BORROW (CY)	CY	0.207
6	210430	HYDROSEED	SQFT	11.039
6	250201	CLASS 2 AGGREGATE SUBBASE	CY	0.407
6	280000	LEAN CONCRETE BASE	CY	0.238
6	390132	HOT MIX ASPHALT (TYPE A)	TON	0.785
6	566012	ROADSIDE SIGN - TWO POST	EA	0.004
6	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	1
6.5	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0.002

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MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

6.5	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0.000302
6.5	190101	ROADWAY EXCAVATION	CY	1.029
6.5	198010	IMPORTED BORROW (CY)	CY	0.158
6.5	210430	HYDROSEED	SQFT	9.659
6.5	250201	CLASS 2 AGGREGATE SUBBASE	CY	0.407
6.5	280000	LEAN CONCRETE BASE	CY	0.238
6.5	390132	HOT MIX ASPHALT (TYPE A)	TON	0.785
6.5	566012	ROADSIDE SIGN - TWO POST	EA	0.004
6.5	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	1
7	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0.002
7	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0.000259
7	190101	ROADWAY EXCAVATION	CY	1.044
7	198010	IMPORTED BORROW (CY)	CY	0.116
7	210430	HYDROSEED	SQFT	8.279
7	250201	CLASS 2 AGGREGATE SUBBASE	CY	0.407
7	280000	LEAN CONCRETE BASE	CY	0.238
7	390132	HOT MIX ASPHALT (TYPE A)	TON	0.785
7	566012	ROADSIDE SIGN - TWO POST	EA	0.004
7	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	1
8	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0.002
8	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0.000173
8	190101	ROADWAY EXCAVATION	CY	1.068
8	198010	IMPORTED BORROW (CY)	CY	0.052
8	210430	HYDROSEED	SQFT	11.52
8	250201	CLASS 2 AGGREGATE SUBBASE	CY	0.407
8	280000	LEAN CONCRETE BASE	CY	0.238
8	390132	HOT MIX ASPHALT (TYPE A)	TON	0.785
8	566012	ROADSIDE SIGN - TWO POST	EA	0.004
8	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	1
8.5	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0.002
8.5	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0.000129
8.5	190101	ROADWAY EXCAVATION	CY	1.076
8.5	198010	IMPORTED BORROW (CY)	CY	0.029
8.5	210430	HYDROSEED	SQFT	4.139
8.5	250201	CLASS 2 AGGREGATE SUBBASE	CY	0.407
8.5	280000	LEAN CONCRETE BASE	CY	0.238
8.5	390132	HOT MIX ASPHALT (TYPE A)	TON	0.785
8.5	566012	ROADSIDE SIGN - TWO POST	EA	0.004
8.5	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	1
10	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0.002
10	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0
10	190101	ROADWAY EXCAVATION	CY	1.086
10	198010	IMPORTED BORROW (CY)	CY	0
10	210430	HYDROSEED	SQFT	0
10	250201	CLASS 2 AGGREGATE SUBBASE	CY	0.407

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

10	280000	LEAN CONCRETE BASE	CY	0.238
10	390132	HOT MIX ASPHALT (TYPE A)	TON	0.785
10	566012	ROADSIDE SIGN - TWO POST	EA	0.004
10	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	1
11	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0.002
11	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0
11	190101	ROADWAY EXCAVATION	CY	1.107
11	198010	IMPORTED BORROW (CY)	CY	0.064
11	210430	HYDROSEED	SQFT	6.2
11	250201	CLASS 2 AGGREGATE SUBBASE	CY	0.407
11	280000	LEAN CONCRETE BASE	CY	0.238
11	390132	HOT MIX ASPHALT (TYPE A)	TON	0.785
11	566012	ROADSIDE SIGN - TWO POST	EA	0.004
11	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	1
12	152387	RELOCATE ROADSIDE SIGN-TWO POST	EA	0.002
12	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0
12	190101	ROADWAY EXCAVATION	CY	1.127
12	198010	IMPORTED BORROW (CY)	CY	0.064
12	210430	HYDROSEED	SQFT	6.2
12	250201	CLASS 2 AGGREGATE SUBBASE	CY	0.407
12	280000	LEAN CONCRETE BASE	CY	0.238
12	390132	HOT MIX ASPHALT (TYPE A)	TON	0.785
12	566012	ROADSIDE SIGN - TWO POST	EA	0.004
12	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	1
CBP	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0.000542
CBP	190101	ROADWAY EXCAVATION	CY	1.208
CBP	198010	IMPORTED BORROW (CY)	CY	0.286
CBP	210430	HYDROSEED	SQFT	13.6
CBP	250201	CLASS 2 AGGREGATE SUBBASE	CY	0.489
CBP	260203	CLASS 2 AGGREGATE BASE (CY)	CY	0.299
CBP	280000	LEAN CONCRETE BASE	CY	0.285
CBP	390132	HOT MIX ASPHALT (TYPE A)	TON	1.088
CBP	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	2
MBL	160103	CLEARING AND GRUBBING (ACRE)	ACRE	0.000773
MBL	190101	ROADWAY EXCAVATION	CY	0.43
MBL	198010	IMPORTED BORROW (CY)	CY	0.585
MBL	210430	HYDROSEED	SQFT	13.654
MBL	250201	CLASS 2 AGGREGATE SUBBASE	CY	0.488
MBL	260203	CLASS 2 AGGREGATE BASE (CY)	CY	0.299
MBL	280000	LEAN CONCRETE BASE	CY	0.285
MBL	390132	HOT MIX ASPHALT (TYPE A)	TON	1.088
MBL	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	2

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

ASSUMPTIONS

General Assumpions

1. Rate of escalation is 3.5% per year.
2. No removal of railway tracks are include. Assumptions are the project can be constructed outside the existing rails.
3. No exiting structures are widened as part of any alternatives (excluding Santa Cruz Alternative 3 HOV lanes).
4. No right-of-way will need to be acquired for any alternative.
5. Unit costs obtained from the 2016 Caltrans cost data book. http://www.dot.ca.gov/hq/esc/oe/awards/

Overhead Sign

1. Existing overhead signs assumed to be type G83-5 (CA), sized at 16' x 7'.
2. Sign structure assumed to be a 24'x7.5' truss, requiring a Type VI post. http://www.dot.ca.gov/des/techpubs/manuals/reference-sheets/page/english/7.pdf
3. Truss weight is 4,400 lbs. http://www.dot.ca.gov/des/techpubs/manuals/reference-sheets/page/english/9.pdf
4. Type VI Post quantity is 3,353 lbs. http://www.dot.ca.gov/des/techpubs/manuals/reference-sheets/page/english/10.pdf
5. Pole pile foundation assumed to be 18' in depth with 60" diameter. http://www.dot.ca.gov/des/techpubs/manuals/reference-sheets/page/english/13.pdf
6. 37.5 LF of guardrail to be removed and constructed for each sign relocation.
7. Guardrail end treatment to be removed and constructed for each sign location.

Drainage Inlet

1. New inlets to be Type OL-10.
2. Assumed depth of new drainage inlets to be 5'.
3. 3.406 CY of structural conctrete per inlet. http://www.dot.ca.gov/hq/esc/oe/project_plans/highway_plans/stdplans_US-customary-units_15/viewable_pdf/rspd072g.pdf
4. Reinforcing steel not calculated; included in misc. construction costs.

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MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Sound Wall

1. Sound walls are Case 2 and 10' in height.
2. Sound wall footings are 5 SF per LF. http://www.dot.ca.gov/hq/esc/oe/project_plans/highway_plans/stdplans_US-customary-units_15/viewable_pdf/b15-01.pdf
3. Reinforcing steel not calculated; included in misc. construction costs.

Retaining Wall

1. Reinforcing steel not calculated; included in misc. construction costs.

Light Pole

1. Pole pile foundation assumed to be 7' in depth with 30" diameter. http://www.dot.ca.gov/hq/esc/oe/project_plans/highway_plans/stdplans_US-customary-units_15/viewable_pdf/rspes-06a.pdf

Santa Cruz Alternative 1: Option A

1. Total length of segments is 4,500'.
2. Quantity take-offs for HMA, AS, LCB, Roadway Excavation, Imported Borrow, bus on shoulder signs, and striping calculated per LF of shoulder widening.
3. Quantity take-offs for overhead signs, call boxes, catch basins, retaining walls, sound walls, and light poles assumed based on Google Earth assessment.

Santa Cruz Alternative 1: Option B

1. Total length of segments is 11,500'.
2. Quantity take-offs for HMA, AS, LCB, Roadway Excavation, Imported Borrow, bus on shoulder signs, and striping calculated per LF of shoulder widening.
3. Quantity take-offs for overhead signs, call boxes, catch basins, retaining walls, sound walls, and light poles assumed based on Google Earth assessment.

Santa Cruz Alternative 1: Option C

1. Total length of segments is 6,000'.
2. Quantity take-offs for HMA, AS, LCB, Roadway Excavation, Imported Borrow, bus on shoulder signs, and striping calculated per LF of shoulder widening.
3. Quantity take-offs for overhead signs, call boxes, catch basins, retaining walls, sound walls, and light poles assumed based on Google Earth assessment.

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Santa Cruz Alternative 2: Option A

1. Total length of all segments is 10,150'.
2. Alternative consists of adding bus on shoulder lanes through interchanges in conjunction with the auxiliary lane project per the line diagram.

Santa Cruz Alternative 2: Option B

1. Total length of all segments is 42,700'.
2. Alternative consists of adding bus on shoulder lanes outside of the auxiliary lanes in conjuction with the auxiliary lane project per the line diagram.
3. Per the TSM project plans, shoulders are typically 10', however some locations are narrower. Assuming 10% of the shoulders are on average 8' wide, the corridor average shoulder width is 9.8'.
4. All sound walls required are costed as part of the TSM project.
5. Sign structures, light poles, catch basins, and call box relocations are costed as part of the TSM project.
6. 10% of Retaining walls proposed as part of the TSM project will need to be 2' higher as a result of widened shoulders.

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MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Santa Cruz Alternative 3

1. Current RTP estimate was factored down to represent the shortened length of the project.

Monterey Segment 1: Alternative 1A

1. Total length of segments is 29,500'.
2. Quantity take-offs for HMA, AS, LCB, Roadway Excavation, Imported Borrow, bus on shoulder signs, and striping calculated per LF of shoulder widening.
3. Quantity take-offs for overhead signs, call boxes, catch basins, retaining walls, sound walls, and light poles assumed based on Google Earth assessment.

Monterey Segment 1: Alternative 1B

1. Total length of segments is 27,000'.
2. Alternative consists on constructing a busway in the existing Monterey Branch Line rail right-of-way next the the rail tracks.
3. Quantity take-offs for HMA, AS, LCB, Roadway Excavation, Imported Borrow, and striping calculated per LF of shoulder busway.

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MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Monterey Segment 1: Alternative 1B

1. Total length of segments is 27,000'.
2. Alternative consists on constructing a busway in the existing Caltrains bike/pedestrian path right-of-way.
3. Quantity take-offs for HMA, AS, LCB, Roadway Excavation, Imported Borrow, and striping calculated per LF of shoulder busway.

Monterey Segment 2: Alternative 2A

1. Total length of segments is 29,500'.
2. Quantity take-offs for HMA, AS, LCB, Roadway Excavation, Imported Borrow, bus on shoulder signs, and striping calculated per LF of shoulder widening.
3. Quantity take-offs for overhead signs, call boxes, catch basins, retaining walls, sound walls, and light poles assumed based on Google Earth assessment.

Monterey Segment 2: Alternative 2B

1. Total length of segments is 6,500'.
2. Alternative consists on constructing a busway in the existing Monterey Branch Line rail right-of-way next the the rail tracks.
3. 2,200 SF cut and cover tunnel required to cross Monterey Boulevard.
4. Retaining walls for cut and cover tunnel based on an 8% roadway grade.
5. All leased land within the right-of-way will be returned to TAMC will all improvements removed.
6. New traffic signals for crossing Playa Avenue and Tioga Avenue.

Monterey Segment 3: Alternative A

1. Alternative consists of converting the right turn pockets on Del Monte at SR 218 to queue jump lanes.

Monterey Segment 3: Alternative B

1. Total length of segments is 11,000'.
2. Quantity take-offs for HMA, AS, LCB, Roadway Excavation, Imported Borrow, bus on shoulder signs, and striping calculated per LF of shoulder widening.
3. Quantity take-offs for overhead signs, call boxes, catch basins, retaining walls, sound walls, and light poles assumed based on Google Earth assessment.

Estimate prepared by CDM Smith
Date: 6/26/2018

MONTEREY BAY AREA FEASIBILITY STUDY OF BUS OPERATIONS ON STATE ROUTE 1 SHOULDER AND MONTEREY BRANCH LINE

Monterey Segment 4: Alternative A

1. Total length of segments is 10,500'.
2. Quantity take-offs for HMA, AS, LCB, Roadway Excavation, Imported Borrow, bus on shoulder signs, and striping calculated per LF of shoulder widening.
3. Quantity take-offs for overhead signs, call boxes, catch basins, retaining walls, sound walls, and light poles assumed based on Google Earth assessment.

Estimate prepared by CDM Smith
Date: 6/26/2018

APPENDIX B

BENEFIT-COST CALCULATIONS

Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Santa Cruz Alternative 1

All costs and benefits are shown in 2018 $.

Costs			
	Capital Costs		
	Construction Costs	$	6,000,000
	Right-of-Way		-
	Soft Costs	$	2,200,000
	Vehicles	$	5,900,000
	Total Capital Costs	$	14,100,000
	O&M Costs		
	Annual Costs	$	1,350,000
	Total Life-Cycle Costs	$	8,102,774
Benefits			
	Travel Time Benefits		
	Northbound Travel		
	Savings for Transit Users (mins/passenger)		0.00
	Existing transit ridership during the peak period		77
	Annual Savings for Transit Users	$	-
	Savings for Auto Users that Shift to Transit (mins/passenger)		0.00
	2025 auto users that shift to transit during peak period		390
	Annual Savings for Auto Users that Shift to Transit	$	-
	Total Annual Travel Time Savings - Northbound	$	-
	Total Life-Cycle Travel Time Savings - Northbound	$	-
	Southbound Travel		
	Savings for Transit Users (mins/passenger)		8.80
	Existing transit ridership during the peak period		55
	Annual Savings for Transit Users	$	35,345
	Savings for Auto Users that Shift to Transit (mins/passenger)		4.20
	2025 auto users that shift to transit during peak period		690
	Annual Savings for Auto Users that Shift to Transit	$	194,764
	Total Annual Travel Time Savings - SB	$	230,110
	Total Life-Cycle Travel Time Savings - Southbound	$	1,381,131
	Total Life-Cycle Travel Time Savings	$	1,381,131
	Operating Costs Savings		
	Annual Cost Savings	$	450,613
	Total Life-Cycle Savings	$	2,704,602
	CO2 Emissions' Benefits		
	Annual VMT Reductions (miles/year)		3,531,800
	Annual CO_2 Emission Savings	$	64,371
	Total Life-Cycle CO_2 Emission Savings	$	386,357
Benefit-Cost Analysis			
	Present Value of Costs (in 2018 $)	$	22,202,774
	Present Value of Benefits (in 2018 $)	$	4,472,090
	Net Present Value (in 2018 $)	$	(17,730,684)
	B-C Ratio		**0.20**

Assumptions:

Project life-cycle	7	years
Discount rate (Source: Cal-B/C Model)	4.00%	
Value of time (Source: Cal B-C Model)	13.65	$/hour/person
Ratio of travel distance on SR-1 relative to overall bus routes' length	50%	
Annualization factor	321	days/year
Vehicular CO_2 Emissions (Source: EPA, 2017)	411	grams/mile
Monetary Cost of CO_2 Emissions (Source: Institute for Policy Integrity, 2017)	$44	per ton

Note:

Only half of the annual O&M costs associated with bus routes have been applied to the alternative based on the assumption that bus routes would travel about half their trips along SR-1.

Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Santa Cruz Alternative 2A

All costs and benefits are shown in 2018 $.

Costs			
	Capital Costs		
	Construction Costs	$	1,440,000
	Right-of-Way		-
	Soft Costs	$	520,000
	Vehicles	$	5,900,000
	Total Capital Costs	$	7,860,000
	O&M Costs		
	Annual Costs	$	1,350,000
	Total Life-Cycle Costs	$	23,344,245
Benefits			
	Travel Time Benefits		
	Northbound Travel		
	Savings for Transit Users (mins/passenger)		17.10
	Existing transit ridership during the peak period		77
	Annual Savings for Transit Users	$	96,155
	Savings for Auto Users that Shift to Transit (mins/passenger)		4.48
	2025 auto users that shift to transit during peak period		1100
	Annual Savings for Auto Users that Shift to Transit	$	334,688
	Total Annual Travel Time Savings - Northbound	$	430,843
	Total Life-Cycle Travel Time Savings - Northbound	$	7,450,156
	Southbound Travel		
	Savings for Transit Users (mins/passenger)		7.90
	Existing transit ridership during the peak period		55
	Annual Savings for Transit Users	$	31,730
	Savings for Auto Users that Shift to Transit (mins/passenger)		14.20
	2025 auto users that shift to transit during peak period		1050
	Annual Savings for Auto Users that Shift to Transit	$	1,031,806
	Total Annual Travel Time Savings - SB	$	1,063,536
	Total Life-Cycle Travel Time Savings - Southbound	$	18,390,700
	Total Life-Cycle Travel Time Savings	$	25,840,856
	Operating Costs Savings		
	Annual Cost Savings	$	844,523
	Total Life-Cycle Savings	$	14,603,518
	CO2 Emissions' Benefits		
	Annual VMT Reductions (miles/year)		8,686,400
	Annual CO_2 Emission Savings	$	158,319
	Total Life-Cycle CO_2 Emission Savings	$	2,737,652
Benefit-Cost Analysis			
	Present Value of Costs (in 2018 $)	$	31,204,245
	Present Value of Benefits (in 2018 $)	$	43,182,026
	Net Present Value (in 2018 $)	$	11,977,781
	B-C Ratio		**1.38**

Assumptions:

Project life-cycle	30	years
Discount rate (Source: Cal-B/C Model)	4.00%	
Value of time (Source: Cal B-C Model)	13.65	$/hour/person
Ratio of travel distance on SR-1 relative to overall bus routes' length	50%	
Annualization factor	321	days/year
Vehicular CO_2 Emissions (Source: EPA, 2017)	411	grams/mile
Monetary Cost of CO_2 Emissions (Source: Institute for Policy Integrity, 2017)	$44	per ton

Note:

Only half of the annual O&M costs associated with bus routes have been applied to the alternative based on the assumption that bus routes would travel about half their trips along SR-1.

Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Santa Cruz Alternative 2B

All costs and benefits are shown in 2018 $.

Costs			
	Capital Costs		
	Construction Costs	$	1,640,000
	Right-of-Way		-
	Soft Costs	$	590,000
	Vehicles	$	5,900,000
	Total Capital Costs	$	8,130,000
	O&M Costs		
	Annual Costs	$	1,200,000
	Total Life-Cycle Costs	$	20,750,440
Benefits			
	Travel Time Benefits		
	Northbound Travel		
	Savings for Transit Users (mins/passenger)		17.90
	Existing transit ridership during the peak period		77
	Annual Savings for Transit Users	$	100,654
	Savings for Auto Users that Shift to Transit (mins/passenger)		5.58
	2025 auto users that shift to transit during peak period		1110
	Annual Savings for Auto Users that Shift to Transit	$	420,941
	Total Annual Travel Time Savings - Northbound	$	521,595
	Total Life-Cycle Travel Time Savings - Northbound	$	9,019,430
	Southbound Travel		
	Savings for Transit Users (mins/passenger)		9.40
	Existing transit ridership during the peak period		55
	Annual Savings for Transit Users	$	37,755
	Savings for Auto Users that Shift to Transit (mins/passenger)		16.20
	2025 auto users that shift to transit during peak period		1050
	Annual Savings for Auto Users that Shift to Transit	$	1,177,130
	Total Annual Travel Time Savings - SB	$	1,214,885
	Total Life-Cycle Travel Time Savings - Southbound	$	21,007,840
	Total Life-Cycle Travel Time Savings	$	30,027,270
	Operating Costs Savings		
	Annual Cost Savings	$	921,391
	Total Life-Cycle Savings	$	15,932,720
	CO2 Emissions' Benefits		
	Annual VMT Reductions (miles/year)		8,734,100
	Annual CO_2 Emission Savings	$	159,188
	Total Life-Cycle CO_2 Emission Savings	$	2,752,685
Benefit-Cost Analysis			
	Present Value of Costs (in 2018 $)	$	28,880,440
	Present Value of Benefits (in 2018 $)	$	48,712,675
	Net Present Value (in 2018 $)	$	19,832,235
	B-C Ratio		**1.69**

Assumptions:

Project life-cycle	30	years
Discount rate (Source: Cal-B/C Model)	4.00%	
Value of time (Source: Cal B-C Model)	13.65	$/hour/person
Ratio of travel distance on SR-1 relative to overall bus routes' length	50%	
Annualization factor	321	days/year
Vehicular CO_2 Emissions (Source: EPA, 2017)	411	grams/mile
Monetary Cost of CO_2 Emissions (Source: Institute for Policy Integrity, 2017)	$44	per ton

Note:

Only half of the annual O&M costs associated with bus routes have been applied to the alternative based on the assumption that bus routes would travel about half their trips along SR-1.

Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Santa Cruz Alternative 3

All costs and benefits are shown in 2018 $.

Costs			
	Capital Costs		
	Construction Costs	$	257,900,000
	Right-of-Way	$	-
	Soft Costs	$	92,800,000
	Vehicles	$	13,400,000
	Total Capital Costs	$	364,100,000
	O&M Costs		
	Annual Costs	$	17,000,000
	Total Life-Cycle Costs	$	293,964,566
Benefits			
	Travel Time Benefits		
	Northbound Travel		
	Savings for Transit Users (mins/passenger)		11.20
	Existing transit ridership during the peak period		77
	Annual Savings for Transit Users	$	58,859
	Savings for Auto Users that Shift to Transit (mins/passenger)		8.30
	2025 auto users that shift to transit during peak period		1490
	Annual Savings for Auto Users that Shift to Transit	$	800,429
	Total Annual Travel Time Savings - Northbound	$	859,288
	Total Life-Cycle Travel Time Savings - Northbound	$	14,858,836
	Southbound Travel		
	Savings for Transit Users (mins/passenger)		14.10
	Existing transit ridership during the peak period		55
	Annual Savings for Transit Users	$	52,928
	Savings for Auto Users that Shift to Transit (mins/passenger)		8.30
	2025 auto users that shift to transit during peak period		1470
	Annual Savings for Auto Users that Shift to Transit	$	801,562
	Total Annual Travel Time Savings - SB	$	854,490
	Total Life-Cycle Travel Time Savings - Southbound	$	14,775,870
	Total Life-Cycle Travel Time Savings	$	29,634,706
	Operating Costs Savings		
	Annual Cost Savings	$	361,578
	Total Life-Cycle Savings	$	6,011,941
	CO2 Emissions' Benefits		
	Annual VMT Reductions (miles/year)		12,504,600
	Annual CO_2 Emission Savings	$	227,909
	Total Life-Cycle CO_2 Emission Savings	$	3,941,016
Benefit-Cost Analysis			
	Present Value of Costs (in 2018 $)	$	658,064,566
	Present Value of Benefits (in 2018 $)	$	39,587,663
	Net Present Value (in 2018 $)	$	(618,476,903)
	B-C Ratio		**0.06**

Assumptions:

Project life-cycle	30	years
Discount rate (Source: Cal-B/C Model)	4.00%	
Value of time (Source: Cal B-C Model)	13.65	$/hour/person
Ratio of travel distance on SR-1 relative to overall bus routes' length	50%	
Annualization factor	300	days/year
Vehicular CO_2 Emissions (Source: EPA, 2017)	411	grams/mile
Monetary Cost of CO_2 Emissions (Source: Institute for Policy Integrity, 2017)	$44	per ton

Note:

Only half of the annual O&M costs associated with bus routes have been applied to the alternative based on the assumption that bus routes would travel about half their trips along SR-1.

Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Alt 1

All costs and benefits are shown in 2018 $.

Costs			
	Capital Costs		
	Construction Costs	$	22,900,000
	Right-of-Way		-
	Soft Costs	$	8,100,000
	Vehicles	$	4,000,000
	Total Capital Costs	$	35,000,000
	O&M Costs		
	Annual Costs	$	3,490,000
	Total Life-Cycle Costs	$	60,349,196
Benefits			
	Travel Time Benefits		
	Northbound Travel		
	Savings for Transit Users (mins/passenger)		0.00
	Existing transit ridership during the peak period		455
	Annual Savings for Transit Users	$	-
	Savings for Auto Users that Shift to Transit (mins/passenger)		0.00
	2025 auto users that shift to transit during peak period		850
	Annual Savings for Auto Users that Shift to Transit	$	-
	Total Annual Travel Time Savings - Northbound	$	-
	Total Life-Cycle Travel Time Savings - Northbound	$	-
	Southbound Travel		
	Savings for Transit Users (mins/passenger)		7.10
	Existing transit ridership during the peak period		270
	Annual Savings for Transit Users	$	139,994
	Savings for Auto Users that Shift to Transit (mins/passenger)		6.00
	2025 auto users that shift to transit during peak period		640
	Annual Savings for Auto Users that Shift to Transit	$	162,121
	Total Annual Travel Time Savings - SB	$	302,115
	Total Life-Cycle Travel Time Savings - Southbound	$	5,224,179
	Total Life-Cycle Travel Time Savings	$	5,224,179
	Operating Costs Savings		
	Annual Cost Savings	$	659,786
	Total Life-Cycle Savings	$	11,409,033
	CO2 Emissions' Benefits		
	Annual VMT Reductions (miles/year)		613,100
	Annual CO_2 Emission Savings	$	11,174
	Total Life-Cycle CO_2 Emission Savings	$	193,228
Benefit-Cost Analysis			
	Present Value of Costs (in 2018 $)	$	95,349,196
	Present Value of Benefits (in 2018 $)	$	16,826,439
	Net Present Value (in 2018 $)	$	(78,522,757)
	B-C Ratio		**0.176**

Assumptions:

Project life-cycle	30	years
Discount rate (Source: Cal-B/C Model)	4.00%	
Value of time (Source: Cal B-C Model)	13.65	$/hour/person
Ratio of travel distance on SR-1 relative to overall bus routes' length	50%	
Annualization factor	321	days/year
Vehicular CO_2 Emissions (Source: EPA, 2017)	411	grams/mile
Monetary Cost of CO_2 Emissions (Source: Institute for Policy Integrity, 2017)	$44	per ton

Note:

Only half of the annual O&M costs associated with bus routes have been applied to the alternative based on the assumption that bus routes would travel about half their trips along SR-1.

Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Alt 2

All costs and benefits are shown in 2018 $.

Costs			
	Capital Costs		
	Construction Costs	$	20,800,000
	Right-of-Way		-
	Soft Costs	$	7,400,000
	Vehicles	$	4,000,000
	Total Capital Costs	$	32,200,000
	O&M Costs		
	Annual Costs	$	3,240,000
	Total Life-Cycle Costs	$	56,026,188
Benefits			
	Travel Time Benefits		
	Northbound Travel		
	Savings for Transit Users (mins/passenger)		0.00
	Existing transit ridership during the peak period		455
	Annual Savings for Transit Users	$	-
	Savings for Auto Users that Shift to Transit (mins/passenger)		0.00
	2025 auto users that shift to transit during peak period		1060
	Annual Savings for Auto Users that Shift to Transit	$	-
	Total Annual Travel Time Savings - Northbound	$	-
	Total Life-Cycle Travel Time Savings - Northbound	$	-
	Southbound Travel		
	Savings for Transit Users (mins/passenger)		10.10
	Existing transit ridership during the peak period		270
	Annual Savings for Transit Users	$	199,146
	Savings for Auto Users that Shift to Transit (mins/passenger)		3.56
	2025 auto users that shift to transit during peak period		670
	Annual Savings for Auto Users that Shift to Transit	$	103,991
	Total Annual Travel Time Savings - SB	$	303,137
	Total Life-Cycle Travel Time Savings - Southbound	$	5,241,858
	Total Life-Cycle Travel Time Savings	$	5,241,858
	Operating Costs Savings		
	Annual Cost Savings	$	929,840
	Total Life-Cycle Savings	$	16,078,816
	CO2 Emissions' Benefits		
	Annual VMT Reductions (miles/year)		1,663,100
	Annual CO_2 Emission Savings	$	30,312
	Total Life-Cycle CO_2 Emission Savings	$	524,151
Benefit-Cost Analysis			
	Present Value of Costs (in 2018 $)	$	88,226,188
	Present Value of Benefits (in 2018 $)	$	21,844,825
	Net Present Value (in 2018 $)	$	(66,381,363)
	B-C Ratio		**0.25**

Assumptions:

Project life-cycle	30	years
Discount rate (Source: Cal-B/C Model)	4.00%	
Value of time (Source: Cal B-C Model)	13.65	$/hour/person
Ratio of travel distance on SR-1 relative to overall bus routes' length	50%	
Annualization factor	321	days/year
Vehicular CO_2 Emissions (Source: EPA, 2017)	411	grams/mile
Monetary Cost of CO_2 Emissions (Source: Institute for Policy Integrity, 2017)	$44	per ton

Note:

Only half of the annual O&M costs associated with bus routes have been applied to the alternative based on the assumption that bus routes would travel about half their trips along SR-1.

Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Alt 3

Costs			
	Capital Costs		
	Construction Costs	$	21,900,000
	Right-of-Way		-
	Soft Costs	$	7,500,000
	Vehicles	$	4,000,000
	Total Capital Costs	$	33,400,000
	O&M Costs		
	Annual Costs	$	3,040,000
	Total Life-Cycle Costs	$	52,567,781
Benefits			
	Travel Time Benefits		
	Northbound Travel		
	Savings for Transit Users (mins/passenger)		15.90
	Existing transit ridership during the peak period		455
	Annual Savings for Transit Users	$	528,317
	Savings for Auto Users that Shift to Transit (mins/passenger)		10.69
	2025 auto users that shift to transit during peak period		1200
	Annual Savings for Auto Users that Shift to Transit	$	581,595
	Total Annual Travel Time Savings - Northbound	$	1,109,912
	Total Life-Cycle Travel Time Savings - Northbound	$	19,192,637
	Southbound Travel		
	Savings for Transit Users (mins/passenger)		15.90
	Existing transit ridership during the peak period		270
	Annual Savings for Transit Users	$	313,507
	Savings for Auto Users that Shift to Transit (mins/passenger)		10.69
	2025 auto users that shift to transit during peak period		710
	Annual Savings for Auto Users that Shift to Transit	$	343,492
	Total Annual Travel Time Savings - SB	$	656,999
	Total Life-Cycle Travel Time Savings - Southbound	$	11,360,852
	Total Life-Cycle Travel Time Savings	$	30,553,489
	Operating Costs Savings		
	Annual Cost Savings	$	1,472,243
	Total Life-Cycle Savings	$	25,458,066
	CO2 Emissions' Benefits		
	Annual VMT Reductions (miles/year)		2,451,200
	Annual CO_2 Emission Savings	$	44,676
	Total Life-Cycle CO_2 Emission Savings	$	772,533
Benefit-Cost Analysis			
	Present Value of Costs (in 2018 $)	$	85,967,781
	Present Value of Benefits (in 2018 $)	$	56,784,089
	Net Present Value (in 2018 $)	$	(29,183,692)
	B-C Ratio		**0.66**

Assumptions:

Project life-cycle	30	years
Discount rate (Source: Cal-B/C Model)	4.00%	
Value of time (Source: Cal B-C Model)	13.65	$/hour/person
Ratio of travel distance on SR-1 relative to overall bus routes' length	50%	
Annualization factor	321	days/year
Vehicular CO_2 Emissions (Source: EPA, 2017)	411	grams/mile
Monetary Cost of CO_2 Emissions (Source: Institute for Policy Integrity, 2017)	$44	per ton

Note:

Only half of the annual O&M costs associated with bus routes have been applied to the alternative based on the assumption that bus routes would travel about half their trips along SR-1.

Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Alt 3 -Option I-B Only

Costs			
	Capital Costs		
	Construction Costs	$	14,890,000
	Right-of-Way		-
	Soft Costs	$	5,100,000
	Vehicles	$	4,000,000
	Total Capital Costs	$	23,990,000
	O&M Costs		
	Annual Costs	$	2,604,000
	Total Life-Cycle Costs	$	45,028,455
Benefits			
	Travel Time Benefits		
	Northbound Travel		
	Savings for Transit Users (mins/passenger)		15.90
	Existing transit ridership during the peak period		455
	Annual Savings for Transit Users	$	528,317
	Savings for Auto Users that Shift to Transit (mins/passenger)		10.69
	2025 auto users that shift to transit during peak period		1200
	Annual Savings for Auto Users that Shift to Transit	$	581,595
	Total Annual Travel Time Savings - Northbound	$	1,109,912
	Total Life-Cycle Travel Time Savings - Northbound	$	19,192,637
	Southbound Travel		
	Savings for Transit Users (mins/passenger)		15.90
	Existing transit ridership during the peak period		270
	Annual Savings for Transit Users	$	313,507
	Savings for Auto Users that Shift to Transit (mins/passenger)		10.69
	2025 auto users that shift to transit during peak period		710
	Annual Savings for Auto Users that Shift to Transit	$	343,492
	Total Annual Travel Time Savings - SB	$	656,999
	Total Life-Cycle Travel Time Savings - Southbound	$	11,360,852
	Total Life-Cycle Travel Time Savings	$	30,553,489
	Operating Costs Savings		
	Annual Cost Savings	$	1,472,243
	Total Life-Cycle Savings	$	25,458,066
	CO2 Emissions' Benefits		
	Annual VMT Reductions (miles/year)		2,451,200
	Annual CO_2 Emission Savings	$	44,676
	Total Life-Cycle CO_2 Emission Savings	$	772,533
Benefit-Cost Analysis			
	Present Value of Costs (in 2018 $)	$	69,018,455
	Present Value of Benefits (in 2018 $)	$	56,784,089
	Net Present Value (in 2018 $)	$	(12,234,366)
	B-C Ratio		**0.82**

Assumptions:

Project life-cycle	30	years
Discount rate (Source: Cal-B/C Model)	4.00%	
Value of time (Source: Cal B-C Model)	13.65	$/hour/person
Ratio of travel distance on SR-1 relative to overall bus routes' length	50%	
Annualization factor	321	days/year
Vehicular CO_2 Emissions (Source: EPA, 2017)	411	grams/mile
Monetary Cost of CO_2 Emissions (Source: Institute for Policy Integrity, 2017)	$44	per ton

Note:

Only half of the annual O&M costs associated with bus routes have been applied to the alternative based on the assumption that bus routes would travel about half their trips along SR-1.

Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Alt 4

All costs and benefits are shown in 2018 $.

Costs		
Capital Costs		
Construction Costs	$	21,300,000
Right-of-Way		-
Soft Costs	$	7,300,000
Vehicles	$	4,000,000
Total Capital Costs	$	32,600,000
O&M Costs		
Annual Costs	$	3,020,000
Total Life-Cycle Costs	$	52,221,941
Benefits		
Travel Time Benefits		
Northbound Travel		
Savings for Transit Users (mins/passenger)		15.90
Existing transit ridership during the peak period		455
Annual Savings for Transit Users	$	528,317
Savings for Auto Users that Shift to Transit (mins/passenger)		10.69
2025 auto users that shift to transit during peak period		1200
Annual Savings for Auto Users that Shift to Transit	$	581,595
Total Annual Travel Time Savings - Northbound	$	1,109,912
Total Life-Cycle Travel Time Savings - Northbound	$	19,192,637
Southbound Travel		
Savings for Transit Users (mins/passenger)		15.90
Existing transit ridership during the peak period		270
Annual Savings for Transit Users	$	313,507
Savings for Auto Users that Shift to Transit (mins/passenger)		10.69
2025 auto users that shift to transit during peak period		710
Annual Savings for Auto Users that Shift to Transit	$	343,492
Total Annual Travel Time Savings - SB	$	656,999
Total Life-Cycle Travel Time Savings - Southbound	$	11,360,852
Total Life-Cycle Travel Time Savings	$	30,553,489
Operating Costs Savings		
Annual Cost Savings	$	1,472,243
Total Life-Cycle Savings	$	25,458,066
CO2 Emissions' Benefits		
Annual VMT Reductions (miles/year)		2,451,200
Annual CO_2 Emission Savings	$	44,676
Total Life-Cycle CO_2 Emission Savings	$	772,533
Benefit-Cost Analysis		
Present Value of Costs (in 2018 $)	$	84,821,941
Present Value of Benefits (in 2018 $)	$	56,784,089
Net Present Value (in 2018 $)	$	(28,037,852)
B-C Ratio		**0.67**

Assumptions:

Project life-cycle	30	years
Discount rate (Source: Cal-B/C Model)	4.00%	
Value of time (Source: Cal B-C Model)	13.65	$/hour/person
Ratio of travel distance on SR-1 relative to overall bus routes' length	50%	
Annualization factor	321	days/year
Vehicular CO_2 Emissions (Source: EPA, 2017)	411	grams/mile
Monetary Cost of CO_2 Emissions (Source: Institute for Policy Integrity, 2017)	$44	per ton

Note:

Only half of the annual O&M costs associated with bus routes have been applied to the alternative based on the assumption that bus routes would travel about half their trips along SR-1.

Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Alt 5

All costs and benefits are shown in 2018 $.

Costs			
	Capital Costs		
	Construction Costs	$	4,800,000
	Right-of-Way		-
	Soft Costs	$	1,700,000
	Vehicles	$	4,000,000
	Total Capital Costs	$	10,500,000
	O&M Costs		
	Annual Costs	$	2,690,000
	Total Life-Cycle Costs	$	46,515,570
Benefits			
	Travel Time Benefits		
	Northbound Travel		
	Savings for Transit Users (mins/passenger)		4.80
	Existing transit ridership during the peak period		455
	Annual Savings for Transit Users	$	159,492
	Savings for Auto Users that Shift to Transit (mins/passenger)		4.80
	2025 auto users that shift to transit during peak period		1150
	Annual Savings for Auto Users that Shift to Transit	$	243,620
	Total Annual Travel Time Savings - Northbound	$	403,112
	Total Life-Cycle Travel Time Savings - Northbound	$	6,970,623
	Southbound Travel		
	Savings for Transit Users (mins/passenger)		0.00
	Existing transit ridership during the peak period		270
	Annual Savings for Transit Users	$	-
	Savings for Auto Users that Shift to Transit (mins/passenger)		0.00
	2025 auto users that shift to transit during peak period		500
	Annual Savings for Auto Users that Shift to Transit	$	-
	Total Annual Travel Time Savings - SB	$	-
	Total Life-Cycle Travel Time Savings - Southbound	$	-
	Total Life-Cycle Travel Time Savings	$	6,970,623
	Operating Costs Savings		
	Annual Cost Savings	$	441,873
	Total Life-Cycle Savings	$	7,640,883
	CO2 Emissions' Benefits		
	Annual VMT Reductions (miles/year)		1,313,400
	Annual CO_2 Emission Savings	$	23,938
	Total Life-Cycle CO_2 Emission Savings	$	413,938
Benefit-Cost Analysis			
	Present Value of Costs (in 2018 $)	$	57,015,570
	Present Value of Benefits (in 2018 $)	$	15,025,443
	Net Present Value (in 2018 $)	$	(41,990,126)
	B-C Ratio		**0.26**

Assumptions:

Project life-cycle	30	years
Discount rate (Source: Cal-B/C Model)	4.00%	
Value of time (Source: Cal B-C Model)	13.65	$/hour/person
Ratio of travel distance on SR-1 relative to overall bus routes' length	50%	
Annualization factor	321	days/year
Vehicular CO_2 Emissions (Source: EPA, 2017)	411	grams/mile
Monetary Cost of CO_2 Emissions (Source: Institute for Policy Integrity, 2017)	$44	per ton

Note:

Only half of the annual O&M costs associated with bus routes have been applied to the alternative based on the assumption that bus routes would travel about half their trips along SR-1.

Monterey Bay Area Feasibility Study of Bus Operations on State Route 1 Shoulder and Monterey Branch Line
Monterey Alt 7

All costs and benefits are shown in 2018 $.

Costs		
Capital Costs		
Construction Costs	$	327,700,000
Right-of-Way		-
Soft Costs	$	118,000,000
Vehicles	$	4,000,000
Total Capital Costs	$	449,700,000
O&M Costs		
Annual Costs	$	24,660,000
Total Life-Cycle Costs	$	426,421,541
Benefits		
Travel Time Benefits		
Northbound Travel		
Savings for Transit Users (mins/passenger)		14.20
Existing transit ridership during the peak period		455
Annual Savings for Transit Users	$	471,831
Savings for Auto Users that Shift to Transit (mins/passenger)		14.20
2025 auto users that shift to transit during peak period		1210
Annual Savings for Auto Users that Shift to Transit	$	782,928
Total Annual Travel Time Savings - Northbound	$	1,254,759
Total Life-Cycle Travel Time Savings - Northbound	$	21,697,326
Southbound Travel		
Savings for Transit Users (mins/passenger)		14.20
Existing transit ridership during the peak period		270
Annual Savings for Transit Users	$	279,987
Savings for Auto Users that Shift to Transit (mins/passenger)		14.20
2025 auto users that shift to transit during peak period		720
Annual Savings for Auto Users that Shift to Transit	$	466,646
Total Annual Travel Time Savings - SB	$	746,633
Total Life-Cycle Travel Time Savings - Southbound	$	12,910,805
Total Life-Cycle Travel Time Savings	$	34,608,131
Operating Costs Savings		
Annual Cost Savings	$	1,312,340
Total Life-Cycle Savings	$	22,693,018
CO2 Emissions' Benefits		
Annual VMT Reductions (miles/year)		2,538,500
Annual CO_2 Emission Savings	$	46,267
Total Life-Cycle CO_2 Emission Savings	$	800,047
Benefit-Cost Analysis		
Present Value of Costs (in 2018 $)	$	876,121,541
Present Value of Benefits (in 2018 $)	$	58,101,197
Net Present Value (in 2018 $)	$	(818,020,344)
B-C Ratio		**0.07**

Assumptions:

Project life-cycle	30	years
Discount rate (Source: Cal-B/C Model)	4.00%	
Value of time (Source: Cal B-C Model)	13.65	$/hour/person
Ratio of travel distance on SR-1 relative to overall bus routes' length	50%	
Annualization factor	321	days/year
Vehicular CO_2 Emissions (Source: EPA, 2017)	411	grams/mile
Monetary Cost of CO_2 Emissions (Source: Institute for Policy Integrity, 2017)	$44	per ton

Note:

Only half of the annual O&M costs associated with bus routes have been applied to the alternative based on the assumption that bus routes would travel about half their trips along SR-1.


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