CALTRANS

Adaptation Priorities

REPORT

DISTRICT 5

February

2021

CONTENTS

1. INTRODUCTION 1
  1.1. Purpose of Report 2
  1.2. Report Organization 2
2. CALTRANS' CLIMATE ADAPTATION FRAMEWORK 3
3. PRIORITIZATION METHODOLOGY 6
  3.1. General Description of the Methodology 6
  3.2. Asset Types and Hazards Studied 7
  3.3. Prioritization Metrics 11
    3.3.1. Exposure Metrics 14
    3.3.2. Consequence Metrics 19
  3.4. Calculation of Initial Prioritization Scores 21
  3.5. Adjustments to Prioritization 25
4. DISTRICT ADAPTATION PRIORITIES 26
  4.1. Bridges 26
  4.2. Large Culverts 30
  4.3. Small Culverts 32
  4.4. Roadways 38
5. NEXT STEPS 42
6. APPENDIX 45

TABLES

Table 1: Asset-Hazard Combinations Studied 7
Table 2: Metrics Included for Each Asset-Hazard Combination Studied 13
Table 3: Weights by Metric for Each Asset-Hazard Combination Studied 23
Table 4: Priority 1 Bridges 27
Table 5: Priority 1 Large Culverts 30
Table 6: Priority 1 Small Culverts 32
Table 7: Priority 1 Roadways 39
Table 8: Prioritization of Bridges for Detailed Climate Change Adaptation Assessments 45
Table 9: Prioritization of Large Culverts for Detailed Climate Change Adaptation Assessments 52
Table 10: Prioritization of small culverts for detailed climate change adaptation assessments 53
Table 11: Prioritization of Roadways for Detailed Climate Change Adaptation Assessments 72

FIGURES

Figure 1: Caltrans' Climate Adaptation Framework (FEAR NAHT Framework) 4
Figure 2: Ocean Protection Council Sea Level Rise Projections for Port San Luis 16
Figure 3: Prioritization of Bridges for Detailed Adaptation Assessments 29
Figure 4: Prioritization of Large Culverts for Detailed Adaptation Assessments 31
Figure 5: Prioritization of Small Culverts for Detailed Adaptation Assessments 37
Figure 6: Prioritization of Roadways for Detailed Adaptation Assessments 41

Term and Definitions

- **Adaptation:** The steps taken to prepare a community or modify a targeted asset prior to a weather or climate-related disruption to minimize or avoid the impacts of that event. An example would be elevating assets in areas likely to experience increased flooding in the future.
- **Carriageway:** Each of the two sides of a highway, each of which may have two or more lanes. A dual carriageway is where the right and left sides of a highway are divided by a barrier (e.g., median). The Caltrans State Highway System is most often represented by one centerline that represents each carriageway.
- **Exposure:** The presence of infrastructure in places and settings where it could be adversely affected by hazards and threats, for example, a road in a floodplain.[1]
- **Hazards and Stressors:** Stresses on transportation system performance and condition. Whether such impacts occur today (e.g., riverine flooding that closes major highways) or whether they are part of a long- term trend (e.g., sea level rise). The terms are used interchangeably to refer to impacts originating primarily from natural causes (e.g., flooding or wildfire hazards).
- **Resilience:** The characteristic of a system that allows it to absorb, recover from, or more successfully adapt to adverse events.
- **Risk***:* "A combination of the likelihood that an asset will experience a particular climate impact and the severity or consequence of that impact."[2]
- **Sensitivity:** Per the Federal Highway Administration, "refers to how an asset or system responds to, or is affected by, exposure to a climate change stressor. A highly sensitive asset will experience a large degree of impact if the climate varies even a small amount, where as a less sensitive asset could withstand high levels of climate variation before exhibiting any response."[3]
- **Uncertainty:** The degree to which a future condition or system performance cannot be forecasted. Both human-caused and natural disruptions, especially for longer-term climate changes, are uncertain events (as no one knows for sure exactly when and where and with what intensity they will occur). Sensitivity tests using multiple plausible scenarios of future conditions can help identify the range of uncertainty and its implications. This approach is used routinely when working with climate projections to help understand the range of possible conditions given different future greenhouse gas emission scenarios.

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[1] This definition is adopted from the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report. 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

[2] FHWA. 2017. "Vulnerability Assessment and Adaptation Framework: Third Edition." Retrieved September 25, 2020 from https://www.fhwa.dot.gov/environment/sustainability/resilience/adaptation_framework/climate_adaptation.pdf

[3] Ibid.

- **Vulnerability:** Per the Federal Highway Administration, "the degree to which a system is susceptible to or unable to cope with adverse effects of climate change or extreme weather events."[4]

[4] FHWA. 2014. "FHWA Order 5520. "Transportation System Preparedness and Resilience to Climate Change and Extreme Weather Events." Dec. 15. Retrieved June 30, 2020 from https://www.fhwa.dot.gov/legsregs/directives/orders/5520.cfm

1. INTRODUCTION

California's climate is changing. Temperatures are warming, sea levels are rising, wet years are becoming wetter, dry years are becoming drier, and wildfires are becoming more intense. The State of California attributes these extreme weather conditions to the unprecedented amounts of greenhouse gases in the atmosphere. Given that global emissions of these gases continue at record rates, further changes in California's climate are, unfortunately, very likely.

The hazards brought on by climate change pose a serious threat to California's transportation infrastructure. District 5 is already experiencing the impacts of climate change as higher than anticipated sea levels and extreme flood events damage bridges and flood roadways, rapidly moving wildfires present profound challenges to timely evacuations, and higher than anticipated temperatures can cause pavement damage over broad areas. The district is already experiencing cliff erosion impacts along State Route 1 (SR 1) and is faced with identifying adaptation responses within the coastal zone. The most recent example of this occurred on February 1, 2021 when the Rat Creek Mudslide closed approximately 23 miles of SR 1. The area lost approximately 125,000 acres due to the Dolan Fire in August 2020. The burn areas left barren hillsides, which reached critical saturation due to heavy rains and caused a mudslide to washout both northbound and southbound lanes of SR 1 at Rat Creek. The damage also left a 150-foot chasm in SR 1 at Rat Creek. As Caltrans' assets near the end of their design life, some may need to be re-designed or adapted to meet new and increasingly severe weather conditions. New assets will need to be put in place with future climate projections in mind, to ensure that the State Highway System continues to support the safety and economic vitality of California communities.

RAT CREEK MUDSLIDE CAUSES 150-CHASM
SR 1 MONTEREY COUNTY

Recognizing this, Caltrans has initiated a major agency-wide effort to adapt its infrastructure so that it can withstand future conditions. The effort began by determining which assets are most likely to be adversely impacted by climate change in each Caltrans district. That assessment, described in the Caltrans Climate Change Vulnerability Assessment Report for District 5, identified stretches of the State Highway System within the district that are exposed to different climate stressors. This Adaptation Priorities Report picks up where the vulnerability assessment left off and considers the implications of those impacts on Caltrans and the traveling public, so that facilities with the greatest potential risk receive the highest priority for adaptation. District 5 anticipates that planning for, and adapting to, climate change will continue to evolve subsequent to this report's release as more data and experience is gained.

1.1. Purpose of Report

The purpose of this report is to prioritize the order in which assets found to be exposed to climate hazards will undergo detailed asset-level climate assessments. These detailed assessments can also be conducted at the corridor level, especially where stretches of roadway are exposed to climate hazards or where groups of high priority assets are near one another. Since there are many potentially exposed assets in the district, detailed assessments will need to be done sequentially according to their priority level. The prioritization considers, amongst other things, the timing of the climate impacts, their severity and extensiveness, the condition of each asset (a measure of the sensitivity of the asset to damage), the number of system users affected, and the level of network redundancy, or available detour routes, in the area. Prioritization scores are generated for each potentially exposed asset based on these factors and used to rank them.

1.2. Report Organization

The main feature of this report is the prioritized list of potentially exposed assets within District 5. Per above, this information will inform the timing of the detailed adaptation assessments of each asset, which is the next phase of Caltrans' adaptation work. The final prioritized list of assets for District 5 can be found in Chapter 4 of this document. The interim chapters provide important background information on the prioritization process. For example, those interested in learning more about Caltrans' overall adaptation efforts, and how the prioritization fits into that, should refer to Chapter 2. Likewise, those who are interested in learning more about how the prioritization was determined should refer to Chapter 3.

2. CALTRANS' CLIMATE ADAPTATION FRAMEWORK

Enhancing Caltrans' capability to consider adaptation in all its activities requires an agency-wide perspective and a multi-step process to make Caltrans more resilient to future climate changes. The process for doing so will take place over many years and will, undoubtedly, evolve over time as everyone learns more about climate hazards, better data is collected, and experience shows which techniques are most effective. Researchers have just started examining what steps an overarching adaptation framework for a department of transportation should entail. Figure 1 provides a graphical illustration of one such path called the Framework for Enhancing Agency Resiliency to Natural and Anthropogenic Hazards and Threats (FEAR-NAHT).[5] This framework, developed through the National Cooperative Highway Research program (NCHRP), has been adopted by Caltrans as part of its long-term plan for incorporating adaptation into its activities (hereafter referred to as the Caltrans Climate Adaptation Framework or "Framework"). In addition, information developed by local and regional agencies through adaptation planning studies and other analysis also provides critical input for Caltrans.

Steps 1 through 4 of the Framework represent activities that are currently underway at Caltrans Headquarters to effectively manage its new climate adaptation program and develop policies that will help jumpstart adaptation actions throughout the organization. Step 1, *Assess Current Practice*, and Step 4, *Implement Early Wins*, are both addressed within a document called the Caltrans Climate Adaptation Strategy Report. The Adaptation Strategy Report undertook a comprehensive review of all climate adaptation policies and activities currently in place or underway at Caltrans. The report includes numerous "early wins" that can be taken in the near-term to enhance agency resiliency. These early win strategies are easily implementable, programmatic changes. For example, setting policies, procedures, or changing agency guidance. Several of these strategies also touch on elements of Step 2, *Organize for Success*, and Step 3, *Develop an External Communications Strategy and Plan*. In addition to this, a comprehensive adaptation communications strategy and plan for climate change is being developed as part of a Caltrans pilot project with the Federal Highway Administration.

COVER OF THE CALTRANS CLIMATE CHANGE VULNERABILITY ASSESSMENT SUMMARY REPORT FOR DISTRICT 5

Step 5, *Understand the Hazards and Threats*, is the first step where detailed technical analyses are performed, and in this case, identify assets potentially exposed to various climate stressors. This step has been completed for a subset of the assets and hazards in District and the results are presented in the Caltrans Climate Change Vulnerability Assessment Report for District 5. The exposure information generated in the Vulnerability Assessment Report is used as an input to this study.

[5] This framework and related guidance for state DOTs is being developed as part of NCHRP 20-117, Deploying Transportation Resilience Practices in State DOTs (expected completion in early 2021).

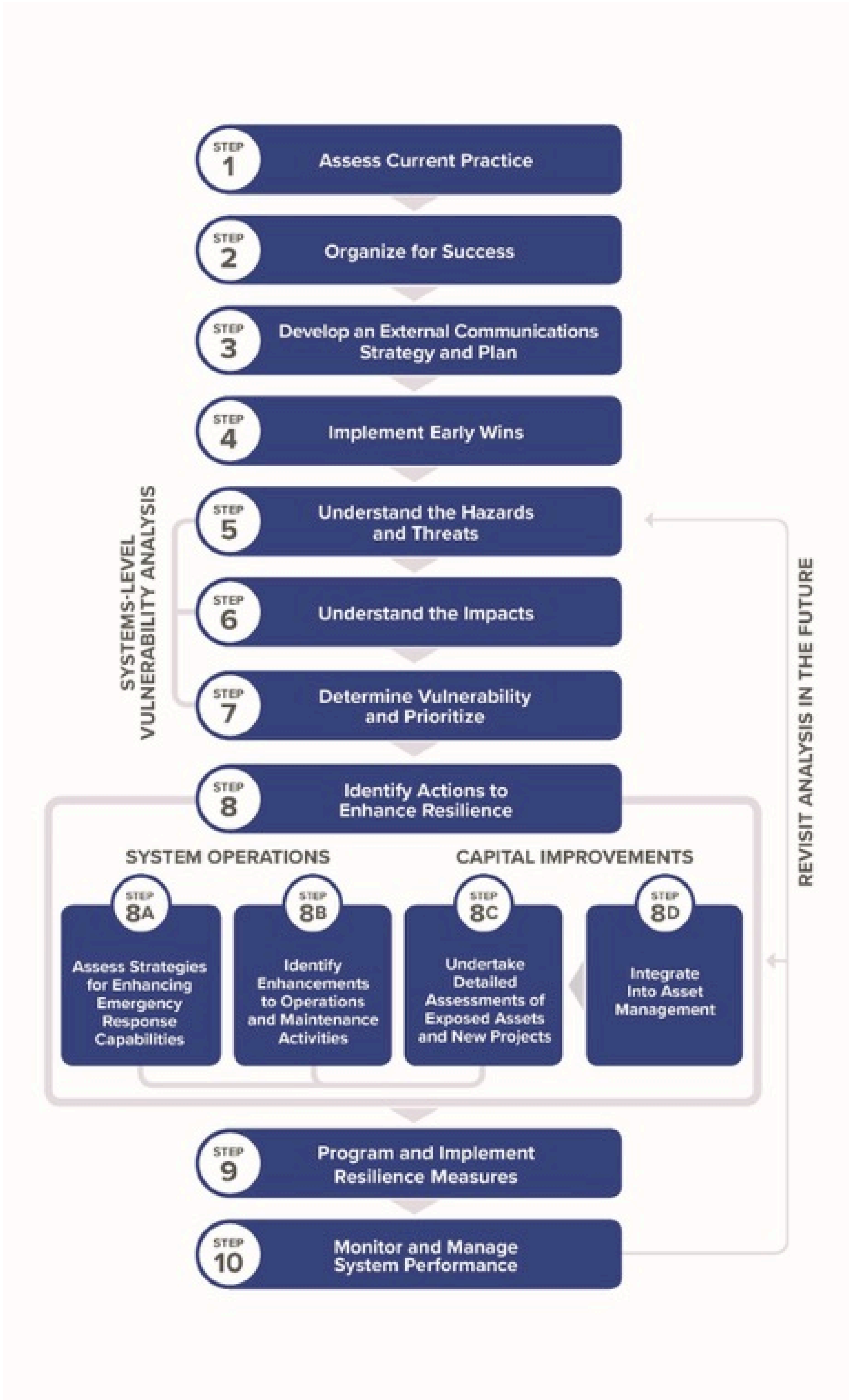

FIGURE 1: CALTRANS' CLIMATE ADAPTATION FRAMEWORK (FEAR NAHT FRAMEWORK)

The work undertaken for this study, the District 5 Adaptation Priorities Report, covers both Steps 6 and 7 in the Framework. Step 6, *Understand the Impacts*, is focused on the implications of the exposure identified in Step 5. This includes understanding the sensitivity of the asset to damage from the climate stressor(s) it is potentially exposed to and understanding the criticality of the asset to the functioning of the transportation network and the communities it serves. Developing an understanding of these considerations is part of the prioritization methodology described in the next chapter.

Step 7, *Determine Vulnerability and Prioritize*, focuses on creating and implementing a prioritization approach that considers both the nature of the exposure identified in Step 5 (its severity, extensiveness, and timing) and the consequence information developed in Step 6. The goal of the prioritization is to identify which assets should undergo detailed adaptation assessments first, because resource constraints will prevent all assets from undergoing detailed study simultaneously.

After Step 7, the Framework divides into two parallel tracks, one focused on operational measures to enhance resiliency and the consideration of adaptation (Steps 8A and 8B) and the other on identifying adaptation-enhancing capital improvement projects (Steps 8C and 8D). Collectively, these represent the next steps that should be undertaken using the information from this report. On the operations track, the results of this assessment should be reviewed for opportunities to enhance emergency response (Step 8A) and operations and maintenance (Step 8C). Caltrans' next step on the capital improvement track should be to undertake detailed assessments of the exposed facilities (Step 8C). The prioritization information generated as part of this assessment should also be integrated into the state's asset management system (Step 8D). All projects recommended through the asset management process should also undergo detailed adaptation assessments (hence the arrow from Step 8D to 8C).

Thus, there will be two parallel pathways for existing assets to get to detailed facility level adaptation assessments. The first is through this prioritization analysis, which is driven primarily by the exposure to climate hazards with asset condition as a secondary consideration. The second is through the existing asset management process, which is driven primarily by asset condition and will have vulnerability to climate hazards as a secondary consideration.

The detailed adaptation assessments in Step 8C will involve engineering-based analyses to verify asset exposure to pertinent climate hazards (some exposed assets featured in this report will not be exposed after closer inspection). Then, if exposure is verified, Step 8C includes the development and evaluation of adaptive measures to mitigate the risk. The highest priority assets from this study will be evaluated first and lower priority assets will be evaluated later. Once specific adaptation measures have been identified, be they operational measures or capital improvements, these projects can then be programmed (Step 9). Step 10 then focuses on continuous monitoring of system performance to track progress towards enhancing resiliency. Note the feedback loops from Step 10 to Steps 5 and 8. The arrow back to Step 5 indicates that the exposure analysis should be revisited in the future as new climate projections are developed. The arrow back to Step 8 indicates how one can learn from the performance indicators and use this data to modify the actions being undertaken to enhance resilience.

3. PRIORITIZATION METHODOLOGY

3.1. General Description of the Methodology

The methodology used to prioritize assets exposed to climate hazards draws upon both technical analyses and the on-the-ground knowledge of district staff. The technical analysis component was undertaken first to provide an initial indication of adaptation priorities. These initial priorities were then reviewed with district staff at a workshop and, if necessary, adjusted to reflect local knowledge and recommendations. These adjustments are embedded in the final priorities shown in Chapter 4.

With respect to the technical analysis, there are a few different approaches for prioritizing assets based on their vulnerability to climate hazards. The approach selected for this study is known as an "indicators approach." The indicators approach involves collecting data on multiple variables that are determined to be important factors for prioritization. These are then put on a common scale, weighted, and used to create a score for each asset. The scores collectively account for all the variables of interest and can be ranked to determine priorities.

It is important to note that, since the prioritization process is focused on determining the order in which detailed adaptation assessments are conducted; only assets that are determined potentially exposed to a climate hazard are included in this analysis. Assets that were determined to have no exposure to the hazards studied in the Caltrans Climate Change Vulnerability Assessment are not included in this study.

RAT CREEK MUDSLIDE DEBRIS FLOW
SR 1 IN MONTEREY COUNTY

The remainder of this chapter describes the prioritization methodology in detail. Section 3.2 begins by describing the asset types and hazards studied. Next, Section 3.3 discusses the individual prioritization metrics (or factors) that were used in the technical analysis. Following this, Section 3.4 describes how those individual factors were brought together into an initial prioritization score for each asset. Lastly, Section 3.5 describes how the initial prioritization was adjusted with input from district staff.

It is important to note the limitations to such a prioritization assessment, which is an indicator-based scoring approach. The prioritization assessment was conducted statewide for all Caltrans districts and therefore the data applied needed to be available statewide, which limited the ability to incorporate regional data. Assessments at a statewide scale can overlook site-specific context, for assets themselves, the broader transportation network and those that use it. The detailed asset-level assessments which would come next for high priority assets would provide an opportunity to use regional or local datasets and identify and respond to important site-specific considerations, including community needs (especially for disadvantaged or disproportionately vulnerable groups), stakeholder goals and requirements, environmental and natural resource impacts, safety concerns, bike and pedestrian access, co-benefits such as habitat preservation, and more. These detailed asset-level assessments are recommended, in part, so this information is not overlooked when Caltrans moves forward with adaptation investments. These details are simply not possible to fully grasp at the statewide scale. This asset prioritization exercise is intended to identify top priority locations to respond to climate change risks and develop responses through more detailed assessments.

3.2. Asset Types and Hazards Studied

Caltrans is responsible for maintaining dozens of different asset types (bridges, culverts, roadway pavement, buildings, etc.). Each of these asset types is uniquely vulnerable to a different set of climate stressors. Resource constraints only allowed this study to investigate a subset of the asset types owned by Caltrans in District 5 and, for those, only a subset of the climate stressors that could impact them. For example, wooden guardrail posts are another State Highway System asset damaged by wildfire and should be replaced with metal posts in wildfire exposure areas. But for this assessment Caltrans focused on small culvert vulnerability to wildfire. Additional exposure and prioritization analyses are needed in the future to gain a fuller understanding of Caltrans' adaptation needs. Caltrans may flag other assets that would be vulnerable or high priority by identifying neighboring high priority assets identified in this analysis, or by using the data generated in this assessment to conduct further asset studies and prioritization.

The subset of asset types and hazards included in this study generally mirror those that were included in the District 5 Climate Change Vulnerability Assessment Report. As in the district vulnerability assessment, assets on the State Highway System were the primary focus for this prioritization analysis. That said, exposure to two additional hazards was included as part of this study: (1) riverine flooding impacts to bridges and culverts and (2) temperature impacts to pavement binder grade. Table 1 shows all the asset types included in this study for District 5 and marks with an "X" the hazards that were evaluated for each in the analysis.

TABLE 1: ASSET-HAZARD COMBINATIONS STUDIED

	Sea Level Rise	Storm Surge	Coastal Cliff Retreat	Wildfire	Temperature	Riverine Flooding
Pavement Binder Grade					X	
At-Grade Roadways	X	X	X			
Bridges	X	X	X			X
Large Culverts[6]	X	X	X			X
Small Culverts[7]	X	X	X	X		X

[6] Culverts 20 feet or greater in width.
[7] Culverts less than 20 feet in width.

The various asset-hazard combinations include:

- **Pavement binder grade exposure to temperature changes:** Binder can be thought of as the glue that holds the various aggregate materials in asphalt together. Binder is sensitive to temperature. If temperatures become too hot, the binder can become pliable and deform under the weight of traffic. On the other hand, if temperatures are too cold, the binder can shrink causing cracking of the pavement. There are various types (grades) of binder, each suited to a different temperature regime. This study considered how climate change will influence high and low temperatures and how this, in turn, could affect pavement binder grade performance.

EXTREME HEAT CAUSES PAVEMENT DAMAGE, SR 58 IN SAN LUIS OBISPO COUNTY

  Assumptions were made that (1) all roadways are currently (or could be in the future) asphalt and (2) the binder grade currently in place on each segment[8] of roadway matches the specifications in the Caltrans Highway Design Manual. From here, the allowable temperature ranges of each binder grade were compared to projected temperatures prior to 2010, 2010-2039, 2040-2069, or 2070-2099. If the temperature parameters exceeded the design tolerance of the assumed binder grade, that segment of roadway was deemed potentially exposed.

- **Bridge exposure to riverine flooding:** Bridges are sensitive to higher flood levels and river flows. With climate change, large precipitation events are generally expected to become more intense in District 5 leading to higher flows in rivers and streams. These higher flows could exceed the design tolerances of bridges. In addition, wildfires are also expected to become more prevalent in District 5 with climate change. After a wildfire burns, the ground can become hard and less capable of absorbing water. As a result, flood flows and debris flows can increase substantially in the aftermath of a fire, which could further exacerbate the risks to bridges. To better understand the threat posed to bridges in District 5, a flood exposure index was developed and calculated for each bridge that crosses a river or stream. The index considered both the changes in precipitation and wildfire likelihood in the area draining to the bridge in the early, mid, and late century timeframes. The index also considers the capacity of the bridge to handle higher flows using waterway adequacy information from the National Bridge Inventory (NBI). A higher score on the index indicates bridges at relatively greater risk due to a combination of higher projected flows and lower capacity.

[8] Roadway are segmented at intersections with other roads.

- **Large culvert exposure to riverine flooding:** A distinction is made in the analysis between large and small culverts due to different data being available for each. Large culverts are included in the NBI and are generally 20 feet or greater in width. Small culverts are generally shorter than 20 feet in width and covered through a different inventory/inspection program. Large culverts, like bridges, are sensitive to increased flood flows. Thus, a flood exposure index was calculated for each large culvert in the same manner as was done for bridges.

FLOODING DUE TO DEBRIS CLOGGED CULVERT
SR 154 IN SANTA BARBARA COUNTY

- **Small culvert exposure to riverine flooding:** Small culverts (those less than 20 feet in width) are, like bridges and large culverts, also sensitive to higher flood flows. Hence, a flood exposure index like the one for bridges and large culverts was calculated for this asset type. The one difference is that the capacity component of the index for small culverts used the actual dimensions of the culvert, information that was not available for bridges and large culverts. Although the actual dimensions of small culverts were available, due to resource and data constraints, no hydraulic analyses were performed to determine overtopping potential. Instead, the size was simply used as a factor in the riverine flood exposure index.

- **Small culvert exposure to wildfire:** In addition to the higher post-fire flood flows captured in the flood exposure analysis, culverts can also be sensitive to the direct impacts of fire on the structure. Certain culvert materials (e.g. wood and plastic) can easily burn or be deformed during a fire. Thus, an assessment was made to determine the likelihood of a wildfire directly impacting each small culvert in the early, mid, and late century timeframes. This analysis was only conducted for small culverts because information on culvert construction materials was not available for large culverts.

- **At-grade roadway exposure to sea level rise:** Sea level rise, caused by the warming of ocean waters and the melting of land-based glaciers, is a prominent hazard brought on by climate change. In low-lying coastal areas, at-grade roads (defined here as those portions of the road network that are not elevated on a bridge) may become subject to regular inundation at high tides as sea levels rise. In low-lying areas like those around Moss Landing (Monterey County) at-grade roads may become subject to total inundation as sea levels rise. Sea level rise will lead to frequent road closures that disrupt travel and accessibility. In some locations with regular inundation, premature degradation of the pavement may also occur.

- **Bridge exposure to sea level rise:** There are several ways in which sea level rise may adversely affect bridges. For very low bridges, a rise in sea levels may result in water overtopping the deck and impeding travel. It is important to recognize, however, that serious impacts to bridges can still occur from sea level rise even if water does not overtop the deck. For example, on some bridge designs, if sea levels rise just enough to result in waves contacting the bottom of the deck, the uplifting forces may be enough to separate the deck from the rest of the structure. Even bridges whose decks are well above projected water levels may be impacted by sea level rise. For example, waves may contact piers at a higher elevation than they were designed for leading to more rapid corrosion of bridge components and unexpected strain being put on the bridge structure. The bridge abutments may also be adversely impacted by waves regularly hitting higher than initially designed and eroding the approach embankments. Furthermore, the navigability of shipping channels or deltas may be impeded by reduced ship clearances under bridges as sea levels rise.

- **Large and small culvert exposure to sea level rise:** Culverts are primarily used to convey streams and stormwater underneath roadways. Some are also used in tidally influenced environments. If sea levels rise enough for sea water to reach the culvert, this can change the hydraulic performance of the culvert leading to more frequent overtopping of the roadway. For culverts that were not designed for a tidal setting, the frequent unanticipated presence of saltwater can also lead to corrosion and other maintenance issues that may decrease the anticipated useful life of the asset.

- **At-grade roadway exposure to storm surge:** Storm surge refers to the elevating of coastal waters during major storm events. When strong winds blow onshore during such events, this can cause the water to pile up and reach levels much greater than during the normal tidal cycle. Sea level rise can cause the water to reach even higher during major storm events and increase the frequency of inundation. Inundation of at-grade roadways from storm surge may require the road to be closed, disrupting travel. Also, the surge and associated wave action often associated with storm events can cause erosion of the roadway embankment. King Tides, while not storm related, further contribute to roadway exposure.

- **Bridge exposure to storm surge:** Storm surge presents many threats to bridges that may not have been fully anticipated if sea level rise was not considered during the design. Some low bridges may be overtopped by the surge and others may be affected by uplifting forces from wave

SEA LEVEL RISE AT SR 1 BRIDGE AT MOSS LANDING BRIDGE OVER ELKHORN SLOUGH IN MONTEREY COUNTY action hitting the bottom of the deck. Either situation is likely to lead to the closure of the bridge and introduce the potential for serious structural damage. Even if the water is not high enough to reach the bridge deck, the elevated water levels and associated wave action can cause erosion around the bridge approaches. Furthermore, if the surge approaches or recedes at a high enough velocity, scouring of soils can occur around bridge piers and abutments weakening the structure and potentially compromising the bridge's integrity. This is a particularly acute threat for surge impacted bridges built over other roadways or railroads (as opposed to over water) because scour may not have been considered during their initial designs. This assessment focused on the 100-year storm surge event combined with sea level rise, but even regular tidal events including the King Tide can cause these impacts. A King Tide is an exceptionally high tidal event caused by the Earth's alignments with the sun and moon. District 5 is already experiencing damages from the King Tide in Moss Landing, which is expected to worsen as sea levels rise.

- **Large and small culvert exposure to storm surge:** Storm surge can overtop culverts impeding travel. If the velocity of the surge is great enough, then a culvert can also be damaged by the hydraulic forcing of excessive water through too small an opening. Water overtopping the roadway embankment on top of the culvert may also cause erosion resulting in damages to the roadway and the culvert itself.

- **At-grade roadway exposure to coastal cliff retreat:** Cliff retreat refers to the erosion of coastal cliff faces. This process can be accelerated by sea level rise since higher water levels may mean more frequent instances of wave action reaching the base of the cliff and causing erosion. At-grade roadways that are immediately along the coast can be a total loss if erosion encroaches upon them. Caltrans has realigned several roads already, often at significant expense, to avoid retreating coastal cliff faces.

- **Bridge exposure to coastal cliff retreat:** Any bridges in the vicinity of coastal cliff faces are at risk of a total loss should the cliff retreat towards the bridge abutment. Should the abutment of the bridge be compromised by erosion, the structural stability of the bridge will be lost and the bridge no longer usable.

- **Large and small culvert exposure to coastal cliff retreat:** As with bridges and at-grade roadways, any culverts along a segment of road exposed to coastal cliff retreat are at risk of becoming a total loss. The erosion might compromise their stability causing them, and the roadway above them, to fall away.

3.3. Prioritization Metrics

Metrics are the individual variables used to calculate a prioritization score for each asset. These can be thought of as the individual factors that, collectively, help determine the asset's priority for adaptation. Each of the asset-hazard combinations described in the previous section has its own unique set of factors that are used in the prioritization. The metrics were selected based on their relevancy to each asset-hazard combination and data availability. For example, the condition rating of a culvert is a very relevant metric for prioritizing culverts exposed to riverine flooding, however, it is not at all relevant to prioritizing bridges exposed to the same hazard. Table 2 provides an overview of all the metrics included in this study and denotes with an “X” their application to the various asset-hazard combinations studied.

TABLE 2: METRICS INCLUDED FOR EACH ASSET-HAZARD COMBINATION STUDIED

	Sea Level Rise				Storm Surge				Coastal Cliff Retreat				Wildfire	Tempera-ture	Riverine Flooding		
Metrics	**At-Grade Roadways**	**Bridges**	**Large Culverts**	**Small Culverts**	**At-Grade Roadways**	**Bridges**	**Large Culverts**	**Small Culverts**	**At-Grade Roadways**	**Bridges**	**Large Culverts**	**Small Culverts**	**Small Culverts**	**Pavement Binder Grade**	**Bridges**	**Large Culverts**	**Small Culverts**
Exposure																	
Past natural hazard impacts	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Lowest impactful sea level rise (SLR) increment	X	X	X	X													
Percent of road segment exposed to 6.6 or 7 ft. of SLR[9]	X																
Lowest impactful SLR increment with 100-year storm surge					X	X	X	X									
Percent of road segment exposed to a 100-year storm with 4.6 ft. or 6.6. ft. of SLR[10]					X												
Lowest SLR increment that results in damage from coastal cliff retreat									X	X	X	X					
Percent of road segment exposed to coastal cliff retreat under 6.6 ft. of SLR									X								
Initial timeframe for elevated level of concern for wildfire													X				
Highest projected wildfire level of concern													X				
Initial timeframe when asphalt binder grade needs to change														X			
Maximum riverine flooding exposure score for the 2010-2039 timeframe															X	X	X
Maximum riverine flooding exposure score															X	X	X
Consequences																	
Bridge substructure condition rating						X									X		
Channel and channel protection condition rating															X	X	
Culvert condition rating							X	X								X	X
Culvert material				X									X				
Scour rating						X									X		
Average annual daily traffic (AADT)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Average annual daily truck traffic (AADTT)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Incremental travel distance to detour around the asset													X		X	X	X
Incremental travel distance to detour around the asset for the lowest impactful SLR increment	X	X	X	X	X	X	X	X	X	X	X	X					
Incremental travel distance to detour around the asset under the maximum increment of SLR (6.6 or 7 ft. of SLR alone and 4.6 or 6.6 ft. of SLR with a 100-year storm).[11]	X	X	X	X	X	X	X	X	X	X	X	X					

[9] The high SLR increment used varies depending on location in District 5 due to the use of two different SLR models (US Geological Survey (USGS) and National Oceanic and Atmospheric Administration (NOAA)). Santa Cruz, San Luis Obispo, and Santa Barbara Counties used the USGS model and the associated high 6.6 ft. increment was applied for this metric. Monterey County used the NOAA model and the associated high 7 ft. increment was applied for this metric. See the sections below for more detail on models applied.
[10] The high SLR increment used varies depending on location in District 5 due to the use of two different sea level rise and storm surge models (US Geological Survey (USGS) and UC Berkeley). Santa Cruz, San Luis Obispo, and Santa Barbara Counties used the USGS model and the associated high 6.6 ft. increment was applied for this metric. Monterey County used the UC Berkeley sea level rise and surge model and the associated high 4.6 ft. increment was applied for this metric. See the sections below for more detail on models applied.
[11] Sea level rise, storm surge, and cliff retreat datasets were applied when calculating detour routes. Data applied came from different models, which use different methodologies and assumptions. As such, the model results did not match up across the same flood extents. In the detour analysis, if a road was exposed to sea level rise but not surge due to differing model extents, then the detour would assume the roadway was exposed to sea level rise AND surge. See the sections below for more detail on the models applied.

The metrics included in this study fall into two categories: exposure metrics and consequence metrics. Exposure metrics capture the extensiveness, severity, and timing of a hazard's projected impact on an asset. Assets that have more extensive, more severe, and sooner exposure are given a higher priority. Consequence metrics provide an indication of how sensitive an exposed asset is to damage using information on the asset's condition. Consequence metrics also indicate how sensitive the overall transportation network may be to the loss of that asset should it be taken out of service by a hazard. The poorer the initial condition of the potentially exposed asset and the more critical it is to the functioning of the transportation network, the higher the priority given. The specific metrics that are included within each of these categories are described in the sections that follow.

3.3.1. Exposure Metrics

The following metrics were used to assess asset exposure in District 5:

- **Past natural hazard impacts:** Assets that have experienced sea level rise, storm surge, cliff retreat, flood, or fire-related impacts in the past are likely to experience more issues in the future as climate changes and should be prioritized. To obtain information on past impacts, District 5 maintenance staff were surveyed and asked to identify any at-grade roadways, bridges, large culverts, or small culverts that had experienced sea level rise, storm surge, or coastal cliff retreat issues in the past. Staff was also asked to document past riverine flooding impacts for all these asset types except at-grade roadways. In addition, staff was also asked if any small culverts were damaged directly by fire and replaced with culverts of the same material. Any asset that was identified as previously impacted by coastal hazards, riverine flooding, or fire was flagged, and that asset was given a higher priority for adaptation.

DAMAGE TORO CANYON CREEK BRIDGE SR 192 IN SANTA BARBARA COUNTY

- **Lowest impactful sea level rise increment:** Assets that are likely to be impacted by sea level rise sooner should receive higher priority for detailed facility level assessments. To consider this in the asset scoring, a metric was developed that captured the lowest (first) increment of sea level rise[12] to potentially impact each at-grade roadway, bridge[13], large culvert, and small culvert. This metric made use of the sea level rise data used in the District 5 Climate Change Vulnerability Assessment. Sea level rise data came from two sources: the United States

[12] Sea level rise areas hydrologically connected to the sea and hydrologically disconnected low-lying areas potentially vulnerable to sea level rise inundation were both used for this assessment.

[13] For bridges already over coastal waters or channels, potential impacts were assumed to occur at the lowest available increment of sea level rise. No analyses were performed to compare the elevations of the bottoms of the bridge decks to the underlying water elevations. The analysis was set up this way in recognition of the impacts possible at bridges from sea level rise before water touches the deck (i.e., enhanced corrosion and structural stability, erosion, and navigability concerns).

Geological Survey's (USGS) Coastal Storm Modeling System (CoSMoS) and a model developed by the National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management.[14] The CoSMoS data was applied as the primary source for coastal hazards in this assessment, but CoSMoS sea level rise data was not available in Monterey County and the NOAA data was used there instead. It is important to note that the Coastal Resilience Monterey Bay modeling is also available for Monterey Bay. This modeling effort was completed through a large investment of state resources (including from the Coastal Conservancy) to develop a more dynamic model for the Monterey Bay region and the resulting model is used by local stakeholders. The NOAA data was used instead of the Coastal Resilience Monterey Bay modeling due to the nature of this assessment and the need to use statewide data sources.[15]

CoSMoS sea level rise data used was for an annual flooding event under sea level rise increments of 0.0, 0.8, 1.6, 2.5, 3.3, 4.1, 4.9, 5.7, and 6.6 feet. NOAA GIS shapefiles were used for sea level rise in one-foot increments from 1 to 10 feet above mean higher high water (MHHW).[16] For this metric, the lower the sea level rise increment that first impacts the asset studied, the higher priority it received.

- **Percent of road segment exposed to 6.6 or 7 ft. of sea level rise:** For at-grade roadway segments[17], not only is the timing of sea level rise impacts an important factor in prioritization, but also the extensiveness of the impacts. All else being equal, a segment of road that is impacted over a large proportion of its length should receive higher priority than one impacted over only a small proportion. The 6.6 feet increment from the CoSMoS model was used for this metric in Santa Cruz, San Luis Obispo, and Santa Barbara Counties. The 7 feet increment from the NOAA sea level rise model was used for this metric in Monterey County. These heights provide an indicator of potential impacts at the end of the century under very high sea level rise scenarios.

  Figure 2 from the District 5 Climate Change Vulnerability Assessment provides a summary of projected sea level rise for the Port San Luis tide gauge in San Luis Obispo County. The figure demonstrates how greatly sea level rise projections diverge after mid-century under different scenario probabilities and emission concentrations. Approximately 7 feet of sea level rise is expected to occur in Port San Luis by 2080 under the extreme H++ scenario, by 2110 under a 0.5% probability scenario with high emissions, and by 2150 under a 5% probability change with high emissions.[18]

[14] NOAA, Sea Level Rise Viewer, Accessed December 24, 2020 from https://coast.noaa.gov/slr/
[15] The NOAA model is also used in other districts instead of CoSMoS.
[16] See the District 5 Climate Change Vulnerability Assessment Summary or Technical Reports for more information on the models used: https://dot.ca.gov/programs/transportation-planning/2019-climate-change-vulnerability-assessments
[17] At-grade roadways are segmented at intersections with other roads thereby matching the segmentation used for the pavement binder grade analysis.
[18] See the Ocean Protection Council California Sea Level Rise Guidance (2018 Update) for sea level rise projections: https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf

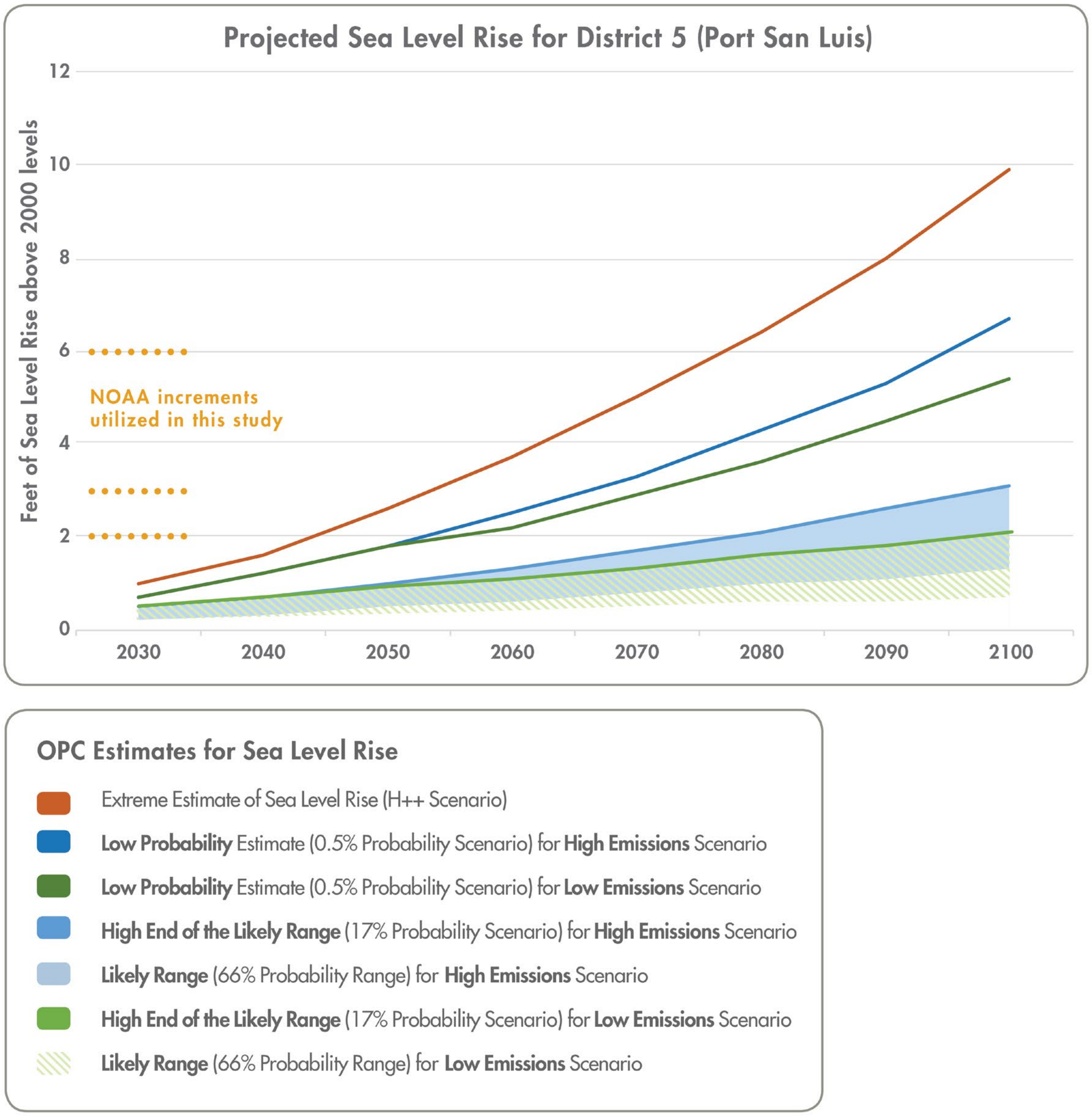

FIGURE 2: OCEAN PROTECTION COUNCIL SEA LEVEL RISE PROJECTIONS FOR PORT SAN LUIS

- **Lowest impactful sea level rise increment with 100-year storm surge:** As with sea level rise, assets that are likely to be impacted by storm surge sooner should receive higher priority for detailed facility level assessments. To factor this into the analysis, this metric captures the lowest (first) sea level rise increment at which the 100-year storm surge could potentially impact each at-grade roadway, bridge[19], large culvert, and small culvert. Again, the CoSMoS model was used across most coastal District 5 counties. The UC Berkeley CalFloD-3D model was used for this exercise in Monterey County, as the CoSMoS sea level rise and storm surge model results were not available there. These are the same datasets used in the District 5 Climate Change Vulnerability Assessment storm surge assessment.[20] USGS CoSMoS storm surge data at increments of 0.0, 0.8, 1.6, 2.5, 3.3, 4.1, 4.9, 5.7, and 6.6 feet was used for the analysis. CalFloD-3D modeled a more limited set of future sea level rise increments than the CoSMoS model. The analysis used sea level rise heights of 0.0, 1.6, 3.3, and 4.6 feet with a 100-year storm event. The lower the sea level rise increment that storm surge first impacts the asset, the higher priority it received.

BIXBY CREEK BRIDGE ALONG SR 1 IN MONTEREY COUNTY

- **Percent of road segment exposed to a 100-year storm with 4.6 or 6.6 feet of sea level rise:** This metric measures the proportion of each at-grade roadway segment exposed to a 100-year storm surge. As with the sea level rise length metric, 6.6 feet of sea level rise was used for counties where the CoSMoS model was available (Santa Cruz, San Luis Obispo, and Santa Barbara). The highest CalFloD-3D model sea level rise and storm surge increment of 4.6 feet was applied in Monterey County. All else being equal, the greater the proportion of roadway length exposed to storm surge, the higher the priority of that segment.

[19] As with sea level rise, no analyses were performed to compare the elevations of the bottoms of the bridge decks to the underlying water elevations. The analysis was set up this way in recognition of the impacts possible at bridges from sea level rise before water touches the deck (i.e., enhanced corrosion and structural stability, erosion, and navigability concerns).

[20] See the District 5 Climate Change Vulnerability Assessment Summary or Technical Reports for more information on the model used: https://dot.ca.gov/programs/transportation-planning/2019-climate-change-vulnerability-assessments

- **Lowest SLR increment that results in damage from coastal cliff retreat:** At-grade roadways, bridges, large culverts, and small culverts that are exposed to coastal cliff retreat sooner should receive higher priority for facility level adaptation assessments. This metric was included to capture the timing of impacts. As in the District 5 Caltrans Climate Change Vulnerability Assessment, this study relied upon coastal cliff retreat data from the USGS CoSMoS model.[21] CoSMoS data was used for sea level rise increments of 0.0, 0.8, 1.6, 2.5, 3.3, 4.1, 4.9, 5.7, and 6.6 feet. The "Do Not Hold the Line" cliff retreat scenario was used from the CoSMoS model, which assumes that coastal protections like sea walls and rip rap are not used to slow retreat.

- **Percent of road segment exposed to coastal cliff retreat under 6.6 feet of sea level rise:** This metric captures the proportion of each at-grade roadway segment that is exposed to coastal cliff retreat. The USGS CoSMoS model was applied for 6.6 feet of sea level rise in order to provide an indicator of potential impacts at the end of the century under a high greenhouse gas emissions scenario. The greater the proportion of roadway length exposed to coastal cliff retreat, the higher the priority of that segment.

- **Initial timeframe for elevated level of concern from wildfire:** Assets that are more likely to be impacted by wildfire sooner should be prioritized first. Using the future wildfire projections developed for the District 5 Climate Change Vulnerability Assessment, the initial timeframe (2010-2039, 2040-2069, 2070-2099, or Beyond 2099) for heightened wildfire risk was determined for each small culvert.[22] The most recent timeframe across the range of available climate scenarios was chosen. Assets that were impacted sooner were given a higher priority for adaptation.

- **Highest projected wildfire level of concern:** Assets that are exposed to a greater wildfire risk should be prioritized. The wildfire modeling conducted for the District 5 Climate Change Vulnerability Assessment classified fire risk into five levels of concern (very low, low, moderate, high, and very high) at various future time periods. Using this data, the highest level of concern was determined for each small culvert between now and 2100 and across all climate scenarios. Assets with higher levels of concern were given a higher priority for adaptation.[23]

- **Initial timeframe when asphalt binder grade needs to change:** Roadway segments that are more likely to need binder grade changes sooner should be prioritized. Using the assumptions and data from the pavement binder grade exposure analysis described above, the initial timeframe (prior to 2010, 2010-2039, 2040-2069, or 2070-2099) for binder grade change was determined. Roadway segments that were found to need binder grade changes sooner were given a higher priority for detailed adaptation assessments.

- **Maximum riverine flooding exposure score for the 2010-2039 timeframe**: Assets that have relatively higher exposure to riverine flooding in the near-term should be prioritized. Using the riverine flood exposure index values calculated using the process described above, the highest score for the near-term (2010-2039) period was determined for each bridge, large culvert, and

[21] See the District 5 Climate Change Vulnerability Assessment Summary or Technical Reports for more information on the model used: https://dot.ca.gov/programs/transportation-planning/2019-climate-change-vulnerability-assessments
[22] See the District 5 Climate Change Vulnerability Assessment Summary or Technical Reports for more information on the model used: https://dot.ca.gov/programs/transportation-planning/2019-climate-change-vulnerability-assessments
[23] Ibid.

small culvert considering all climate scenarios and the range of outputs from all climate and wildfire models. Assets with the highest overall riverine flooding scores in this initial period received a higher priority for adaptation.

- **Maximum riverine flooding exposure score:** In addition to understanding the most pressing near-term needs for dealing with riverine flooding, assets that have relatively higher exposure to riverine flooding at any point over their lifespans should also be prioritized. To calculate this metric, the highest riverine flooding exposure score was determined for each asset considering all time periods (from now through 2100), all climate scenarios, and all climate and wildfire models. Assets with the highest overall riverine flooding scores received a higher priority for adaptation.

3.3.2. Consequence Metrics

The following metrics were used to understand the consequences of each asset's exposure, considering both asset sensitivity to damage and network sensitivity to loss of the asset:

- **Bridge substructure condition rating:** Poor bridge substructure condition can contribute to failure during riverine flooding and storm surge events. The NBI assigns a substructure condition rating to each bridge. Values range from nine to two with lower values indicating poorer condition. Bridges with poor substructure condition ratings were given higher priority for adaptation assessments.

- **Channel and channel protection condition rating:** Poor channel conditions or inadequate channel protection measures can contribute to failure during riverine flooding events. The NBI assigns a channel and channel protection condition rating to each bridge and large culvert. Values range from nine to two with lower values indicating poorer condition. Bridges and large culverts with poor channel or channel protection ratings were given higher priority for adaptation assessments.

- **Culvert condition rating:** Poor culvert condition can contribute to failure during storm surge and riverine flooding events. The NBI assigns a culvert condition rating to each large culvert. Values range from nine to two with lower values indicating poorer condition. Caltrans has developed their own culvert condition rating system for small culverts. Possible ratings in the Caltrans system include good, fair, critical, and poor. Large and small culverts with poorer condition ratings in either system were prioritized.

- **Culvert material:** Culvert material determines the sensitivity of culverts to direct damage from wildfires and material degradation due to sea level rise. Caltrans includes material data in its databases on small culverts (no equivalent information exists for large culverts). Possible culvert materials include HDPE (high density polyethylene [plastic]), PVC (polyvinyl chloride [plastic]), corrugated steel pipe, composite, wood, masonry, and concrete. HDPE, PVC, corrugated steel pipe, composite, and wood culverts are all more sensitive to wildfire and any small culverts made from these materials that are exposed to an elevated risk from wildfire were prioritized for adaptation. Likewise, corrugated steel pipe and concrete are more sensitive to regular saltwater inundation and any small culverts made from these materials that are exposed to sea level rise were assigned a higher priority.

- **Scour rating:** Scour is a condition where water has eroded the soil around bridge piers and abutments. Excessive scour of bridge foundations makes bridges more prone to failure, especially during storm surge and riverine flooding events. The NBI assigns a scour condition rating to each bridge. Values range from eight to two with lower values indicating greater scour concern. Bridges with lower scour values (higher scour concern) were given higher priority for adaptation assessments.

DAMAGE TO TORO CREEK BRIDGE CAUSES DETOURS SR 192 IN SANTA BARBARA COUNTY

- **Average annual daily traffic (AADT):** AADT is a measure of the average traffic volume on a roadway. The consequences of weather and climate hazard-related failures/disruptions/maintenance are greater for assets that convey a higher volume of traffic. Disruptions on higher volume roads affect a greater proportion of the traveling public and there is a greater chance of congestion ripple effects throughout the network because alternate routes are less likely to be able to absorb the diverted traffic. AADT data was obtained from Caltrans databases and assigned to all the asset types included in this study. Exposed assets with higher AADT values were given greater priority for adaptation.

- **Average annual daily truck traffic (AADTT):** AADTT is a measure of the average truck volumes on a roadway. Efficient goods movement is important for maintaining economic resiliency and for providing relief supplies after a disaster. The consequences of weather and climate hazard-related failures/disruptions/maintenance are greater for assets that are a critical link in supply chains. AADTT data was obtained from Caltrans databases and assigned to all the asset types included in this study. Potentially exposed assets with higher AADTT values were given greater priority for adaptation.

- **Incremental travel distance to detour around the asset:** This metric measures the degree of network redundancy around each asset. A detour routing tool was developed for this project that can find the shortest path detour around a segment of road, bridge, large culvert, or small culvert and calculate the additional travel distance that would be required to take that detour.[24] A simplified version of the tool was run for each of the bridge and culvert assets studied that were exposed to riverine flooding. The tool did not consider whether the detour routes would be passible during a flood event. [25] Assets that had very long detour routes were given greater priority for adaptation.

[24] The detour routes for this and other related metrics in this study did not allow unpaved roads to be used as detours. That said, there are some errors in the database regarding paving status such that it is possible that unpaved roads may be shown as detour routes in some cases.

[25] The exposure of detour routes to flooding was not able to be determined within the resources of this project since no future riverine flooding floodplains with climate change were available at the time of publication.

- **Incremental travel distance to detour around the asset for the lowest impactful SLR increment:** A more complex version of the detour routing tool was used to determine the shortest detour for the lowest impactful sea level rise increment that would result in sea level rise, storm surge, and coastal cliff retreat affecting each asset. This provides an indication of the initial network redundancy issues that may be created by impacts in coastal areas. For these hazards, the detour tool considered the inundation/erosion throughout the roadway network for each increment of sea level rise evaluated. This ensured that detours were not routed onto roads that would also be inundated or eroded under the same amount of sea level rise.[26] In other words, when run for assets exposed to sea level rise or coastal cliff retreat, the detour routing algorithm ensured that no road affected by either sea level rise or coastal cliff retreat at that same increment of sea level rise could be considered a detour route. When run for assets exposed to storm surge, the detour routing algorithm ensured that no road affected by either sea level rise, coastal cliff retreat, or storm surge at the same increment of sea level rise could be considered a detour route. As with the riverine flooding detours, assets that had very long detour routes were given greater priority for adaptation.

- **Incremental travel distance to detour around the asset under the maximum extent of SLR (6.6 of SLR and 4.6 feet of SLR with a 100-year storm):** This metric captures the level of network redundancy around exposed at-grade roadways, bridges, large culverts, and small culverts under high sea level rise scenarios. To calculate the results for this metric, different coastal hazard models used in this prioritization assessment were applied. 6.6 feet of sea level rise from the CoSMoS model was used for cliff retreat across the District 5 coastline. The CoSMoS model and 6.6 feet increment was also used in Santa Cruz, San Luis Obispo, and Santa Barbara Counties when evaluating detours around sea level rise and storm surge inundation. The NOAA and UC Berkeley CalFloD-3D models were used for calculating detours in Monterey County; the 7 feet increment was applied from the NOAA model and the 4.6 feet with a 100-year storm scenario was applied from the CalFloD-3D model. The detour values for this metric were calculated the same way as was done for the lowest impactful sea level rise increment detour metrics described above. Likewise, assets that had very long detour routes under this sea level rise increment were given greater priority for adaptation.

3.4. Calculation of Initial Prioritization Scores

Once all the metrics had been gathered/developed, the next step was to combine them and calculate an initial prioritization score for each asset. Calculating prioritization scores is a multi-step process that was conducted using Microsoft Excel. The primary steps are as follows:

[26] An exception was made for Caltrans bridges impacted by sea level rise or storm surge within District 5. These assets were assumed to remain passible for such hazards. This assumption was made because, as noted above, exposure for bridges was assumed to occur for sea level rise and storm surge even if the deck was never touched by water (to reflect concerns over corrosion, navigability, etc.). If the deck was not touched by water, it is likely that the bridge would remain open as a detour route and adaptation/repair work could be done while the asset was still in service. Since most Caltrans bridges shown as exposed in the analysis would not actually be touched by water, it was assumed all would remain passible under these hazards lest excessively long and inaccurate detours be generated. That said, the detour metrics will be inaccurate for the few cases where detour routes traverse a Caltrans bridge whose deck would be touched by water and the bridge shut down. In these cases, the detour algorithm will have incorrectly assumed that the bridge would remain open and return a shorter detour length than would be the case. Note that this exception does not apply to non-Caltrans owned bridges. All non-Caltrans bridges were assumed to be impassible as a detour route if inundation was shown to be underneath them for any of the sea level rise or storm surge scenarios.

1. **Scale the raw metrics:** Several of the metrics described in the previous section have different units of measurement. For example, the AADT metric is measured in vehicles per day whereas the incremental travel time to detour around the asset is measured in minutes. There is a need to put each metric on a common scale to be able to integrate them into one scoring system. For this study, it was decided to use a scale ranging from zero to 100 with zero indicating a value for a metric that would result in the lowest possible priority level and 100 indicating a value for a metric that would result in the highest possible priority level. The districtwide minimum and maximum values for each metric were used to set that metric's zero and 100 values. The past weather/fire impacts metric (which had binary values) was assigned a zero if the condition was false (i.e., there were no previous weather/fire impacts reported) and 100 if the condition was true. Categorized or incremental values, like the various condition rating metrics or the sea level rise increments, were generally parsed out evenly between zero and 100 (e.g., if there were seven condition rating values, the minimum and maximum values were coded as zero and 100, respectively, with the five remaining categories assigned values at intervals of 20). The remaining metrics with continuous values were allowed to fall at their proportional location within the re-scaled zero to 100 range.

2. **Apply weights:** Some metrics have been determined by Caltrans to be more important than others for determining priorities. Therefore, the relative importance of each metric was adjusted by multiplying the scaled score by a weighting factor. Metrics deemed more important to prioritization were multiplied by a larger weight. For consistency, Caltrans Headquarters staff harmonized the weights to be used in all districts based on national best practices and input from the districts. Table 3 shows the weighting schema applied to the asset-hazard combinations in District 5. The weights are percentage based and add to 100% for all the metrics within a given asset-hazard combination (column).

   In general, higher weights were assigned to the future exposure metrics (including those considering both the hazard timing and severity) as they are the primary drivers of adaptation need. This helps ensure adaptations are considered proactively before the hazards affect the assets. It also focuses the first detailed assessments on those assets that are projected most severely affected by climate change.

TABLE 3: WEIGHTS BY METRIC FOR EACH ASSET-HAZARD COMBINATION STUDIED

Metric	Percentage Weights by Asset Class																
	Sea Level Rise				Storm Surge				Cliff Retreat				Wildfire	Tempera-ture	Riverine Flooding		
	At-Grade Roadways	Bridges	Large Culverts	Small Culverts	At-Grade Roadways	Bridges	Large Culverts	Small Culverts	At-Grade Roadways	Bridges	Large Culverts	Small Culverts	Small Culverts	Pavement Binder Grade	Bridges	Large Culverts	Small Culverts
Exposure																	
Past natural hazard impacts	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	-	20%	20%	20%
Lowest impactful sea level rise (SLR) increment	22.5%	45%	45%	40%	-	-	-	-	-	-	-	-	-	-	-	-	-
Percent of road segment exposed to 6.6 or 7 ft. of SLR[27]	22.5%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lowest impactful SLR increment with 100-year storm surge	-	-	-	-	22.5%	45%	45%	45%	-	-	-	-	-	-	-	-	-
Percent of road segment exposed to a 100-year storm with 4.6 ft. or 6.6. ft. of SLR[28]	-	-	-	-	22.5%	-	-	-	-	-	-	-	-	-	-	-	-
Lowest SLR increment that results in damage from coastal cliff retreat	-	-	-	-	-	-	-	-	22.5%	45%	45%	45%	-	-	-	-	-
Percent of road segment exposed to coastal cliff retreat under 6.6 ft. of SLR	-	-	-	-	-	-	-	-	22.5%	-	-	-	-	-	-	-	-
Initial timeframe for elevated level of concern for wildfire	-	-	-	-	-	-	-	-	-	-	-	-	17.5%	-	-	-	-
Highest projected wildfire level of concern	-	-	-	-	-	-	-	-	-	-	-	-	17.5%	-	-	-	-
Initial timeframe when asphalt binder grade needs to change	-	-	-	-	-	-	-	-	-	-	-	-	-	60%	-	-	-
Maximum riverine flooding exposure score for the 2010-2039 timeframe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.5%	22.5%	22.5%
Maximum riverine flooding exposure score	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.5%	22.5%	22.5%
Consequences																	
Bridge substructure condition rating	-	-	-	-	-	1.5%	-	-	-	-	-	-	-	-	1%	-	-
Channel and channel protection condition rating	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.5%	2.5%	-
Culvert condition rating	-	-	-	-	-	-	5%	5%	-	-	-	-	-	-	-	2.5%	5%
Culvert material	-	-	-	15%	-	-	-	-	-	-	-	-	20%	-	-	-	-
Scour rating	-	-	-	-	-	8.5%	-	-	-	-	-	-	-	-	6.5%	-	-
Average annual daily traffic (AADT)	10%	10%	10%	7%	10%	7%	7%	7%	10%	10%	10%	10%	7%	13%	7%	10%	10%
Average annual daily truck traffic (AADTT)	5%	5%	5%	3%	5%	3%	3%	3%	5%	5%	5%	5%	3%	27%	3%	5%	5%
Incremental travel distance to detour around the asset	-	-	-	-	-	-	-	-	-	-	-	-	15%	-	15%	15%	15%
Incremental travel distance to detour around the asset for the lowest impactful SLR increment	10%	10%	10%	7.5%	10%	7.5%	10%	10%	10%	10%	10%	10%	-	-	-	-	-
Incremental travel distance to detour around the asset under the maximum increment of SLR (6.6 or 7 ft. of SLR alone and 4.6 or 6.6 ft. of SLR with a 100-year storm).[29]	10%	10%	10%	7.5%	10%	7.5%	10%	10%	10%	10%	10%	10%	-	-	-	-	-
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

[27] The high SLR increment used varies depending on location in District 5 due to the use of two different SLR models (US Geological Survey (USGS) and National Oceanic and Atmospheric Administration (NOAA)). Santa Cruz, San Luis Obispo, and Santa Barbara Counties used the USGS model and the associated high 6.6 ft. increment was applied for this metric. Monterey County used the NOAA model and the associated high 7 ft. increment was applied for this metric. See the sections below for more detail on models applied.

[28] The high SLR increment used varies depending on location in District 5 due to the use of two different sea level rise and storm surge models (US Geological Survey (USGS) and UC Berkeley). Santa Cruz, San Luis Obispo, and Santa Barbara Counties used the USGS model and the associated high 6.6 ft. increment was applied for this metric. Monterey County used the UC Berkeley sea level rise and surge model and the associated high 4.6 ft. increment was applied for this metric. See the sections below for more detail on models applied.

[29] Sea level rise, storm surge, and cliff retreat datasets were applied when calculating detour routes. Data applied came from different models, which use different methodologies and assumptions. As such, the model results did not match up across the same flood extents. In the detour analysis, if a road was exposed to sea level rise but not surge due to differing model extents, then the detour would assume the roadway was exposed to sea level rise AND surge. See the sections below for more detail on the models applied.

Amongst the consequence metrics, more weight is given to the AADT and detour route variables relative to the condition rating related variables (bridge substructure condition rating, channel and channel protection condition rating, culvert condition rating, and scour rating). The logic for this is as follows. First, except for the scour rating, the connection between asset condition and asset failure during a hazard event is not always straightforward. Where there is less confidence in a metric, it is weighted less.[30] Second, other prioritization systems used by Caltrans, namely the asset management system, focus on condition to prioritize assets. Thus, poor condition assets will already be prioritized through that program and, per Caltrans' Climate Adaptation Framework shown in Figure 1 will also undergo detailed adaptation assessments before upgrades are made. There is little value in duplicating that prioritization system for this report; instead this effort puts more priority on assets based on their exposure to climate change-related hazards. Lastly, the traffic volume and detour length variables are the primary measures by which impacts to users of the system are captured and, given the importance of mobility to the functioning of the state, were weighted higher.[31]

An exception to some of the logic noted above can be found with small culvert exposure to wildfire and sea level rise. For these assets, nearly as much weight is given to the culvert material variable as to the AADT and detour route variables collectively. This is because the very nature of the threat to small culverts from wildfire and sea level rise is highly related to the material of the culvert. For example, if the culvert is plastic or wood, it is much more susceptible to fire damage than, say, a concrete culvert. Since they are less likely to be adversely affected by fire in the first place, one would not want to give high priority to concrete culverts for wildfire just because they convey a high AADT or have long detour routes. That is why more weight is placed on the material metric for this asset-hazard combination.

3. **Calculate prioritization scores for each hazard**: After the weights were applied, the next step was to calculate prioritization scores for each individual hazard. This was done by first summing the products of the weights and scaled values for all the metrics relevant to the particular asset-hazard combination being studied (i.e., summing up the products for each column in Table 3. Since there are different numbers of metrics used to calculate the score for each asset-hazard combination, these values were then re-scaled to range from zero to 100 with zero representing the lowest priority asset and 100 the highest priority asset. These interim scores provide useful information for understanding asset vulnerability to each specific hazard.
4. **Calculate cross-hazard prioritization scores:** While the prioritization scores for each hazard provide useful information, they do not provide the full picture on the threats posed to each asset. It was decided that the final scores used as the basis for prioritization need to look holistically across all the hazards analyzed. This cross-hazard perspective provides a better view of the collective threats faced by each asset and a better basis for prioritization. To calculate

[30] Note that the scour rating metric is weighted somewhat higher than the other condition related assets because of its more direct connection to asset failure.

[31] Within the traffic volume related metrics, note that slightly more weight is given to AADT as opposed to truck AADT given that most traffic on a roadway is non-truck. Thus, it was reasoned that the total volume should factor in somewhat more heavily than the truck volume. One exception to this was for temperature impacts to pavement. This asset-hazard combination is unique in that the traffic volume information is not just an indicator of how many users may be affected by necessary pavement repairs but also an indicator of how much damage may occur to the pavement should temperatures exceed binder grade design thresholds. Given that, for this asset-hazard combination, more weight is given to truck volumes since trucks do disproportionately more damage to temperature-weakened pavement.

the cross-hazard scores, the scores for each hazard analyzed for the asset were summed. These were then re-scaled yet again to a zero to 100 scale since different asset types have different numbers of hazards. As before, the higher the score, the higher the adaptation priority of that asset. These cross-hazard scores represent the final scores calculated for each asset during the technical assessment portion of the methodology.

5. **Assign priority levels**: The final step in the technical assessment was to group together assets into different priority levels based on their cross-hazard scores. This was done to make the outputs more oriented to future actions, decrease the tendency to read too much into minor differences in the cross-hazard scores, and better facilitate dialogue at the workshop with District 5 staff. Five priority levels were developed (Priority 1, 2, 3, 4, and 5) and assets were assigned to those groups on a district-wide basis. An equal number of assets were assigned to each priority level to help facilitate administration of the asset (or corridor) level adaptation assessments that will follow this study.

3.5. Adjustments to Prioritization

A preliminary set of prioritization scores was calculated for District 5 bridges, culverts, and roadways. A workshop was held with the district to explain the scoring methodology and go over the preliminary results. District 5 staff, including those from Planning, Asset Management, Maintenance, Design (e.g., Hydraulics) reviewed the preliminary prioritization results and decided to adjust some of the asset priorities. This district input is necessary as district staff have a more in-depth knowledge about their assets and statewide datasets can have errors. District 5 identified that some of the assets studied and prioritized are being replaced, including San Lorenzo River Bridge and Kings Creek Bridge, making them lower priority once they are replaced. These bridges are flagged in Section 4 below. The district also lowered the priorities of several other bridges because they have already been replaced, including:

- 51 0110 Romero Canyon Creek Bridge (05-SB-192-10.96) replaced with 51 0357 in 2019.
- 51 0052L/R Carpinteria Creek Left and Right Bridges (05-SB-101-2.44-CARP) replaced with 51 0342 in 2020.
- 51 0108 Montecito Creek Bridge (05-SB-192-8.12) replaced with 51 0355 in 2020.
- 51 0112 Toro Canyon Creek Bridge (05-SB-192-12.49) replaced with 51 0359 in 2019.
- 51 0113 Arroyo Parida Bridge (05-SB-192-15.52) replaced with 51 0360 in 2019.
- 49 0001L/R San Marcos Creek Bridges (05-SLO-101-63.57) replaced with 49 0263L/R under 05-0G0404.
- 49 0091 Trout Creek Bridge (05-SLO-058-3.08) replacement currently under construction under EA 05-0L723.

The priority on Salsipuedes Creek Bridge (05-SB-001-15.61) was also lowered because of a recent scour improvement project. Alternatively, the Nojoqui Creek Bridges were both adjusted to Priority 1 as the bridge piles are heavily corroded.

4. DISTRICT ADAPTATION PRIORITIES

This chapter presents Caltrans' priorities for undertaking detailed adaptation assessments of assets exposed to climate change in District 5. The material presented in this chapter reflects the results of the technical analysis and the coordination with District 5 staff described in the previous chapter. The information is broken out by asset type with priorities for bridges discussed in the first section, followed by those for large culverts, small culverts, and roadways.

4.1. Bridges

A total of 251 bridges were assessed for vulnerability to riverine flooding, sea level rise, storm surge, and cliff retreat associated with climate change. All these bridges should eventually undergo detailed adaptation assessments. However, due to resource limitations, this will not be possible to do all at once. Instead, the bridges will be analyzed over time according to the priorities presented here.

PFEIFFER CANYON BRIDGE OPENS AFTER REPAIRS, SR 1 IN MONTEREY COUNTY

Figure 3 provides a map of all the bridges assessed in the district. The color of the points corresponds to the priority assigned to each bridge; darker red colors indicate higher priority assets. The map shows that high priority bridges are scattered throughout the district. District 5 has 50 Priority 1 bridges, located along State Routes (SR) 1, 46, 150, 156, 166, 183, 217, 236, and US 101. Several of these high priority bridges are located along the coastline and are subject to sea level rise, storm surge, and cliff retreat. The bridge on US 101 over Pismo Creek in San Luis Obispo County is the highest priority bridge as it has experienced past riverine flooding impacts, is exposed to near-term sea level rise and storm surge and received a high riverine flood exposure score. The bridges over the Pico Creek, Arroyo de la Cruz, and Arroyo Laguna on SR 1, also in San Luis Obispo County, are also high priority as they have long detours, high traffic volumes, and are subject to near-term sea level rise and storm surge.

Table 4 presents a summary of all the Priority 1 bridges in District 5 sorted by their cross-hazard prioritization scores. A complete listing of all bridges ranked by their prioritization scores appears in Table 8 in the appendix.

TABLE 4: PRIORITY 1 BRIDGES

Priority	Bridge Number	County[32]	Route	Postmile	Feature Crossed	Cross-Hazard Prioritization Score	Priority Override
1	49 0015L	SLO	101 SB	16.4	PISMO CR, N101-PRICE OFF	100.00	
1	49 0239	SLO	1	54.8	PICO CREEK	92.90	
1	49 0056	SLO	1	R66.87	ARROYO DE LA CRUZ	86.72	
1	49 0053	SLO	1	R59.89	ARROYO LAGUNA	84.02	
1	44 0069L	MON	1 SB	R101.98	PAJARO RIVER	81.17	
1	44 0069R	MON	1 NB	R101.98	PAJARO RIVER	81.03	
1	36 0065	SCR	1	36.3	WADDELL CREEK	80.13	
1	36 0031	SCR	1	31.55	SCOTT CREEK	79.95	
1	49 0015R	SLO	101 NB	16.4	PISMO CR, N101-PRICE OFF	79.93	
1	49 0048	SLO	1	56.34	LITTLE PICO CREEK	77.39	
1	36 0011	SCR	1	10.01	APTOS CRK & SPRECKELS DR	74.40	
1	49 0181	SLO	1	30	MORRO CREEK	70.64	
1	49 0055	SLO	1	71.34	SAN CARPOFORO CREEK	70.38	
1	44 0219	MON	1	T91.99	TEMBLADERO SLOUGH	70.12	
1	49 0046	SLO	1	52.92	SAN SIMEON CREEK	68.40	
1	44 0216R	MON	1 NB	R89.19	SALINAS RIVER	67.90	
1	51 0161	SB	217	0.72	GOLETA SLOUGH	67.14	
1	44 0074	MON	1	96.44	ELKHORN SLOUGH	66.70	
1	51 0217	SB	217	1.02	SAN JOSE CREEK	66.61	
1	49 0186	SLO	1	49.89	SANTA ROSA CREEK	63.15	
1	44 0216L	MON	1 SB	R89.18	SALINAS RIVER	63.15	
1	36 0071R	SCR	1 NB	17.41	SAN LORENZO RIVER[33]	62.15	
1	49 0010	SLO	1	15.27	VILLA CREEK	61.86	
1	36 0071L	SCR	1 SB	17.41	SAN LORENZO RIVER[33]	61.48	
1	49 0199	SLO	1	R36.15	CAYUCOS CREEK & ROAD	61.08	
1	51 0273L	SB	101 SB	13.49	GARDEN STREET	60.75	
1	51 0273R	SB	101 NB	13.49	GARDEN STREET	60.55	
1	36 0013	SCR	1	13.31	SOQUEL CREEK, WHARF RD	58.96	
1	49 0068L	SLO	1 SB	32.61	TORO CREEK	57.36	
1	44 0186R	MON	156 EB	R.9	TEMBLADERO SLOUGH	54.95	
1	49 0068R	SLO	1 NB	32.61	TORO CREEK	53.38	
1	44 0014	MON	1	71.18	SAN JOSE CREEK	52.85	
1	49 0249	SLO	1	50.07	SANTA ROSA CREEK	52.46	
1	44 0265	MON	1	72.28	CARMEL RIVER	48.73	

[32] MON = Monterey, SB = Santa Barbara, SBT = San Benito, SCR = Santa Cruz, SLO = San Luis Obispo

[33] The San Lorenzo Bridge was assessed according to its current design. District 5 notes that the San Lorenzo River bridges are being redesigned and will be replaced in the near future.

Priority	Bridge Number	County[32]	Route	Postmile	Feature Crossed	Cross-Hazard Prioritization Score	Priority Override
1	44 0244	MON	1	7.24	HILLSIDE ABOVE OCEAN	38.47	
1	51 0142	SB	150	2.19	RINCON CREEK	38.47	
1	44 0056	MON	1	28.09	BIG CREEK	36.42	
1	44 0036	MON	1	60.05	ROCKY CREEK	36.01	
1	51 0036	SB	166	64.19	BRANCH CANYON	35.80	
1	49 0036	SLO	46	54.77	CHOLAME CREEK	34.96	
1	44 0269	MON	1	21.3	HILLSIDE ABOVE OCEAN	33.58	
1	44 0186L	MON	156 WB	R.9	TEMBLADERO SLOUGH	33.25	
1	36 0006	SCR	236	4.27	BOULDER CREEK	32.10	
1	44 0020	MON	1	56.1	LITTLE SUR RIVER	30.93	
1	49 0002L	SLO	101 SB	49.64	PASO ROBLES CREEK	29.62	
1	36 0090R	SCR	1 NB	R1.35	WATSONVILLE SLOUGH	28.97	
1	36 0090L	SCR	1 SB	R1.35	WATSONVILLE SLOUGH	28.64	
1	44 0024	MON	183	R8.11	TEMBLADERO SLOUGH	28.07	
1	44 0018	MON	1	62.97	GARRAPATA CREEK	27.96	
1	43 0010	SBT	101	4.93	SAN JUAN CREEK	27.93	
1	51 0075R	SB	101 NB	55	NOJOQUI CREEK	23.95	Yes
1	51 0075L	SB	101 SB	55	NOJOQUI CREEK	16.53	Yes

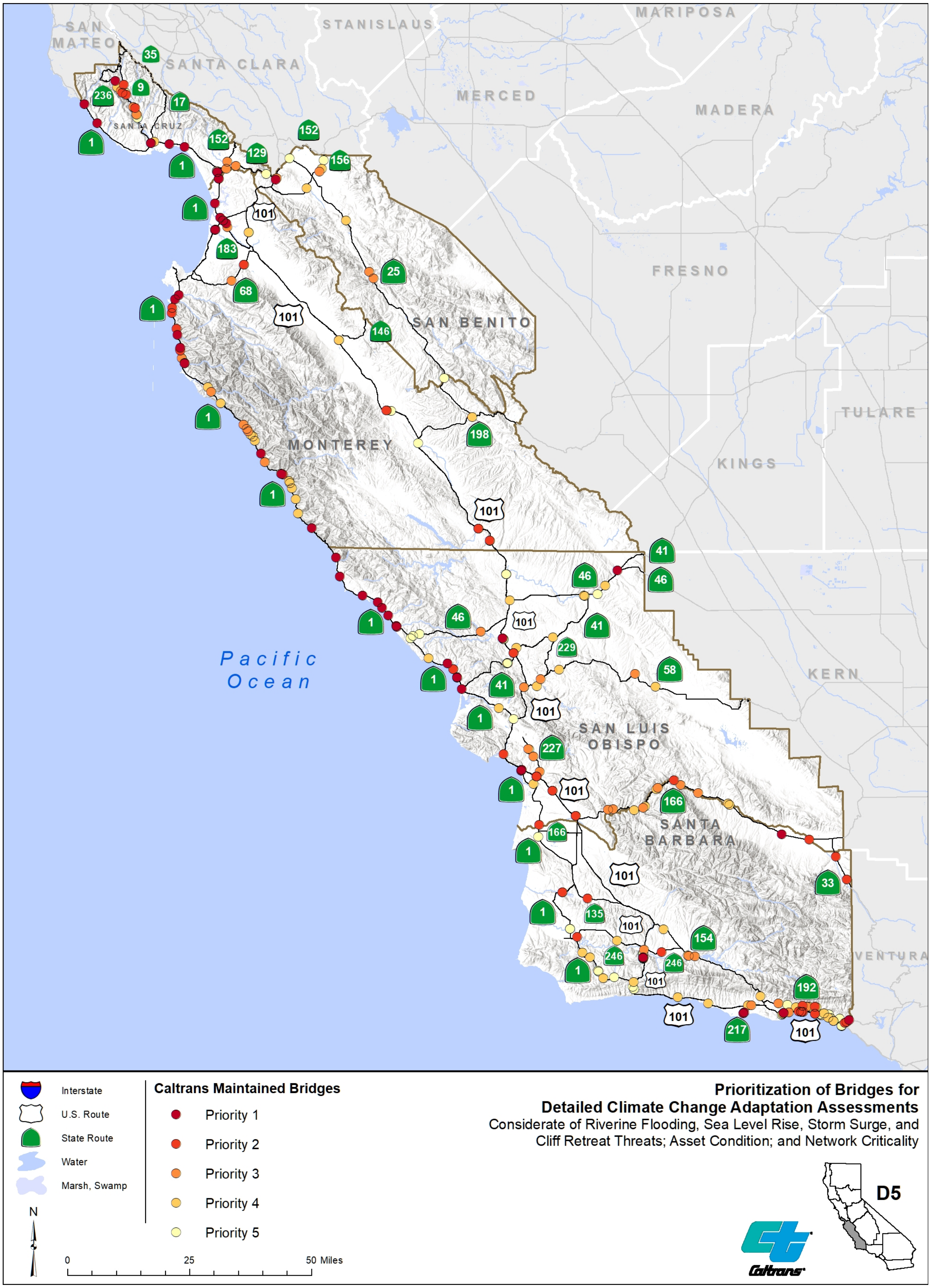

FIGURE 3: PRIORITIZATION OF BRIDGES FOR DETAILED ADAPTATION ASSESSMENTS

4.2. Large Culverts

A total of 21 large culverts were assessed for vulnerability to sea level rise, storm surge, coastal cliff retreat, and more severe riverine flooding associated with climate change. Figure 4 provides a map of all the large culverts potentially exposed to hazards in the district and colored by their priority level. There are four large culverts with the highest priority rating in District 5. The highest priority culvert is on SR 41 over the W Branch of Huer Huero Creek in San Luis Obispo County, where it is exposed to changes in Huer Huero Creek flows associated with climate change.

Table 5 presents the final cross-hazard prioritization scores for the Priority 1 W Branch Huer Huero Creek, Salisbury Canyon, Winchester Creek, and Salsipuedes Creek large culverts. A complete listing of all large culverts ranked by their prioritization scores appears in Table 9 in the appendix.

TABLE 5: PRIORITY 1 LARGE CULVERTS

Priority	Culvert System Number	County[34]	Route	Postmile	Feature Crossed	Cross-Hazard Prioritization Score
1	49 0222	SLO	41	27.74	W BRANCH HUER HUERO CRK	100.00
1	51 0065	SB	166	64.76	SALISBURY CANYON	63.65
1	51 0149	SB	101	27.16	WINCHESTER CREEK	61.86
1	36 0002	SCR	152	R2.06	SALSIPUEDES CREEK	51.11

[34] SB = Santa Barbara, SBT = San Benito, SCR = Santa Cruz, SLO = San Luis Obispo

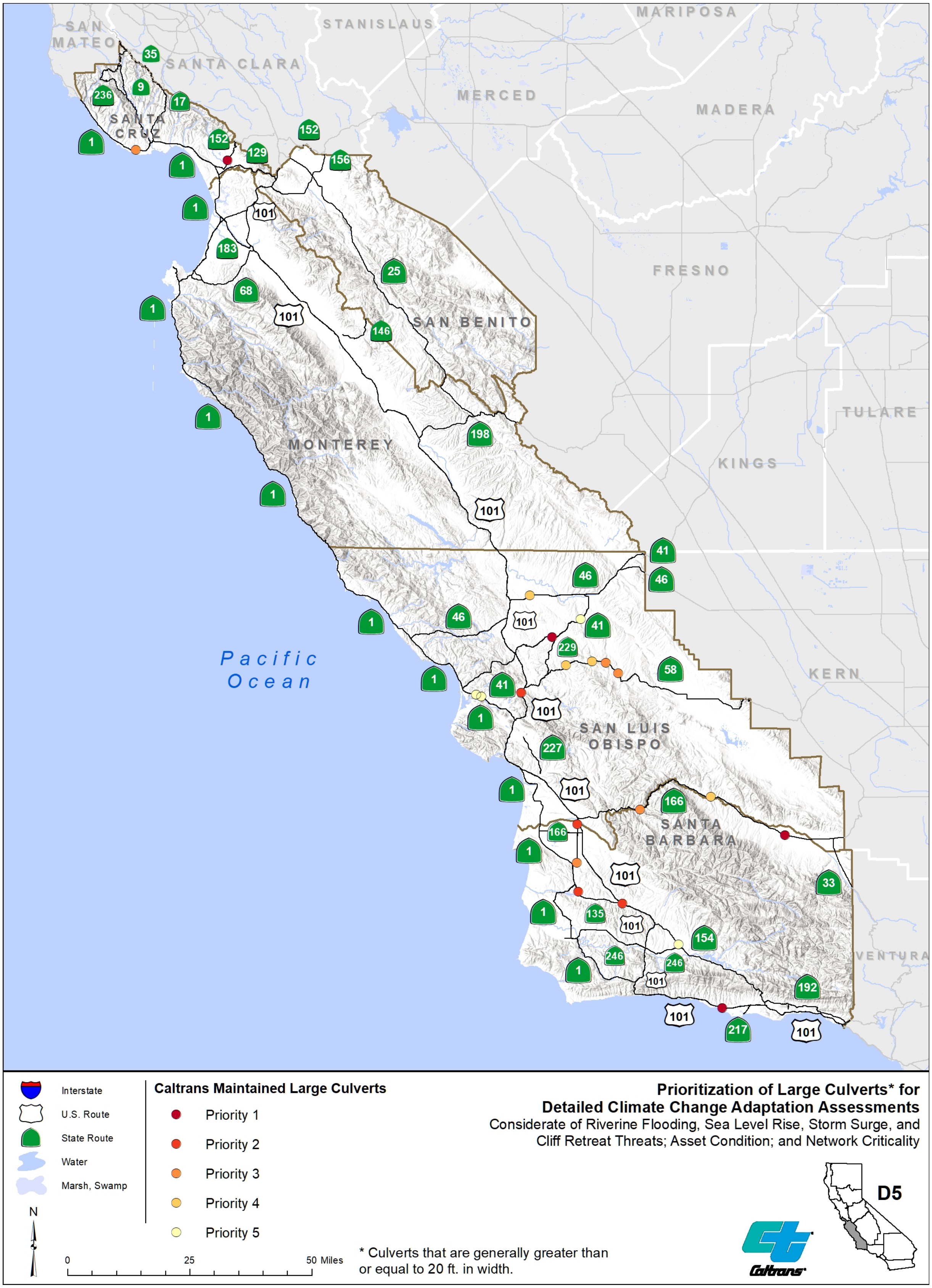

FIGURE 4: PRIORITIZATION OF LARGE CULVERTS FOR DETAILED ADAPTATION ASSESSMENTS

4.3. Small Culverts

A total of 766 small culverts were assessed for vulnerability to sea level rise, storm surge, coastal cliff retreat, wildfire, and riverine flooding associated with climate change. Figure 5 provides a map of all the small culverts evaluated for their exposure to these stressors and associated consequence metrics (asset condition, network redundancy) in the district. The small culverts are colored according to their priority level.

REPAIRS OVERTOPPING ROADWAY WITH TRACTORS ON SR 154 IN SANTA BARBARA COUNTY

There are 153 high priority small culverts in District 5. The map indicates many clusters of high priority small culverts throughout the district. Notable groupings of high priority culverts can be found along SR 1, 25, 46, 58, 68, 154, 166, and the US 101. The highest priority small culvert is on SR 1 in San Luis Obispo County, where it is exposed to near-term sea level rise, storm surge, and cliff retreat. Many of the Priority 1 small culverts are exposed to coastal hazards, which contribute to their high cross-hazard prioritization scores. In addition, significant clusters of small culverts are inland, where they are exposed to wildfire and flooding, in addition to having limited detour routes.

Table 6 presents a summary of all the Priority 1 small culverts in District 5 sorted by their cross-hazard prioritization scores. A complete listing of all small culverts ranked by their prioritization scores appears in Table 10 in the appendix.

TABLE 6: PRIORITY 1 SMALL CULVERTS

Priority	Culvert System Number	County[35]	Route	Postmile	Cross-Hazard Prioritization Score
1	490010006248	SLO	1	62.48	100.00
1	490010006541	SLO	1	65.41	93.82
1	490010106006	SLO	1	60.06	73.71
1	360010003709	SCR	1	37.09	65.53
1	490010005762	SLO	1	57.62	62.93
1	440010000794	MON	1	7.94	61.77
1	360010003745	SCR	1	37.45	61.68
1	440010002740	MON	1	27.4	56.01
1	511010003524	SB	101	35.24	51.75
1	440010006414	MON	1	64.14	51.49
1	440010004863	MON	1	48.63	50.77
1	440010003018	MON	1	30.18	50.30

[35] MON = Monterey, SB = Santa Barbara, SBT = San Benito, SCR = Santa Cruz, SLO = San Luis Obispo

Priority	Culvert System Number	County[35]	Route	Postmile	Cross-Hazard Prioritization Score
1	440010006713	MON	1	67.13	49.75
1	511010003568	SB	101	35.68	49.22
1	490010006203	SLO	1	62.03	49.06
1	490010006493	SLO	1	64.93	48.60
1	440010000890	MON	1	8.9	48.37
1	440010006672	MON	1	66.72	47.63
1	440010000846	MON	1	8.46	47.04
1	440010003584	MON	1	35.84	45.94
1	490010005801	SLO	1	58.01	45.84
1	440010009555	MON	1	95.55	45.65
1	440010006485	MON	1	64.85	45.38
1	440010006590	MON	1	65.9	44.87
1	490010006476	SLO	1	64.76	44.42
1	511540001917	SB	154	19.17	42.58
1	440010006619	MON	1	66.19	41.69
1	440010006018	MON	1	60.18	41.69
1	440010002512	MON	1	25.12	41.54
1	440010000705	MON	1	7.05	41.52
1	511546001991	SB	154	19.91	41.08
1	440010001710	MON	1	17.1	40.83
1	440010004181	MON	1	41.81	40.15
1	440010004088	MON	1	40.88	39.76
1	440010001269	MON	1	12.69	39.59
1	511540001894	SB	154	18.94	38.95
1	511540001777	SB	154	17.77	38.94
1	511540001736	SB	154	17.36	38.75
1	440010001777	MON	1	17.77	38.62
1	440010004355	MON	1	43.55	38.54
1	511540001685	SB	154	16.85	38.07
1	440010005055	MON	1	50.55	37.95
1	440010007048	MON	1	70.48	37.80
1	440010006763	MON	1	67.63	37.61
1	440010006629	MON	1	66.29	37.36
1	440010001986	MON	1	19.86	35.73
1	512176000099	SB	217	0.99	35.28
1	440010005006	MON	1	50.06	35.03
1	511546002570	SB	154	25.7	33.82
1	511016003393	SB	101	33.93	33.41
1	440010002330	MON	1	23.3	32.29
1	440010006953	MON	1	69.53	32.25
1	440010002694	MON	1	26.94	32.04
1	491010103422	SLO	101	34.22	31.96

Priority	Culvert System Number	County[35]	Route	Postmile	Cross-Hazard Prioritization Score
1	511010004072	SB	101	40.72	31.55
1	511544002676	SB	154	26.76	31.38
1	491014003600	SLO	101	36	31.00
1	511016001946	SB	101	19.46	30.74
1	440010005127	MON	1	51.27	30.31
1	490010006742	SLO	1	67.42	30.05
1	440010002266	MON	1	22.66	29.89
1	440010006333	MON	1	63.33	29.19
1	440010006152	MON	1	61.52	29.14
1	430250002140	SBT	25	21.4	29.13
1	491010103407	SLO	101	34.07	29.07
1	511664103561	SB	166	35.61	28.84
1	490464004124	SLO	46	41.24	28.66
1	511012004742	SB	101	47.42	28.44
1	440010003680	MON	1	36.8	28.34
1	511014001232	SB	101	12.32	28.27
1	440010002218	MON	1	22.18	28.09
1	440014003974	MON	1	39.74	28.09
1	430254002713	SBT	25	27.13	28.07
1	440010005673	MON	1	56.73	28.05
1	491014003560	SLO	101	35.6	27.99
1	491664001862	SLO	166	18.62	27.93
1	511540001557	SB	154	15.57	27.90
1	491664001904	SLO	166	19.04	27.84
1	491664001548	SLO	166	15.48	27.61
1	511540002200	SB	154	22	27.56
1	491010103356	SLO	101	33.56	27.54
1	491664001613	SLO	166	16.13	27.50
1	490010006308	SLO	1	63.08	27.44
1	491664004049	SLO	166	40.49	27.38
1	490464100505	SLO	46	5.05	27.37
1	491664004187	SLO	166	41.87	27.35
1	511660102599	SB	166	25.99	27.35
1	430250001405	SBT	25	14.05	27.34
1	511016006305	SB	101	63.05	27.29
1	440010006981	MON	1	69.81	27.27
1	430254002656	SBT	25	26.56	27.21
1	440010000636	MON	1	6.36	27.19
1	440680000682	MON	68	6.82	26.92
1	491660002309	SLO	166	23.09	26.82
1	491010103391	SLO	101	33.91	26.79
1	491010103356	SLO	101	33.56	26.76

Priority	Culvert System Number	County[35]	Route	Postmile	Cross-Hazard Prioritization Score
1	511664103540	SB	166	35.4	26.76
1	430254002263	SBT	25	22.63	26.75
1	490414003446	SLO	41	34.46	26.73
1	511540002128	SB	154	21.28	26.72
1	511010004417	SB	101	44.17	26.63
1	511010003187	SB	101	31.87	26.58
1	490580001229	SLO	58	12.29	26.55
1	490580001266	SLO	58	12.66	26.52
1	491014003236	SLO	101	32.36	26.51
1	440010107811	MON	1	78.11	26.48
1	491664001962	SLO	166	19.62	26.36
1	491664002032	SLO	166	20.32	26.30
1	430254002605	SBT	25	26.05	26.30
1	440010107811	MON	1	78.11	26.29
1	490580002341	SLO	58	23.41	26.23
1	491014003267	SLO	101	32.67	26.15
1	440011207501	MON	1	75.01	26.10
1	491664001503	SLO	166	15.03	26.04
1	491664001595	SLO	166	15.95	26.03
1	491010003745	SLO	101	37.45	25.98
1	511660102730	SB	166	27.3	25.82
1	491014003267	SLO	101	32.67	25.80
1	511010002870	SB	101	28.7	25.76
1	490460003984	SLO	46	39.84	25.68
1	491018005413	SLO	101	54.13	25.63
1	491010004143	SLO	101	41.43	25.61
1	491664004293	SLO	166	42.93	25.61
1	511016003669	SB	101	36.69	25.61
1	490014001973	SLO	1	19.73	25.60
1	511016002986	SB	101	29.86	25.59
1	491014003990	SLO	101	39.9	25.56
1	491014004020	SLO	101	40.2	25.56
1	490584000274	SLO	58	2.74	25.46
1	492290000386	SLO	229	3.86	25.33
1	490584103498	SLO	58	34.98	25.31
1	512464003280	SB	246	32.8	25.30
1	491010003745	SLO	101	37.45	25.22
1	490414003388	SLO	41	33.88	25.20
1	430250001578	SBT	25	15.78	25.19
1	490414003349	SLO	41	33.49	25.18
1	490464100374	SLO	46	3.74	25.13
1	490464100640	SLO	46	6.4	25.09

Priority	Culvert System Number	County[35]	Route	Postmile	Cross-Hazard Prioritization Score
1	430254002746	SBT	25	27.46	25.04
1	490464100510	SLO	46	5.1	24.95
1	490580003662	SLO	58	36.62	24.94
1	440014003786	MON	1	37.86	24.94
1	440680001056	MON	68	10.56	24.93
1	490584003689	SLO	58	36.89	24.92
1	490464100315	SLO	46	3.15	24.92
1	430254000730	SBT	25	7.3	24.83
1	430250002799	SBT	25	27.99	24.81
1	490010001473	SLO	1	14.73	24.77
1	440016107738	MON	1	77.38	24.76
1	440010004405	MON	1	44.05	24.70
1	511660102887	SB	166	28.87	24.67
1	510014102681	SB	1	26.81	24.65
1	441010010095	MON	101	100.95	24.62

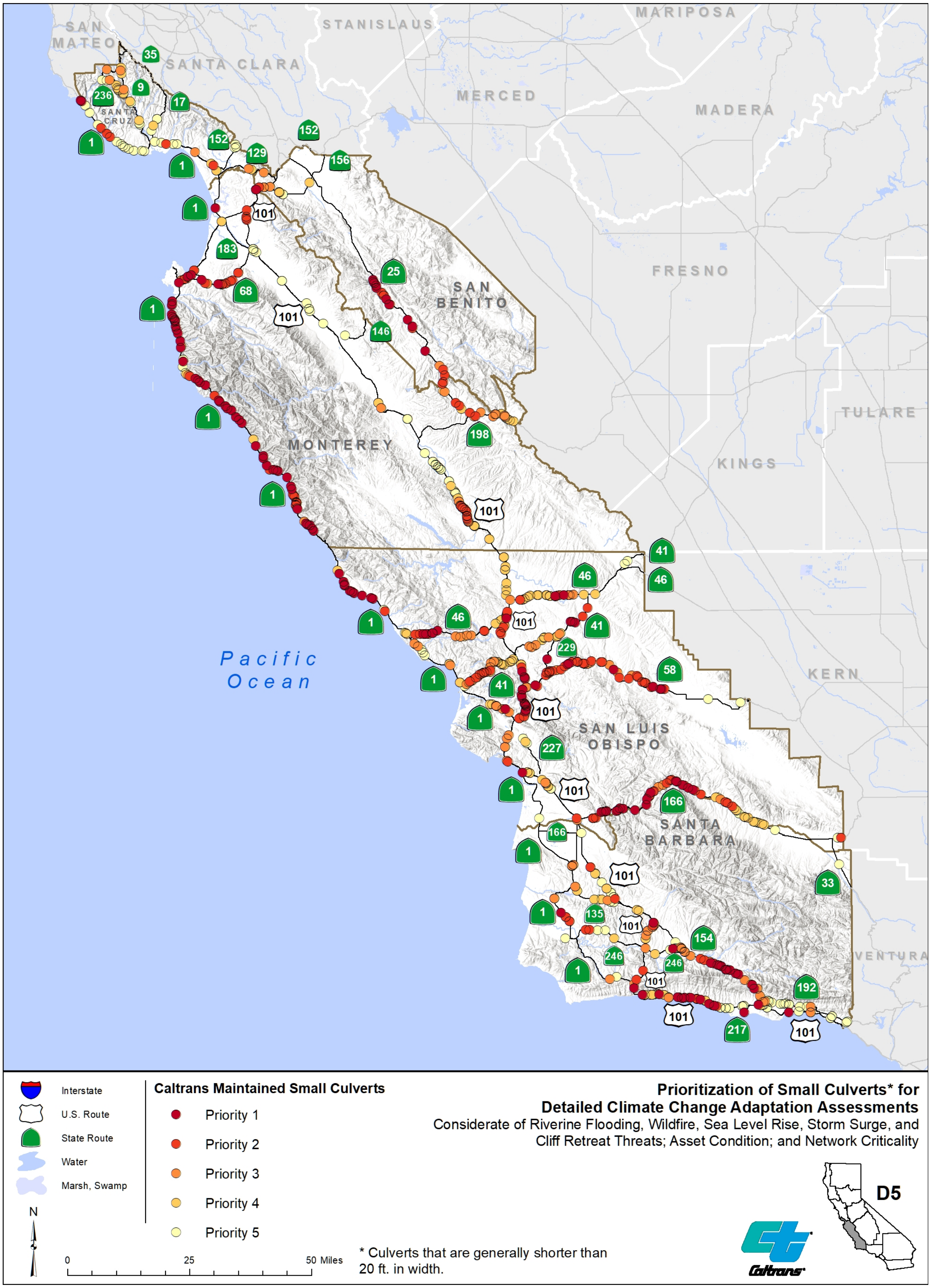

FIGURE 5: PRIORITIZATION OF SMALL CULVERTS FOR DETAILED ADAPTATION ASSESSMENTS

4.4. Roadways

A total of 917 roadway segments were assessed for vulnerability to sea level rise, storm surge, coastal cliff retreat, and temperature changes that affect pavement performance. To make the analysis as detailed as possible, the original segments were short with beginning and end points at intersections with other streets (including smaller local streets) in the roadway network. Once the processing of vulnerability scores was complete, smaller segments sharing the same priority score as their neighbors on the same route were consolidated into longer segments to simplify the presentation of the results. This process brings the total prioritized roadway segments to 219.

REPAIRS AND CLEAN UP AFTER MUDSLIDE ON SR 1 IN MONTEREY COUNTY

Figure 6 provides a map of the entire prioritized roadway segments assessed in District 5. Each segment of roadway is colored by priority level. There are 49 highest priority roadways that are the SR 1, SR 46, SR 33, SR 58, SR 156, SR 166, SR 198, and US 101. These roadways are exposed to sea level rise, storm surge, and cliff retreat along the coast as well as temperature impacts to pavement binder grade along inland routes. The highest priority routes are SR 156, SR 1, and SR 166; these routes are also highly trafficked with long detour routes, which would present greater consequences to users if they were closed.

Table 7 presents a summary of all the Priority 1 roadways in District 5 sorted by their cross-hazard prioritization scores. A complete listing of all roadways ranked by their prioritization scores appears in Table 11 in the appendix.

TABLE 7: PRIORITY 1 ROADWAYS

Priority	County[36]	Route	From Postmile / To Postmile	Carriageway[37]	Average Cross-Hazard Prioritization Score[38]
1	MON	156	156 R0.339 / 156 R1.109	P	59.84
1	SLO	1	1 14.752 / 1 15.119	S	59.62
1	MON	156	156 R0.342 / 156 R0.944	S	55.71
1	MON	1	1 14.715 / 1 20.936	P	53.18
1	MON	1	1 2.82 / 1 13.699	P	53.18
1	MON	1	1 28.065 / 1 28.833	P	53.18
1	MON	1	1 51.175 / 1 52.409	P	53.18
1	MON	1	1 53.839 / 1 58.782	P	53.18
1	MON	1	1 63.071 / 1 63.071	P	53.18
1	MON	1	1 69.665 / 1 71.456	P	53.18
1	MON	1	1 71.74 / 1 73.143	P	53.18
1	MON	1	1 94.134 / 1 96.099	P	53.18
1	MON	1	1 96.36 / 1 97.562	P	53.18
1	MON	1	1 97.6 / 1 98.349	P	53.18
1	SCR	1	1 36.411 / 1 37.45	P	53.18
1	SLO	1	1 14.752 / 1 15.115	P	53.18
1	SLO	1	1 15.202 / 1 15.316	P	53.18
1	SLO	1	1 49.01 / 1 50.121	P	53.18
1	SLO	1	1 55.074 / 1 56.252	P	53.18
1	SLO	1	1 58.248 / 1 63.772	P	53.18
1	SLO	1	1 R65.218 / 1 R67.291	P	53.18
1	SB	166	166 64.421 / 166 73.008	P	50.65
1	SB	166	166 64.3 / 166 64.796	S	50.54
1	SB	166	166 65.146 / 166 65.273	S	50.54
1	SB	166	166 69.073 / 166 69.183	S	50.54
1	MON	198	198 18.379 / 198 25.786	P	50.47
1	VEN	33	33 57.504 / 33 1.943	P	50.47
1	SLO	58	58 52.808 / KER 58 0.001	P	50.44
1	SLO	58	58 D1.351 / KER 58 2.7	P	50.44
1	MON	101	101 51.233 / 101 53.104	S	36.29
1	MON	101	101 53.362 / 101 54.653	S	36.29
1	MON	101	101 57.085 / 101 60.397	S	36.29
1	MON	101	101 R7.955 / 101 R15.467	S	36.29
1	SB	101	101 11.761 / 101 12.421	S	36.29

[36] MON = Monterey, SB = Santa Barbara, SBT = San Benito, SCR = Santa Cruz, SLO = San Luis Obispo
[37] Caltrans' alignment codes designate the carriageway on divided roadways: "P" always represents northbound or eastbound carriageways whereas "S" always represents southbound or westbound carriageways. Undivided roadways are always indicated with a "P".
[38] The average of the cross-hazard prioritization scores amongst all the abutting small segments on the same route sharing a common priority level that were aggregated to form the longer segments listed in this table.

Priority	County[36]	Route	From Postmile / To Postmile	Carriageway[37]	Average Cross-Hazard Prioritization Score[38]
1	SB	101	101 3.643 / 101 R5.3	S	36.29
1	SLO	101	101 51.441 / 101 59.909	S	36.29
1	SLO	101	101 63.74 / 101 67.282	S	36.29
1	MON	101	101 51.225 / 101 53.105	P	36.27
1	MON	101	101 53.359 / 101 54.787	P	36.27
1	MON	101	101 57.079 / 101 60.399	P	36.27
1	MON	101	101 R8.168 / 101 R15.464	P	36.27
1	SB	101	101 12.014 / 101 12.136	P	36.27
1	SB	101	101 3.646 / 101 R5.297	P	36.27
1	SLO	101	101 51.456 / 101 59.909	P	36.27
1	SLO	101	101 63.738 / 101 67.241	P	36.27
1	SLO	46	46 29.761 / 46 40.883	S	34.74
1	SLO	46	46 51.427 / 46 52.834	S	34.74
1	SLO	46	46 29.761 / 46 40.623	P	34.57
1	SLO	46	46 50.852 / 46 55.106	P	34.57

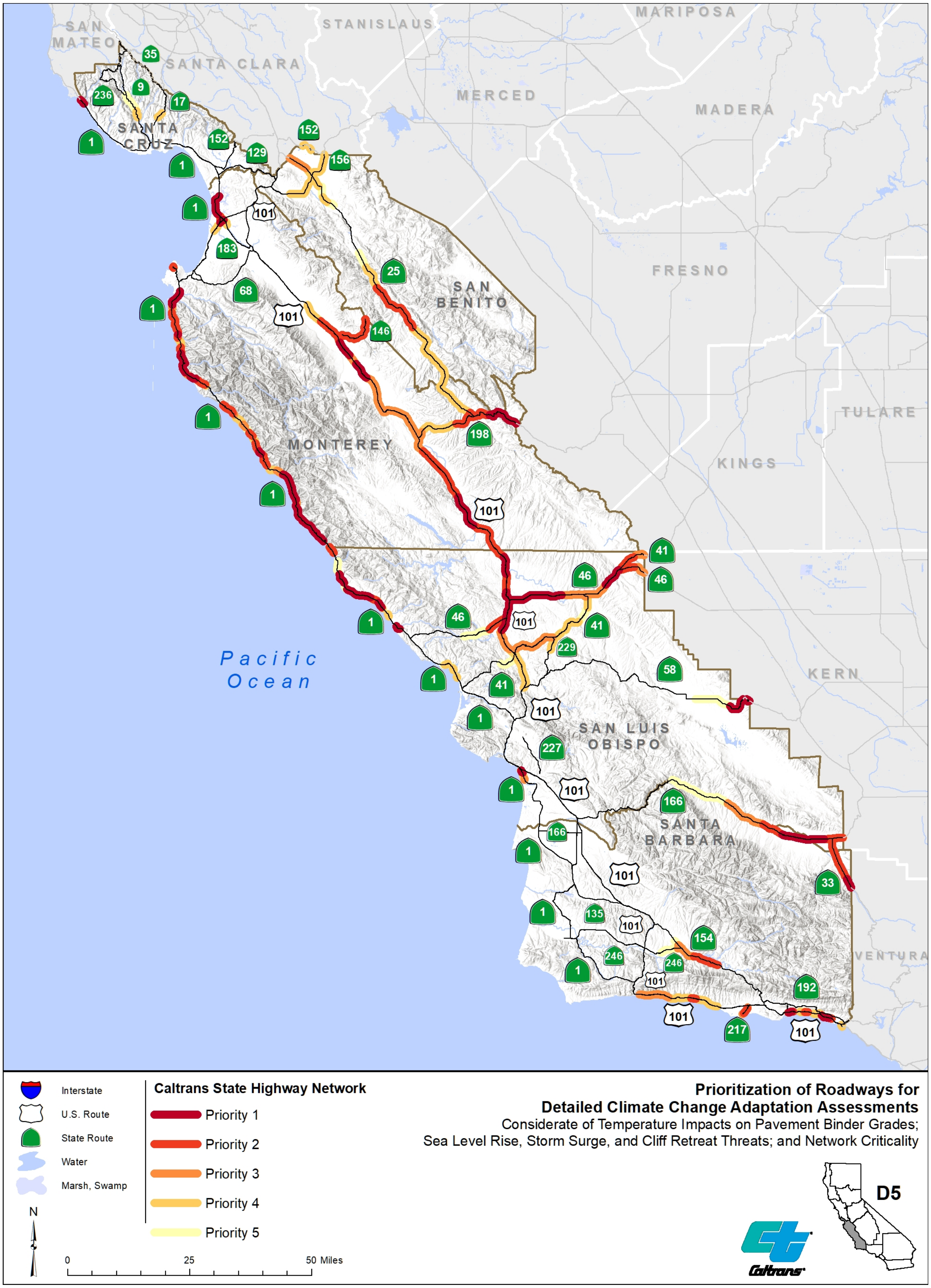

FIGURE 6: PRIORITIZATION OF ROADWAYS FOR DETAILED ADAPTATION ASSESSMENTS

5. NEXT STEPS

This report has identified the bridge, large culvert, small culvert, and roadway assets exposed to a variety of climate hazards in District 5 and assigned them priority levels for detailed assessments based on their vulnerability rating. Caltrans' next step will be to begin undertaking these detailed adaptation assessments for the identified assets starting with the highest priority (Priority 1) assets first and then proceeding to lower priority assets thereafter. These detailed adaptation assessments will take a closer look at the exposure to each asset using more localized climate projections and more detailed engineering analyses. If impacts are verified, Caltrans will develop and evaluate adaptation options for the asset to ensure that it is able to withstand future climate changes. Importantly, the detailed adaptation assessments will include coordination with key stakeholder groups whose actions affect or are affected by the asset and its adaptation. Local and regional agencies in District 5 are developing adaptation plans and Climate Action Plans, which can help further inform the more detailed adaptation analysis of the high priority assets. Some studies, including the Central Coast Highway 1 Climate Resiliency Study, conducted detailed analysis of the potential impacts of sea level rise. This is one of 11 Adaptation Planning Grant funded studies in District 5.

BIXBY CREEK BRIDGE, SR 1 IN MONTEREY COUNTY

Another next step will be to integrate the prioritization measures into the asset management system used in the district. This will ensure that climate change is a consideration in the identification of future projects alongside traditional asset condition metrics. As noted previously, assets identified for capital investments, especially those flagged as being a high priority for climate change, should then undergo detailed climate change assessments prior to project programming. For assets ending their useful life, an asset-level assessment could be incorporated into the planning and design of a replacement asset. Additionally, long-term maintenance plays an important part in managing and protecting these assets.

When conducting facility level assessments, the district should consider any potential changes to long-term scheduled maintenance needed to preserve chosen adaptation strategies. Operations and maintenance strategies can also be evaluated instead, or in addition to, design changes. When evaluating the cost effectiveness of different adaptation strategies, operations and maintenance responses may be more cost-effective for assets with shorter useful lives, or assets nearing the end of their useful life.

VIEW OF MONTECITO DEBRIS FLOW FROM THE OLIVE MILL OVERCROSSING
US 101 IN SANTA BARBARA COUNTY

In addition, district staff can use the results of this study as a tool to facilitate discussions with various important stakeholders in the district about addressing climate change and its impacts. This may include state and federal environmental agencies regional transportation authorities, universities or academic partners, and others. Multi-agency stakeholder coordination and involvement of the private sector is also essential because the impacts from climate change, and ability to effectively address those impacts, cross both jurisdictional and ownership boundaries. For example, Caltrans could increase the size of a culvert to accommodate higher stormwater and debris flows while the more cost-effective solution may be better land management in the adjacent drainage area. The approach to climate change cannot just be Caltrans-centric. A common framework across all state agencies and key stakeholders must be established for truly effective long-term solutions to be achieved.

Caltrans District 5 has already begun funding and working with cities and counties on updating planning efforts in coastal areas and community plans to reflect increasing climate impacts and extreme weather conditions. Plans such as the Monterey County Local Coastal Program, Moss Landing Community Plan[39], and the corresponding Coastal Implementation Plan are currently being updated to improve and enhance the coastal community while conserving natural and cultural resources and providing public access and public recreation opportunities.[40] This plan is being prepared with the input and assistance from the community, stakeholders, planning, and environmental consultants and associated agencies. Santa Barbara County is similarly planning for future changes to Goleta Beach County Park in relation to sea level rise, coastal erosion, and the potential need to redesign, relocate, or remove park facilities due to sea level rise and storm-related projected increasing damage to the park overtime. The Goleta Beach Adaptive Plan Update and SR 217 Plan outlines the protection of essential local- and regional-serving utilities, State Route 217, regional access to UCSB, California Coastal Trail/Obern Regional Bike Path, and the Santa Barbara Airport.[41] In 2018 the City of Morro Bay prepared the Sea Level Rise Adaptation Strategy Report, which investigated the potential impacts of sea level rise on a 1,700-foot stretch of SR 1 in the northern portion of the city.[42]

Caltrans District 5 looks forward to continuing on-the-ground climate adaptation planning efforts and undertaking its own asset-level adaptation assessments of vulnerable assets or corridors on the State Highway System. These detailed assessments at priority locations will lead to actionable adaptation strategies that improve the State Highway System.

[39] Moss Landing Community Plan, Draft November 2020, https://www.co.monterey.ca.us/home/showpublisheddocument?id=97823
[40] County of Monterey, Resource Management Agency, Planning "Ordinances and Plans Under Development," https://www.co.monterey.ca.us/government/departments-i-z/resource-management-agency-rma-/planning/ordinances-plans-under-development
[41] Santa Barbara County Parks, https://www.countyofsb.org/parks/home.c
[42] City of Morro Bay, Sea Level Rise Adaptation Strategy Report, http://www.morro-bay.ca.us/DocumentCenter/View/11753/Sea-Level-Rise-Adaptation-Report-January-2018

6. APPENDIX

TABLE 8: PRIORITIZATION OF BRIDGES FOR DETAILED CLIMATE CHANGE ADAPTATION ASSESSMENTS

Priority	Bridge Number	County[43]	Route	Postmile	Feature Crossed	Cross-Hazard Prioritization Score	Priority Override
1	49 0015L	SLO	101 SB	16.4	PISMO CR, N101-PRICE OFF	100.00	
1	49 0239	SLO	1	54.8	PICO CREEK	92.90	
1	49 0056	SLO	1	R66.87	ARROYO DE LA CRUZ	86.72	
1	49 0053	SLO	1	R59.89	ARROYO LAGUNA	84.02	
1	44 0069L	MON	1 SB	R101.98	PAJARO RIVER	81.17	
1	44 0069R	MON	1 NB	R101.98	PAJARO RIVER	81.03	
1	36 0065	SCR	1	36.3	WADDELL CREEK	80.13	
1	36 0031	SCR	1	31.55	SCOTT CREEK	79.95	
1	49 0015R	SLO	101 NB	16.4	PISMO CR, N101-PRICE OFF	79.93	
1	49 0048	SLO	1	56.34	LITTLE PICO CREEK	77.39	
1	36 0011	SCR	1	10.01	APTOS CRK & SPRECKELS DR	74.40	
1	49 0181	SLO	1	30	MORRO CREEK	70.64	
1	49 0055	SLO	1	71.34	SAN CARPOFORO CREEK	70.38	
1	44 0219	MON	1	T91.99	TEMBLADERO SLOUGH	70.12	
1	49 0046	SLO	1	52.92	SAN SIMEON CREEK	68.40	
1	44 0216R	MON	1 NB	R89.19	SALINAS RIVER	67.90	
1	51 0161	SB	217	0.72	GOLETA SLOUGH	67.14	
1	44 0074	MON	1	96.44	ELKHORN SLOUGH	66.70	
1	51 0217	SB	217	1.02	SAN JOSE CREEK	66.61	
1	49 0186	SLO	1	49.89	SANTA ROSA CREEK	63.15	
1	44 0216L	MON	1 SB	R89.18	SALINAS RIVER	63.15	
1	36 0071R	SCR	1 NB	17.41	SAN LORENZO RIVER[44]	62.15	
1	49 0010	SLO	1	15.27	VILLA CREEK	61.86	
1	36 0071L	SCR	1 SB	17.41	SAN LORENZO RIVER[44]	61.48	
1	49 0199	SLO	1	R36.15	CAYUCOS CREEK & ROAD	61.08	
1	51 0273L	SB	101 SB	13.49	GARDEN STREET	60.75	
1	51 0273R	SB	101 NB	13.49	GARDEN STREET	60.55	
1	36 0013	SCR	1	13.31	SOQUEL CREEK, WHARF RD	58.96	
1	49 0068L	SLO	1 SB	32.61	TORO CREEK	57.36	
1	44 0186R	MON	156 EB	R.9	TEMBLADERO SLOUGH	54.95	
1	49 0068R	SLO	1 NB	32.61	TORO CREEK	53.38	
1	44 0014	MON	1	71.18	SAN JOSE CREEK	52.85	

[43] MON = Monterey, SB = Santa Barbara, SBT = San Benito, SCR = Santa Cruz, SLO = San Luis Obispo

[44] The San Lorenzo Bridge was assessed according to its current design. District 5 notes that the San Lorenzo River bridges are being redesigned and will be replaced in the near future.

Priority	Bridge Number	County[43]	Route	Postmile	Feature Crossed	Cross-Hazard Prioritization Score	Priority Override
1	49 0249	SLO	1	50.07	SANTA ROSA CREEK	52.46	
1	44 0265	MON	1	72.28	CARMEL RIVER	48.73	
1	44 0244	MON	1	7.24	HILLSIDE ABOVE OCEAN	38.47	
1	51 0142	SB	150	2.19	RINCON CREEK	38.47	
1	44 0056	MON	1	28.09	BIG CREEK	36.42	
1	44 0036	MON	1	60.05	ROCKY CREEK	36.01	
1	51 0036	SB	166	64.19	BRANCH CANYON	35.80	
1	49 0036	SLO	46	54.77	CHOLAME CREEK	34.96	
1	44 0269	MON	1	21.3	HILLSIDE ABOVE OCEAN	33.58	
1	44 0186L	MON	156 WB	R.9	TEMBLADERO SLOUGH	33.25	
1	36 0006	SCR	236	4.27	BOULDER CREEK	32.10	
1	44 0020	MON	1	56.1	LITTLE SUR RIVER	30.93	
1	49 0002L	SLO	101 SB	49.64	PASO ROBLES CREEK	29.62	
1	36 0090R	SCR	1 NB	R1.35	WATSONVILLE SLOUGH	28.97	
1	36 0090L	SCR	1 SB	R1.35	WATSONVILLE SLOUGH	28.64	
1	44 0024	MON	183	R8.11	TEMBLADERO SLOUGH	28.07	
1	44 0018	MON	1	62.97	GARRAPATA CREEK	27.96	
1	43 0010	SBT	101	4.93	SAN JUAN CREEK	27.93	
1	51 0075R	SB	101 NB	55	NOJOQUI CREEK	23.95	Yes
1	51 0075L	SB	101 SB	55	NOJOQUI CREEK	16.53	Yes
2	51 0144	SB	33	1.84	QUATAL CANYON	25.89	
2	51 0317	SB	150	R1.55	RINCON CREEK	25.67	
2	49 0175R	SLO	101 NB	13.02	ARROYO GRANDE CREEK	25.20	
2	49 0175L	SLO	101 SB	13.02	ARROYO GRANDE CREEK	24.91	
2	51 0006	SB	135	R7.22	SAN ANTONIO CREEK	24.89	
2	51 0133	SB	101	9.66	OAK CREEK	24.24	
2	51 0128	SB	246	9.82	SANTA YNEZ RIVER	24.04	
2	44 0019	MON	1	59.37	BIXBY CREEK	23.89	
2	51 0041	SB	166	R34.95	CUYAMA RIVER	23.80	
2	51 0109	SB	192	R9.68	SAN YSIDRO CREEK	23.65	
2	51 0316	SB	150	1.09	RINCON CREEK	23.56	
2	49 0042	SLO	1	0.01	SANTA MARIA RIVER	23.39	
2	36 0054	SCR	9	15.49	KINGS CREEK[45]	23.01	
2	49 0118R	SLO	101 NB	1.36	NIPOMO CREEK	23.00	
2	44 0058	MON	1	20.95	LIMEKILN CREEK	22.92	
2	49 0014R	SLO	101 NB	R21.49	SAN LUIS OBISPO CREEK	22.82	
2	51 0130	SB	246	30.32	ALAMO PINTADO CREEK	22.62	
2	51 0053	SB	101	9.34	ROMERO CREEK	22.57	

[45] The Kings Creek Bridge was assessed according to its current design. District 5 notes that the Kings Creek Bridge is being redesigned and will be replaced in the near future.

Priority	Bridge Number	County[43]	Route	Postmile	Feature Crossed	Cross-Hazard Prioritization Score	Priority Override
2	44 0141R	MON	101 NB	R6.66	SAN ANTONIO RIVER & DR	22.00	
2	51 0047	SB	101	9.56	SAN YSIDRO CREEK	21.98	
2	44 0012	MON	1	64.33	GRANITE CANYON	21.95	
2	51 0187	SB	101	10.18	MONTECITO CREEK	21.93	
2	36 0051	SCR	9	13.11	BOULDER CREEK	21.91	
2	51 0066	SB	166	R69.94	CUYAMA RIVER	21.91	
2	44 0141L	MON	101 SB	R6.66	SAN ANTONIO RIVER & DR	21.89	
2	51 0237R	SB	1 NB	M33.1	SAN ANTONIO CREEK	21.84	
2	44 0017	MON	1	67.85	MALPASO CREEK	21.77	
2	49 0018R	SLO	101 NB	8.52	LOS BERROS CREEK	21.49	
2	51 0145	SB	33	7.05	BALLINGER CANYON	21.48	
2	51 0111	SB	192	12.14	TORO CREEK	21.39	
2	44 0139R	MON	101 NB	R2.43	NACIMIENTO RIVER	21.21	
2	36 0048	SCR	9	9.33	SAN LORENZO RIVER[44]	21.11	
2	49 0118L	SLO	101 SB	1.36	NIPOMO CREEK	20.91	
2	36 0010	SCR	236	1.03	BOULDER CREEK	20.76	
2	49 0018L	SLO	101 SB	8.52	LOS BERROS CREEK	19.94	
2	49 0070L	SLO	1 SB	34.46	OLD CREEK	19.79	
2	49 0151L	SLO	101 SB	45.72	ATASCADERO CREEK	19.73	
2	49 0151R	SLO	101 NB	45.72	ATASCADERO CREEK	19.71	
2	44 0040R	MON	68 EB	R17.69	SALINAS RIVER	19.66	
2	51 0054R	SB	101 NB	R6.79	TORO CREEK	19.65	
2	44 0016	MON	1	69.02	WILDCAT CREEK	19.22	
2	51 0054L	SB	101 SB	R6.79	TORO CREEK	19.20	
2	44 0032R	MON	101 NB	R41.36R	SALINAS RIVER	18.99	
3	44 0032L	MON	101 SB	R41.36L	SALINAS RIVER	18.94	
3	51 0221R	SB	101 NB	R56.64	SANTA YNEZ RIVER	18.87	
3	49 0110	SLO	227	1.43	CORBETT CANYON CREEK	18.81	
3	43 0015	SBT	25	R30.05	SAN BENITO RIVER	17.93	
3	36 0050	SCR	9	9.85	MARSHALL CREEK	17.18	
3	43 0014	SBT	25	28.23	WILLOW CREEK	17.02	
3	49 0002R	SLO	101 NB	49.64	PASO ROBLES CREEK	16.71	
3	44 0267	MON	1	34.24	BURNS CREEK	16.31	
3	36 0040	SCR	129	2.56	COWARD CREEK	16.31	
3	36 0034	SCR	129	0.56	SALSIPUEDES CREEK	16.04	
3	51 0237L	SB	1 SB	M33.1	SAN ANTONIO CREEK	15.81	
3	51 0121	SB	154	R11.51	SAN LUCAS CREEK	15.49	
3	49 0070R	SLO	1 NB	34.46	OLD CREEK	15.29	
3	49 0204	SLO	227	R7.34	WEST CORRAL DE PIEDRA CR	15.11	
3	51 0332	SB	101	12.3	SYCAMORE CREEK	14.89	

Priority	Bridge Number	County[43]	Route	Postmile	Feature Crossed	Cross-Hazard Prioritization Score	Priority Override
3	44 0040L	MON	68 WB	R17.69	SALINAS RIVER	14.72	
3	44 0254	MON	1	57.59	HILLSIDE	14.65	
3	44 0295	MON	1	59.9	HILLSIDE	14.65	
3	51 0162L	SB	101 SB	20.95	MARIA YGNACIO CREEK	14.61	
3	36 0046	SCR	9	7.76	SAN LORENZO RIVER[44]	14.50	
3	36 0001	SCR	152	1.94	CORRALITOS CREEK	14.41	
3	36 0009	SCR	236	1.61	BOULDER CREEK	14.37	
3	49 0179	SLO	166	17.73	ALAMO CREEK	14.20	
3	44 0139L	MON	101 SB	R2.43	NACIMIENTO RIVER	13.95	
3	44 0023	MON	183	R7.3	ESPINOSA SLOUGH	13.83	
3	51 0105	SB	192	3.36	MISSION CREEK	13.58	
3	44 0251	MON	1	56.25	HILLSIDE	13.10	
3	51 0056	SB	166	R24.99	MIRANDA PINE CREEK	12.72	
3	49 0178	SLO	166	16.45	HUASNA RIVER	12.61	
3	44 0049	MON	1	35.35	ANDERSON CANYON	12.53	
3	51 0079	SB	154	R10.12	SANTA INEZ RIVER	12.48	
3	43 0045	SBT	156	R13.43	SANTA ANA CREEK	12.41	
3	44 0051	MON	1	R33.67	BUCK CREEK	12.40	
3	51 0042	SB	192	10.53	BUENA VISTA CREEK	12.31	
3	49 0112	SLO	227	5.26	EAST FORK PISMO CREEK	12.03	
3	49 0105	SLO	46	R15.85	JACK CREEK (PSO RBLS CR)	11.97	
3	43 0004L	SBT	101 SB	5.21	SAN BENITO RIVER	11.69	
3	49 0153L	SLO	101 SB	37.99	SANTA MARGARITA CREEK	11.29	
3	51 0219	SB	166	R30.73	CUYAMA RIVER	11.06	
3	49 0257	SLO	166	40.11	GIFFORD CREEK	11.03	
3	44 0057	MON	1	R25.89	VICENTE CREEK	10.91	
3	49 0041	SLO	166	44.26	CARRIZO CREEK	10.75	
3	44 0021	MON	1	46.6	BIG SUR RIVER	10.39	
3	49 0170	SLO	58	R29.92	NAVAJO CREEK	10.35	
3	49 0237	SLO	58	4.89	SALINAS RIVER	10.29	
3	44 0264	MON	68	13.3	EL TORRO CREEK	10.27	
4	51 0095	SB	1	15.61	SALSIPUEDES CREEK	24.55	Yes
4	51 0110	SB	192	10.96	ROMERO CANYON CREEK	24.16	Yes
4	51 0052L	SB	101 SB	2.44	CARPINTERIA CREEK	23.56	Yes
4	51 0052R	SB	101 NB	2.44	CARPINTERIA CREEK	23.01	Yes
4	51 0108	SB	192	8.12	MONTECITO CREEK	19.74	Yes
4	51 0112	SB	192	12.49	TORO CANYON CREEK	19.18	Yes
4	51 0113	SB	192	15.52	ARROYO PARIDA	15.58	Yes
4	49 0091	SLO	58	3.08	TROUT CREEK	10.23	Yes
4	49 0251	SLO	58	9.94	MIDLE FORK HUER HUERO CR	10.17	

Priority	Bridge Number	County[43]	Route	Postmile	Feature Crossed	Cross-Hazard Prioritization Score	Priority Override
4	44 0054	MON	1	31.17	DOLAN CREEK	10.05	
4	44 0052	MON	1	32.81	HOT SPRINGS CREEK	10.01	
4	51 0033L	SB	101 SB	30.07	DOS PUEBLOS CRK & CYN RD	9.79	
4	44 0061	MON	1	18.91	KIRK CREEK	9.48	
4	49 0180	SLO	166	22.86	CUYAMA RIVER	9.44	
4	49 0043	SLO	166	R51.02	CUYAMA RIVER	9.17	
4	51 0233	SB	166	R25.49	ALISO CREEK	9.14	
4	51 0059	SB	166	R51.41	COTTONWOOD CREEK	9.12	
4	36 0061	SCR	1	16.49	CARBONERA CREEK	9.08	
4	44 0002L	MON	101 SB	60.75	SALINAS RIVER	8.98	
4	44 0053	MON	1	32.25	LIME CREEK	8.93	
4	51 0215R	SB	101 NB	R36.62	REFUGIO ROAD	8.90	
4	44 0063	MON	1	17.32	WILD CATTLE CREEK	8.90	
4	44 0068	MON	1	47.98	JUAN HIGUERA CREEK	8.80	
4	44 0002R	MON	101 NB	60.75	SALINAS RIVER	8.71	
4	44 0035	MON	1	43.12	CASTRO CANYON	8.68	
4	49 0073	SLO	1	40.29	VILLA CREEK	8.65	
4	43 0044	SBT	156	R8.45	SAN BENITO RIVER	8.58	
4	49 0019	SLO	1	10.94	ARROYO GRANDE CREEK	8.57	
4	49 0219	SLO	41	R16.94	SALINAS R,UP RR,SYCAMORE	8.39	
4	51 0163L	SB	101 SB	21.62	SAN JOSE CREEK	7.75	
4	51 0076	SB	154	R2.55	ALAMO PINTADO CREEK	7.64	
4	51 0078	SB	154	R9.97	SANTA AGUEDA CREEK	7.60	
4	49 0098	SLO	58	35.49	SAN JUAN CREEK	7.44	
4	51 0240R	SB	1 NB	R.16	GAVIOTA CREEK	7.42	
4	44 0064	MON	1	14.93	PREWITT CREEK	7.35	
4	51 0139	SB	246	R20.22	SANTA ROSA CREEK	7.33	
4	51 0276R	SB	101 NB	13.79	STATE STREET	7.32	
4	51 0020R	SB	101 NB	54.71	NOJOQUI CREEK	7.27	
4	51 0276L	SB	101 SB	13.79	STATE STREET	7.27	
4	51 0094	SB	1	13.34	EL JARO CREEK	7.20	
4	51 0074L	SB	101 SB	54.85	NOJOQUI CREEK	7.18	
4	49 0104	SLO	41	28.05	HUER HUERO CREEK	7.18	
4	49 0264	SLO	41	R41.7	ESTRELLA RIVER	7.07	
4	44 0066	MON	1	11.67	WILLOW CREEK	6.77	
4	43 0009	SBT	156	R15.43	TEQUISQUITA SLOUGH	6.49	
4	43 0017	SBT	25	42.42	TRES PINOS CREEK	6.37	
4	51 0218	SB	166	R30.37	CUYAMA RIVER	6.34	
4	36 0007	SCR	236	2.86	BOULDER CREEK	6.30	
4	49 0035	SLO	46	29.8	SALINAS RIVER, RIVER RD	6.25	

Priority	Bridge Number	County[43]	Route	Postmile	Feature Crossed	Cross-Hazard Prioritization Score	Priority Override
4	49 0063	SLO	1	21.14	KERN AVE, CHORRO CREEK	6.23	
4	51 0090	SB	1	R6.78	EL JARO CREEK	6.19	
4	51 0084	SB	154	30.21	SAN ANTONIO CREEK	6.17	
4	49 0265	SLO	41	R41.96	MCMILLAN CANYON CREEK	6.06	
4	44 0062	MON	1	18.46	MILL CREEK	5.94	
4	51 0050R	SB	101 NB	3.77	SANTA MONICA CREEK	5.90	
4	44 0030	MON	198	R13.77	SAN LORENZO CREEK	5.83	
4	49 0029	SLO	46	50.66	CHOLAME CREEK	5.79	
4	44 0175R	MON	101 NB	R91.29	LITTLE BEAR CREEK	5.69	
5	49 0001L	SLO	101 SB	63.57	SAN MARCOS CREEK	11.10	Yes
5	49 0001R	SLO	101 NB	63.57	SAN MARCOS CREEK	10.99	Yes
5	44 0175L	MON	101 SB, S 101 OFF	R91.27	LITTLE BEAR CREEK	5.69	
5	49 0205	SLO	46	R.18	PERRY CREEK	5.67	
5	43 0001	SBT	25	60.04	PAJARO RIVER	5.66	
5	51 0163R	SB	101 NB	21.62	SAN JOSE CREEK	5.60	
5	51 0097R	SB	1 NB	22.52	SANTA YNEZ RIVER	5.59	
5	49 0003L	SLO	101 SB	49.4	GRAVES CREEK	5.55	
5	49 0103	SLO	227	7.1	EAST CORRAL DE PIEDRA CR	5.54	
5	44 0179R	MON	101 NB	R40.42	SAN LORENZO CREEK	5.52	
5	51 0097L	SB	1 SB	22.52	SANTA YNEZ RIVER	5.48	
5	49 0153R	SLO	101 NB	37.99	SANTA MARGARITA CREEK	5.47	
5	49 0003R	SLO	101 NB	49.4	GRAVES CREEK	5.44	
5	51 0092	SB	1	10.11	YTIAS CREEK	5.43	
5	44 0263	MON	25	11.73	LEWIS CREEK	5.35	
5	44 0177L	MON	101 SB	R30.8	SALINAS RIVER	5.25	
5	49 0123	SLO	1	17.05	STENNER CREEK	5.24	
5	36 0052	SCR	9	13.61	SAN LORENZO RIVER[44]	5.23	
5	51 0018L	SB	101 SB	56	NOJOQUI CREEK	5.22	
5	49 0206	SLO	46	R.89	GREEN VALLEY CREEK	5.16	
5	51 0115	SB	192	R19.09	CARPINTERIA CREEK	5.05	
5	51 0023L	SB	101 SB	47.9	GAVIOTA CREEK	4.99	
5	49 0207	SLO	46	R2.32	BRANCH GREEN VALLEY CRK	4.76	
5	51 0051L	SB	101 SB	3.3	FRANKLIN CREEK	4.74	
5	44 0290	MON	1	21.5	HILLSIDE	4.71	
5	51 0051R	SB	101 NB	3.3	FRANKLIN CREEK	4.68	
5	49 0095	SLO	46	48.32	CHOLAME CREEK	4.59	
5	51 0229L	SB	101 SB	R.26	UP RR & AMTRAK	4.59	
5	51 0277L	SB	101 SB	13.96	MISSION CREEK	4.57	

Priority	Bridge Number	County[43]	Route	Postmile	Feature Crossed	Cross-Hazard Prioritization Score	Priority Override
5	51 0103	SB	1	47.91	SOLOMON CANYON CREEK	4.43	
5	36 0049	SCR	9	9.71	SAN LORENZO RIVER[44]	4.41	
5	51 0024L	SB	101 SB	47.23	GAVIOTA CREEK	4.32	
5	51 0019R	SB	101 NB	55.66	NOJOQUI CREEK	4.32	
5	51 0091	SB	1	9.89	EL JARO CREEK	4.15	
5	51 0018R	SB	101 NB	56	NOJOQUI CREEK	4.08	
5	36 0045	SCR	9	7.01	FALL CREEK	3.82	
5	51 0150	SB	1	R4.38	EL JARO CREEK	3.73	
5	51 0228R	SB	101 NB	R5.28	SOUTH PADARO LANE	3.55	
5	51 0114	SB	192	16.57	SANTA MONICA CANYON	3.51	
5	51 0228L	SB	101 SB	R5.28	SOUTH PADARO LANE	3.50	
5	43 0012	SBT	156	R17.28	PACHECO CREEK	2.98	
5	51 0106	SB	192	5.98	SYCAMORE CANYON CREEK	2.92	
5	49 0049	SLO	41	13.05	ATASCADERO CREEK	2.67	
5	36 0088R	SCR	1 NB	R1.59	STRUVE SLOUGH	2.66	
5	49 0050	SLO	41	13.18	ATASCADERO CREEK	2.63	
5	49 0051	SLO	41	13.29	ATASCADERO CREEK	2.62	
5	51 0049L	SB	101 SB	R5.63	ARROYO PARIDA	2.34	
5	36 0047	SCR	9	7.87	SAN LORENZO RIVER[44]	2.20	
5	43 0013	SBT	129	0.01	PAJARO RIVER	2.17	
5	51 0049R	SB	101 NB	R5.63	ARROYO PARIDA	1.82	
5	36 0088L	SCR	1 SB	R1.59	STRUVE SLOUGH	0.00	
5	51 0229R	SB	101 NB	R.25	UP RR & AMTRAK	0.00	

TABLE 9: PRIORITIZATION OF LARGE CULVERTS FOR DETAILED CLIMATE CHANGE ADAPTATION ASSESSMENTS

Priority	Culvert System Number	County[46]	Route	Postmile	Feature Crossed	Cross-Hazard Prioritization Score
1	49 0222	SLO	41	27.74	W BRANCH HUER HUERO CRK	100.00
1	51 0065	SB	166	64.76	SALISBURY CANYON	63.65
1	51 0149	SB	101	27.16	WINCHESTER CREEK	61.86
1	36 0002	SCR	152	R2.06	SALSIPUEDES CREEK	51.11
2	51 0244	SB	135	M9.98	HARRIS CANYON CREEK	44.92
2	49 0007	SLO	101	36.58	SANTA MARGARITA CREEK	39.41
2	51 0067	SB	101	70.99	SAN ANTONIO CREEK	34.16
2	51 0238	SB	135	17.55	BRADLEY CHANNEL	32.23
3	51 0251	SB	135	R10.37	ORCUTT CREEK	29.78
3	36 0080	SCR	1	21.51	MEDER CREEK	21.22
3	51 0055	SB	166	R24.07	BUCKHORN CREEK	18.81
3	49 0169	SLO	58	24.54	CAMMATTI CREEK	18.71
3	49 0168	SLO	58	21	FERNANDEZ CREEK	16.81
4	49 0233	SLO	166	46.84	RED ROCK CANYON CREEK	16.03
4	49 0172	SLO	58	11.78	EAST FORK HUER HUERO CRK	15.79
4	49 0167	SLO	58	17.73	INDIAN CREEK	10.24
4	49 0138	SLO	46	34.14	DRY CREEK	7.96
5	49 0223	SLO	41	35.82	SHEDD CANYON	7.14
5	51 0267	SB	154	R6.94	BRANCH COTA CREEK	4.39
5	49 0064	SLO	1	25.71	SAN LUISITO CREEK	1.69
5	49 0066	SLO	1	26.86	SAN BERNARDO CREEK	0.00

[46] MON = Monterey, SB = Santa Barbara, SBT = San Benito, SCR = Santa Cruz, SLO = San Luis Obispo

TABLE 10: PRIORITIZATION OF SMALL CULVERTS FOR DETAILED CLIMATE CHANGE ADAPTATION ASSESSMENTS

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
1	490010006248	SLO	1	62.48	100.00
1	490010006541	SLO	1	65.41	93.82
1	490010106006	SLO	1	60.06	73.71
1	360010003709	SCR	1	37.09	65.53
1	490010005762	SLO	1	57.62	62.93
1	440010000794	MON	1	7.94	61.77
1	360010003745	SCR	1	37.45	61.68
1	440010002740	MON	1	27.4	56.01
1	511010003524	SB	101	35.24	51.75
1	440010006414	MON	1	64.14	51.49
1	440010004863	MON	1	48.63	50.77
1	440010003018	MON	1	30.18	50.30
1	440010006713	MON	1	67.13	49.75
1	511010003568	SB	101	35.68	49.22
1	490010006203	SLO	1	62.03	49.06
1	490010006493	SLO	1	64.93	48.60
1	440010000890	MON	1	8.9	48.37
1	440010006672	MON	1	66.72	47.63
1	440010000846	MON	1	8.46	47.04
1	440010003584	MON	1	35.84	45.94
1	490010005801	SLO	1	58.01	45.84
1	440010009555	MON	1	95.55	45.65
1	440010006485	MON	1	64.85	45.38
1	440010006590	MON	1	65.9	44.87
1	490010006476	SLO	1	64.76	44.42
1	511540001917	SB	154	19.17	42.58
1	440010006619	MON	1	66.19	41.69
1	440010006018	MON	1	60.18	41.69
1	440010002512	MON	1	25.12	41.54
1	440010000705	MON	1	7.05	41.52
1	511546001991	SB	154	19.91	41.08
1	440010001710	MON	1	17.1	40.83
1	440010004181	MON	1	41.81	40.15
1	440010004088	MON	1	40.88	39.76
1	440010001269	MON	1	12.69	39.59
1	511540001894	SB	154	18.94	38.95
1	511540001777	SB	154	17.77	38.94
1	511540001736	SB	154	17.36	38.75

[47] MON = Monterey, SB = Santa Barbara, SBT = San Benito, SCR = Santa Cruz, SLO = San Luis Obispo

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
1	440010001777	MON	1	17.77	38.62
1	440010004355	MON	1	43.55	38.54
1	511540001685	SB	154	16.85	38.07
1	440010005055	MON	1	50.55	37.95
1	440010007048	MON	1	70.48	37.80
1	440010006763	MON	1	67.63	37.61
1	440010006629	MON	1	66.29	37.36
1	440010001986	MON	1	19.86	35.73
1	512176000099	SB	217	0.99	35.28
1	440010005006	MON	1	50.06	35.03
1	511546002570	SB	154	25.7	33.82
1	511016003393	SB	101	33.93	33.41
1	440010002330	MON	1	23.3	32.29
1	440010006953	MON	1	69.53	32.25
1	440010002694	MON	1	26.94	32.04
1	491010103422	SLO	101	34.22	31.96
1	511010004072	SB	101	40.72	31.55
1	511544002676	SB	154	26.76	31.38
1	491014003600	SLO	101	36	31.00
1	511016001946	SB	101	19.46	30.74
1	440010005127	MON	1	51.27	30.31
1	490010006742	SLO	1	67.42	30.05
1	440010002266	MON	1	22.66	29.89
1	440010006333	MON	1	63.33	29.19
1	440010006152	MON	1	61.52	29.14
1	430250002140	SBT	25	21.4	29.13
1	491010103407	SLO	101	34.07	29.07
1	511664103561	SB	166	35.61	28.84
1	490464004124	SLO	46	41.24	28.66
1	511012004742	SB	101	47.42	28.44
1	440010003680	MON	1	36.8	28.34
1	511014001232	SB	101	12.32	28.27
1	440010002218	MON	1	22.18	28.09
1	440014003974	MON	1	39.74	28.09
1	430254002713	SBT	25	27.13	28.07
1	440010005673	MON	1	56.73	28.05
1	491014003560	SLO	101	35.6	27.99
1	491664001862	SLO	166	18.62	27.93
1	511540001557	SB	154	15.57	27.90
1	491664001904	SLO	166	19.04	27.84
1	491664001548	SLO	166	15.48	27.61
1	511540002200	SB	154	22	27.56

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
1	491010103356	SLO	101	33.56	27.54
1	491664001613	SLO	166	16.13	27.50
1	490010006308	SLO	1	63.08	27.44
1	491664004049	SLO	166	40.49	27.38
1	490464100505	SLO	46	5.05	27.37
1	491664004187	SLO	166	41.87	27.35
1	511660102599	SB	166	25.99	27.35
1	430250001405	SBT	25	14.05	27.34
1	511016006305	SB	101	63.05	27.29
1	440010006981	MON	1	69.81	27.27
1	430254002656	SBT	25	26.56	27.21
1	440010000636	MON	1	6.36	27.19
1	440680000682	MON	68	6.82	26.92
1	491660002309	SLO	166	23.09	26.82
1	491010103391	SLO	101	33.91	26.79
1	491010103356	SLO	101	33.56	26.76
1	511664103540	SB	166	35.4	26.76
1	430254002263	SBT	25	22.63	26.75
1	490414003446	SLO	41	34.46	26.73
1	511540002128	SB	154	21.28	26.72
1	511010004417	SB	101	44.17	26.63
1	511010003187	SB	101	31.87	26.58
1	490580001229	SLO	58	12.29	26.55
1	490580001266	SLO	58	12.66	26.52
1	491014003236	SLO	101	32.36	26.51
1	440010107811	MON	1	78.11	26.48
1	491664001962	SLO	166	19.62	26.36
1	491664002032	SLO	166	20.32	26.30
1	430254002605	SBT	25	26.05	26.30
1	440010107811	MON	1	78.11	26.29
1	490580002341	SLO	58	23.41	26.23
1	491014003267	SLO	101	32.67	26.15
1	440011207501	MON	1	75.01	26.10
1	491664001503	SLO	166	15.03	26.04
1	491664001595	SLO	166	15.95	26.03
1	491010003745	SLO	101	37.45	25.98
1	511660102730	SB	166	27.3	25.82
1	491014003267	SLO	101	32.67	25.80
1	511010002870	SB	101	28.7	25.76
1	490460003984	SLO	46	39.84	25.68
1	491018005413	SLO	101	54.13	25.63
1	491010004143	SLO	101	41.43	25.61

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
1	491664004293	SLO	166	42.93	25.61
1	511016003669	SB	101	36.69	25.61
1	490014001973	SLO	1	19.73	25.60
1	511016002986	SB	101	29.86	25.59
1	491014003990	SLO	101	39.9	25.56
1	491014004020	SLO	101	40.2	25.56
1	490584000274	SLO	58	2.74	25.46
1	492290000386	SLO	229	3.86	25.33
1	490584103498	SLO	58	34.98	25.31
1	512464003280	SB	246	32.8	25.30
1	491010003745	SLO	101	37.45	25.22
1	490414003388	SLO	41	33.88	25.20
1	430250001578	SBT	25	15.78	25.19
1	490414003349	SLO	41	33.49	25.18
1	490464100374	SLO	46	3.74	25.13
1	490464100640	SLO	46	6.4	25.09
1	430254002746	SBT	25	27.46	25.04
1	490464100510	SLO	46	5.1	24.95
1	490580003662	SLO	58	36.62	24.94
1	440014003786	MON	1	37.86	24.94
1	440680001056	MON	68	10.56	24.93
1	490584003689	SLO	58	36.89	24.92
1	490464100315	SLO	46	3.15	24.92
1	430254000730	SBT	25	7.3	24.83
1	430250002799	SBT	25	27.99	24.81
1	490010001473	SLO	1	14.73	24.77
1	440016107738	MON	1	77.38	24.76
1	440010004405	MON	1	44.05	24.70
1	511660102887	SB	166	28.87	24.67
1	510014102681	SB	1	26.81	24.65
1	441010010095	MON	101	100.95	24.62
2	490580001330	SLO	58	13.3	24.62
2	511660102947	SB	166	29.47	24.61
2	441014009352	MON	101	93.52	24.60
2	490580000320	SLO	58	3.2	24.59
2	441014010089	MON	101	100.89	24.59
2	440010001291	MON	1	12.91	24.54
2	430254002371	SBT	25	23.71	24.46
2	430254002363	SBT	25	23.63	24.46
2	430250002120	SBT	25	21.2	24.33
2	440010005253	MON	1	52.53	24.33
2	490410003889	SLO	41	38.89	24.28

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
2	430250001363	SBT	25	13.63	24.27
2	490464101657	SLO	46	16.57	24.24
2	491010003326	SLO	101	33.26	24.16
2	360010002870	SCR	1	28.7	24.16
2	511540001380	SB	154	13.8	24.15
2	490464100363	SLO	46	3.63	24.12
2	430254002449	SBT	25	24.49	24.08
2	511010002910	SB	101	29.1	24.06
2	511010002816	SB	101	28.16	24.04
2	511540001302	SB	154	13.02	24.04
2	511010002870	SB	101	28.7	23.98
2	440010001376	MON	1	13.76	23.94
2	491018005060	SLO	101	50.6	23.93
2	440010001567	MON	1	15.67	23.85
2	440010001358	MON	1	13.58	23.84
2	440010001542	MON	1	15.42	23.82
2	360010002763	SCR	1	27.63	23.74
2	511660102829	SB	166	28.29	23.72
2	440250000483	MON	25	4.83	23.70
2	441016009559	MON	101	95.59	23.70
2	491014005212	SLO	101	52.12	23.68
2	490460004003	SLO	46	40.03	23.66
2	490414000632	SLO	41	6.32	23.65
2	491664004337	SLO	166	43.37	23.61
2	490584001153	SLO	58	11.53	23.59
2	491664004091	SLO	166	40.91	23.56
2	510010102412	SB	1	24.12	23.47
2	491664001301	SLO	166	13.01	23.43
2	440680001089	MON	68	10.89	23.42
2	440010001417	MON	1	14.17	23.42
2	510010102552	SB	1	25.52	23.42
2	440684000767	MON	68	7.67	23.41
2	440250000113	MON	25	1.13	23.41
2	490460003984	SLO	46	39.84	23.40
2	510010102552	SB	1	25.52	23.40
2	440250000387	MON	25	3.87	23.35
2	511010104959	SB	101	49.59	23.31
2	491018005557	SLO	101	55.57	23.31
2	490580000855	SLO	58	8.55	23.30
2	491014003021	SLO	101	30.21	23.28
2	441984001442	MON	198	14.42	23.25
2	490580000750	SLO	58	7.5	23.25

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
2	440014004550	MON	1	45.5	23.25
2	441014101028	MON	101	10.28	23.21
2	441014101056	MON	101	10.56	23.21
2	511660103450	SB	166	34.5	23.19
2	440680001150	MON	68	11.5	23.17
2	490464100249	SLO	46	2.49	23.13
2	511540001610	SB	154	16.1	23.09
2	430254000056	SBT	25	0.56	23.08
2	440010107650	MON	1	76.5	23.06
2	440010107635	MON	1	76.35	22.99
2	490584001040	SLO	58	10.4	22.96
2	491016000081	SLO	101	0.81	22.94
2	490464100423	SLO	46	4.23	22.91
2	440016107934	MON	1	79.34	22.87
2	490464100141	SLO	46	1.41	22.86
2	491014003127	SLO	101	31.27	22.84
2	510010102412	SB	1	24.12	22.83
2	441016101101	MON	101	11.01	22.81
2	490580001606	SLO	58	16.06	22.55
2	430254000175	SBT	25	1.75	22.49
2	441010009430	MON	101	94.3	22.49
2	441014009380	MON	101	93.8	22.47
2	511010005220	SB	101	52.2	22.47
2	490580001464	SLO	58	14.64	22.41
2	490580001577	SLO	58	15.77	22.38
2	440684001193	MON	68	11.93	22.37
2	490580000647	SLO	58	6.47	22.36
2	491016101970	SLO	101	19.7	22.34
2	511010002910	SB	101	29.1	22.33
2	490414000226	SLO	41	2.26	22.31
2	440686001565	MON	68	15.65	22.31
2	490414000570	SLO	41	5.7	22.28
2	490580003050	SLO	58	30.5	22.28
2	490414000485	SLO	41	4.85	22.28
2	490414000379	SLO	41	3.79	22.26
2	490464101662	SLO	46	16.62	22.23
2	440250001082	MON	25	10.82	22.22
2	440250001041	MON	25	10.41	22.22
2	492294000040	SLO	229	0.4	22.21
2	441014101347	MON	101	13.47	22.19
2	441014101290	MON	101	12.9	22.19
2	441014101244	MON	101	12.44	22.18

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
2	441014101310	MON	101	13.1	22.18
2	441014101192	MON	101	11.92	22.15
2	440010002406	MON	1	24.06	22.08
2	491664105090	SLO	166	50.9	22.08
2	360010003016	SCR	1	30.16	22.05
2	512460101376	SB	246	13.76	22.05
2	511660102812	SB	166	28.12	22.03
2	490410003671	SLO	41	36.71	22.00
2	490414000587	SLO	41	5.87	22.00
2	440686001565	MON	68	15.65	21.98
2	512464101295	SB	246	12.95	21.98
2	511660102800	SB	166	28	21.97
2	490580003292	SLO	58	32.92	21.95
2	490584003239	SLO	58	32.39	21.93
2	511016006305	SB	101	63.05	21.93
2	490464003204	SLO	46	32.04	21.93
2	490464003204	SLO	46	32.04	21.93
2	440010001428	MON	1	14.28	21.90
2	490414000540	SLO	41	5.4	21.86
2	440010001412	MON	1	14.12	21.86
2	440680001116	MON	68	11.16	21.82
2	440684001318	MON	68	13.18	21.78
2	360016001400	SCR	1	14	21.77
2	490584003313	SLO	58	33.13	21.75
2	440016107730	MON	1	77.3	21.75
2	360010100307	SCR	1	3.07	21.74
2	490584001444	SLO	58	14.44	21.67
2	490410000755	SLO	41	7.55	21.66
2	511010003267	SB	101	32.67	21.65
2	490580000769	SLO	58	7.69	21.65
2	441014101102	MON	101	11.02	21.64
2	511660103323	SB	166	33.23	21.62
2	490584003456	SLO	58	34.56	21.59
2	440010001609	MON	1	16.09	21.57
2	490584002562	SLO	58	25.62	21.56
2	491664001235	SLO	166	12.35	21.56
2	491014005103	SLO	101	51.03	21.54
2	490584003079	SLO	58	30.79	21.54
2	490580000784	SLO	58	7.84	21.49
2	491664005050	SLO	166	50.5	21.47
2	491664001248	SLO	166	12.48	21.47
2	490010005404	SLO	1	54.04	21.46

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
2	440680001366	MON	68	13.66	21.46
2	490584002829	SLO	58	28.29	21.44
2	511010006250	SB	101	62.5	21.44
2	490330000463	SLO	33	4.63	21.43
2	491664004490	SLO	166	44.9	21.41
2	511660005228	SB	166	52.28	21.41
2	431014000048	SBT	101	0.48	21.39
2	511010008106	SB	101	81.06	21.38
2	511664103429	SB	166	34.29	21.37
2	490580001783	SLO	58	17.83	21.36
2	490580003758	SLO	58	37.58	21.36
2	511010007259	SB	101	72.59	21.34
2	491018004233	SLO	101	42.33	21.33
2	490584002026	SLO	58	20.26	21.33
2	511018003269	SB	101	32.69	21.29
2	511660102976	SB	166	29.76	21.26
3	490414000448	SLO	41	4.48	21.23
3	361294000563	SCR	129	5.63	21.20
3	511352100919	SB	135	9.19	21.17
3	430254000299	SBT	25	2.99	21.17
3	431014000282	SBT	101	2.82	21.16
3	511660103092	SB	166	30.92	21.12
3	511540001496	SB	154	14.96	21.12
3	440010006050	MON	1	60.5	21.08
3	491018102569	SLO	101	25.69	21.05
3	490464004255	SLO	46	42.55	21.03
3	441984001636	MON	198	16.36	21.01
3	511010008106	SB	101	81.06	21.01
3	490014002038	SLO	1	20.38	21.00
3	491018005255	SLO	101	52.55	20.98
3	441014101356	MON	101	13.56	20.97
3	441014101269	MON	101	12.69	20.96
3	441014101356	MON	101	13.56	20.96
3	490414000288	SLO	41	2.88	20.95
3	441014101209	MON	101	12.09	20.95
3	440016007589	MON	1	75.89	20.95
3	441014101331	MON	101	13.31	20.95
3	441014101269	MON	101	12.69	20.95
3	440250000812	MON	25	8.12	20.95
3	441014101209	MON	101	12.09	20.94
3	441014101331	MON	101	13.31	20.94
3	441014101320	MON	101	13.2	20.92

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
3	441014101320	MON	101	13.2	20.90
3	490464004229	SLO	46	42.29	20.89
3	511660103228	SB	166	32.28	20.88
3	362360000620	SCR	236	6.2	20.88
3	441014100997	MON	101	9.97	20.87
3	441014100997	MON	101	9.97	20.87
3	490414000201	SLO	41	2.01	20.79
3	490584002042	SLO	58	20.42	20.77
3	490414000134	SLO	41	1.34	20.76
3	511540002379	SB	154	23.79	20.75
3	491014102493	SLO	101	24.93	20.74
3	490414000250	SLO	41	2.5	20.72
3	440016107730	MON	1	77.3	20.70
3	441018100967	MON	101	9.67	20.66
3	510010100533	SB	1	5.33	20.64
3	441018100967	MON	101	9.67	20.64
3	441984001418	MON	198	14.18	20.60
3	490410000920	SLO	41	9.2	20.58
3	491014003127	SLO	101	31.27	20.56
3	490410002717	SLO	41	27.17	20.56
3	490464004335	SLO	46	43.35	20.54
3	491664005033	SLO	166	50.33	20.52
3	491014003192	SLO	101	31.92	20.51
3	491014003192	SLO	101	31.92	20.51
3	441980002022	MON	198	20.22	20.51
3	441980002034	MON	198	20.34	20.50
3	431012000152	SBT	101	1.52	20.48
3	511014006209	SB	101	62.09	20.48
3	490410002381	SLO	41	23.81	20.48
3	511014006209	SB	101	62.09	20.47
3	441980002285	MON	198	22.85	20.46
3	361294000952	SCR	129	9.52	20.42
3	491010000052	SLO	101	0.52	20.41
3	511010006087	SB	101	60.87	20.39
3	511010006087	SB	101	60.87	20.37
3	441980001921	MON	198	19.21	20.37
3	360090001439	SCR	9	14.39	20.35
3	490584002199	SLO	58	21.99	20.34
3	441980002300	MON	198	23	20.34
3	491014003990	SLO	101	39.9	20.32
3	491014004020	SLO	101	40.2	20.32
3	511010003859	SB	101	38.59	20.32

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
3	440684000813	MON	68	8.13	20.27
3	511016104853	SB	101	48.53	20.26
3	490580001612	SLO	58	16.12	20.26
3	440680001248	MON	68	12.48	20.24
3	491014102303	SLO	101	23.03	20.18
3	490584001672	SLO	58	16.72	20.17
3	490410002966	SLO	41	29.66	20.13
3	441014101102	MON	101	11.02	20.11
3	490584001448	SLO	58	14.48	20.11
3	491664004923	SLO	166	49.23	20.08
3	490414000512	SLO	41	5.12	20.08
3	492290000009	SLO	229	0.09	20.08
3	492290000001	SLO	229	0.01	20.06
3	360016100767	SCR	1	7.67	20.04
3	490460101030	SLO	46	10.3	19.97
3	490584002008	SLO	58	20.08	19.97
3	510010803047	SB	1	30.47	19.94
3	510010803047	SB	1	30.47	19.94
3	511010006250	SB	101	62.5	19.90
3	441014101371	MON	101	13.71	19.89
3	490464101370	SLO	46	13.7	19.87
3	511354000307	SB	135	3.07	19.86
3	490464101138	SLO	46	11.38	19.82
3	511544003012	SB	154	30.12	19.77
3	490464101270	SLO	46	12.7	19.75
3	490580000953	SLO	58	9.53	19.74
3	490410002271	SLO	41	22.71	19.62
3	490584001752	SLO	58	17.52	19.54
3	490584003327	SLO	58	33.27	19.52
3	511540101058	SB	154	10.58	19.52
3	511920001136	SB	192	11.36	19.45
3	511546002560	SB	154	25.6	19.43
3	491016102005	SLO	101	20.05	19.43
3	490580000074	SLO	58	0.74	19.39
3	490010103547	SLO	1	35.47	19.38
3	490014004362	SLO	1	43.62	19.37
3	490010002186	SLO	1	21.86	19.35
3	490414001003	SLO	41	10.03	19.33
3	440010005293	MON	1	52.93	19.28
3	511014005974	SB	101	59.74	19.25
3	490010002186	SLO	1	21.86	19.24
3	490410000823	SLO	41	8.23	19.19

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
3	511350100956	SB	135	9.56	19.19
3	511350100956	SB	135	9.56	19.19
3	440010000946	MON	1	9.46	19.18
3	490414002222	SLO	41	22.22	19.15
3	490580002439	SLO	58	24.39	19.10
3	490584002922	SLO	58	29.22	19.09
3	491014005520	SLO	101	55.2	19.05
3	512464102661	SB	246	26.61	19.05
3	431012000157	SBT	101	1.57	19.04
3	490464004019	SLO	46	40.19	19.02
3	491014005438	SLO	101	54.38	19.02
3	511544002767	SB	154	27.67	18.99
3	441014104397	MON	101	43.97	18.99
3	490010002194	SLO	1	21.94	18.97
3	490580000048	SLO	58	0.48	18.96
3	490460002997	SLO	46	29.97	18.96
3	491014005520	SLO	101	55.2	18.94
3	362364001328	SCR	236	13.28	18.94
3	511924000000	SB	192	0	18.94
3	490014001868	SLO	1	18.68	18.93
3	511924000037	SB	192	0.37	18.93
3	360090001858	SCR	9	18.58	18.92
3	491014005438	SLO	101	54.38	18.92
3	440016107934	MON	1	79.34	18.89
3	491018005465	SLO	101	54.65	18.86
3	491018005465	SLO	101	54.65	18.86
3	441014101457	MON	101	14.57	18.84
3	441014101457	MON	101	14.57	18.83
3	511350100930	SB	135	9.3	18.82
3	511016100779	SB	101	7.79	18.80
3	511016100779	SB	101	7.79	18.80
3	511548100813	SB	154	8.13	18.71
3	440016107934	MON	1	79.34	18.71
3	491018005255	SLO	101	52.55	18.70
3	511544100895	SB	154	8.95	18.70
3	491010001067	SLO	101	10.67	18.69
3	511544100907	SB	154	9.07	18.69
3	491014102303	SLO	101	23.03	18.67
3	490014004457	SLO	1	44.57	18.67
3	431014000048	SBT	101	0.48	18.66
3	511350801113	SB	135	11.13	18.64
3	511548100813	SB	154	8.13	18.64

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
3	511544100778	SB	154	7.78	18.59
4	360014100173	SCR	1	1.73	18.58
4	360014100173	SCR	1	1.73	18.58
4	511010003430	SB	101	34.3	18.50
4	441014104517	MON	101	45.17	18.48
4	491018005131	SLO	101	51.31	18.48
4	490410002909	SLO	41	29.09	18.46
4	362364000072	SCR	236	0.72	18.45
4	511544100071	SB	154	0.71	18.41
4	431012000162	SBT	101	1.62	18.40
4	490414000721	SLO	41	7.21	18.40
4	491018005131	SLO	101	51.31	18.33
4	431014000282	SBT	101	2.82	18.33
4	512464003429	SB	246	34.29	18.32
4	362364000228	SCR	236	2.28	18.25
4	490414001233	SLO	41	12.33	18.23
4	441014104397	MON	101	43.97	18.23
4	490464003826	SLO	46	38.26	18.22
4	491012001068	SLO	101	10.68	18.21
4	490410001421	SLO	41	14.21	18.20
4	490410002345	SLO	41	23.45	18.20
4	490414001193	SLO	41	11.93	18.19
4	360091201789	SCR	9	17.89	18.18
4	490410001375	SLO	41	13.75	18.18
4	490410002547	SLO	41	25.47	18.17
4	441980002322	MON	198	23.22	18.10
4	490014004712	SLO	1	47.12	18.10
4	511010003981	SB	101	39.81	18.09
4	362364000084	SCR	236	0.84	18.08
4	490410001466	SLO	41	14.66	18.07
4	440010003164	MON	1	31.64	18.05
4	491018004288	SLO	101	42.88	18.02
4	360174000352	SCR	17	3.52	18.02
4	490414001086	SLO	41	10.86	18.01
4	490410001072	SLO	41	10.72	17.96
4	490464003853	SLO	46	38.53	17.96
4	490460003763	SLO	46	37.63	17.95
4	490464101215	SLO	46	12.15	17.93
4	490014004434	SLO	1	44.34	17.93
4	490410001421	SLO	41	14.21	17.91
4	440010005338	MON	1	53.38	17.90
4	490460003769	SLO	46	37.69	17.89

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
4	512460101938	SB	246	19.38	17.87
4	491010003053	SLO	101	30.53	17.87
4	360094001930	SCR	9	19.3	17.83
4	512468002884	SB	246	28.84	17.82
4	511010004377	SB	101	43.77	17.75
4	431564000995	SBT	156	9.95	17.73
4	491014003021	SLO	101	30.21	17.71
4	511014005903	SB	101	59.03	17.69
4	511544103055	SB	154	30.55	17.67
4	490414001021	SLO	41	10.21	17.66
4	511014005903	SB	101	59.03	17.63
4	491014005925	SLO	101	59.25	17.63
4	362360000342	SCR	236	3.42	17.63
4	511014004217	SB	101	42.17	17.63
4	441984002504	MON	198	25.04	17.62
4	490010006827	SLO	1	68.27	17.61
4	491018004288	SLO	101	42.88	17.60
4	490464101946	SLO	46	19.46	17.59
4	490464004551	SLO	46	45.51	17.56
4	441980002186	MON	198	21.86	17.54
4	441560100059	MON	156	0.59	17.53
4	490460003595	SLO	46	35.95	17.53
4	511354000431	SB	135	4.31	17.53
4	511010003981	SB	101	39.81	17.50
4	490010002274	SLO	1	22.74	17.49
4	441014104516	MON	101	45.16	17.48
4	440250000304	MON	25	3.04	17.45
4	490460003442	SLO	46	34.42	17.45
4	511660005638	SB	166	56.38	17.44
4	491014006170	SLO	101	61.7	17.44
4	490460003577	SLO	46	35.77	17.44
4	362360000271	SCR	236	2.71	17.42
4	511660005334	SB	166	53.34	17.36
4	491016001516	SLO	101	15.16	17.34
4	491016001516	SLO	101	15.16	17.29
4	511350801113	SB	135	11.13	17.29
4	511660006005	SB	166	60.05	17.23
4	441560100059	MON	156	0.59	17.21
4	511014007938	SB	101	79.38	17.17
4	511660005776	SB	166	57.76	17.17
4	490410002624	SLO	41	26.24	17.12
4	441980002365	MON	198	23.65	17.11

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
4	490464004776	SLO	46	47.76	17.11
4	490410002606	SLO	41	26.06	17.10
4	511660005562	SB	166	55.62	17.09
4	491016102005	SLO	101	20.05	17.08
4	491014006024	SLO	101	60.24	17.07
4	491016001472	SLO	101	14.72	17.05
4	491016001472	SLO	101	14.72	17.05
4	490460003254	SLO	46	32.54	17.03
4	490414000410	SLO	41	4.1	17.00
4	490460003373	SLO	46	33.73	16.98
4	511660005582	SB	166	55.82	16.96
4	511010003524	SB	101	35.24	16.96
4	490414000985	SLO	41	9.85	16.94
4	360094001139	SCR	9	11.39	16.91
4	511660005967	SB	166	59.67	16.88
4	490016103583	SLO	1	35.83	16.87
4	511660005812	SB	166	58.12	16.82
4	491016006454	SLO	101	64.54	16.81
4	490460003294	SLO	46	32.94	16.80
4	441014100283	MON	101	2.83	16.76
4	490014004750	SLO	1	47.5	16.76
4	511010007541	SB	101	75.41	16.76
4	491018006722	SLO	101	67.22	16.76
4	491014006451	SLO	101	64.51	16.76
4	431560000215	SBT	156	2.15	16.75
4	491664004803	SLO	166	48.03	16.70
4	361294000617	SCR	129	6.17	16.69
4	511660005276	SB	166	52.76	16.67
4	441014100283	MON	101	2.83	16.64
4	440250000844	MON	25	8.44	16.64
4	490016103583	SLO	1	35.83	16.63
4	490410002997	SLO	41	29.97	16.58
4	490010002324	SLO	1	23.24	16.56
4	511010006708	SB	101	67.08	16.50
4	511014006752	SB	101	67.52	16.46
4	490464102101	SLO	46	21.01	16.43
4	441014100763	MON	101	7.63	16.38
4	441014100763	MON	101	7.63	16.38
4	491018006505	SLO	101	65.05	16.38
4	511016003640	SB	101	36.4	16.35
4	441980002431	MON	198	24.31	16.33
4	491010000991	SLO	101	9.91	16.31

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
4	491010001060	SLO	101	10.6	16.29
4	492276100900	SLO	227	9	16.27
4	511350801021	SB	135	10.21	16.23
4	362364000208	SCR	236	2.08	16.16
4	490410001161	SLO	41	11.61	16.16
4	491010001174	SLO	101	11.74	16.07
4	441018100778	MON	101	7.78	16.07
4	441018100778	MON	101	7.78	16.05
4	491012000983	SLO	101	9.83	16.01
4	441018101531	MON	101	15.31	16.01
4	511010003873	SB	101	38.73	15.98
4	491012001056	SLO	101	10.56	15.97
4	491018006722	SLO	101	67.22	15.93
4	490410002873	SLO	41	28.73	15.93
4	490410002885	SLO	41	28.85	15.88
4	511010007541	SB	101	75.41	15.77
4	511016001901	SB	101	19.01	15.77
4	490414000969	SLO	41	9.69	15.73
4	360094000642	SCR	9	6.42	15.63
4	511016003085	SB	101	30.85	15.63
4	441014101828	MON	101	18.28	15.61
4	490410000858	SLO	41	8.58	15.57
4	431564000203	SBT	156	2.03	15.55
4	431564000203	SBT	156	2.03	15.54
4	490010003145	SLO	1	31.45	15.54
4	490010003145	SLO	1	31.45	15.54
4	360010100351	SCR	1	3.51	15.53
4	490410000999	SLO	41	9.99	15.52
4	511354000583	SB	135	5.83	15.48
5	512464003221	SB	246	32.21	15.41
5	511660005829	SB	166	58.29	15.36
5	511012007705	SB	101	77.05	15.34
5	490010004129	SLO	1	41.29	15.34
5	511014007938	SB	101	79.38	15.34
5	511660005848	SB	166	58.48	15.31
5	512464003375	SB	246	33.75	15.27
5	441014102490	MON	101	24.9	15.26
5	490584004786	SLO	58	47.86	15.25
5	491664004851	SLO	166	48.51	15.18
5	511014006752	SB	101	67.52	15.18
5	511660005427	SB	166	54.27	15.17
5	511010004108	SB	101	41.08	15.13

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
5	511660005352	SB	166	53.52	15.11
5	511010004173	SB	101	41.73	15.01
5	361520000687	SCR	152	6.87	14.96
5	511010004371	SB	101	43.71	14.95
5	441014101657	MON	101	16.57	14.95
5	492270100977	SLO	227	9.77	14.90
5	511924000539	SB	192	5.39	14.89
5	511350801021	SB	135	10.21	14.88
5	511660005895	SB	166	58.95	14.81
5	440010005513	MON	1	55.13	14.79
5	440010005716	MON	1	57.16	14.72
5	441014101934	MON	101	19.34	14.71
5	362360000748	SCR	236	7.48	14.69
5	441014101934	MON	101	19.34	14.67
5	360094000594	SCR	9	5.94	14.65
5	360010002189	SCR	1	21.89	14.56
5	511010004417	SB	101	44.17	14.54
5	490580005630	SLO	58	56.3	14.53
5	492270100858	SLO	227	8.58	14.53
5	360018001642	SCR	1	16.42	14.51
5	360010002999	SCR	1	29.99	14.50
5	441014102390	MON	101	23.9	14.38
5	361520000598	SCR	152	5.98	14.21
5	362360000851	SCR	236	8.51	14.21
5	511010004108	SB	101	41.08	14.14
5	431560000291	SBT	156	2.91	14.11
5	360010100346	SCR	1	3.46	14.08
5	441014101693	MON	101	16.93	14.07
5	490414004650	SLO	41	46.5	14.06
5	431560000291	SBT	156	2.91	14.03
5	360010002304	SCR	1	23.04	14.02
5	360094000545	SCR	9	5.45	14.01
5	510010100385	SB	1	3.85	13.88
5	441014102431	MON	101	24.31	13.86
5	490410004553	SLO	41	45.53	13.86
5	441014102431	MON	101	24.31	13.83
5	441014102581	MON	101	25.81	13.80
5	441014102490	MON	101	24.9	13.77
5	441014102581	MON	101	25.81	13.77
5	441014101640	MON	101	16.4	13.42
5	441018102341	MON	101	23.41	13.40
5	512464003322	SB	246	33.22	13.38

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
5	441014101657	MON	101	16.57	13.37
5	441018102341	MON	101	23.41	13.37
5	490010004200	SLO	1	42	13.07
5	441016008622	MON	101	86.22	13.04
5	511010004218	SB	101	42.18	13.02
5	360010002385	SCR	1	23.85	12.92
5	361520000560	SCR	152	5.6	12.74
5	490330000399	SLO	33	3.99	12.33
5	511010003430	SB	101	34.3	12.30
5	511010003568	SB	101	35.68	12.20
5	441464000215	MON	146	2.15	11.87
5	511010004268	SB	101	42.68	11.65
5	511664000890	SB	166	8.9	11.51
5	490014004764	SLO	1	47.64	11.48
5	360010002031	SCR	1	20.31	11.48
5	360010003596	SCR	1	35.96	11.37
5	511010004173	SB	101	41.73	11.21
5	360094001090	SCR	9	10.9	11.20
5	360170000249	SCR	17	2.49	11.13
5	441014008717	MON	101	87.17	10.79
5	511010002742	SB	101	27.42	10.69
5	511010002742	SB	101	27.42	10.68
5	511010007416	SB	101	74.16	10.38
5	512464101539	SB	246	15.39	10.17
5	511010000331	SB	101	3.31	10.17
5	360010003125	SCR	1	31.25	10.14
5	360016001250	SCR	1	12.5	10.06
5	360010001504	SCR	1	15.04	10.04
5	511010000331	SB	101	3.31	9.97
5	511016001015	SB	101	10.15	9.77
5	440010005364	MON	1	53.64	9.39
5	360010003415	SCR	1	34.15	9.36
5	441010006952	MON	101	69.52	9.34
5	511010007416	SB	101	74.16	9.27
5	511350000171	SB	135	1.71	9.21
5	511010007315	SB	101	73.15	9.11
5	511924000636	SB	192	6.36	8.89
5	511016001759	SB	101	17.59	8.89
5	511010007315	SB	101	73.15	8.89
5	511016001759	SB	101	17.59	8.83
5	511016001869	SB	101	18.69	8.75
5	511354000243	SB	135	2.43	8.69

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
5	490464102062	SLO	46	20.62	8.68
5	511354000474	SB	135	4.74	8.68
5	441010007821	MON	101	78.21	8.60
5	441010007821	MON	101	78.21	8.60
5	511016001869	SB	101	18.69	8.57
5	441014008726	MON	101	87.26	8.55
5	511504000172	SB	150	1.72	8.43
5	360016001182	SCR	1	11.82	8.36
5	491010000905	SLO	101	9.05	8.36
5	511924000111	SB	192	1.11	8.33
5	491010000905	SLO	101	9.05	8.30
5	490010005440	SLO	1	54.4	8.17
5	441010006571	MON	101	65.71	8.16
5	440680002191	MON	68	21.91	7.78
5	511924000468	SB	192	4.68	7.39
5	441016007003	MON	101	70.03	7.10
5	511010002622	SB	101	26.22	7.08
5	441010007117	MON	101	71.17	7.04
5	511924001055	SB	192	10.55	6.90
5	490010004269	SLO	1	42.69	6.89
5	490010000132	SLO	1	1.32	6.88
5	511016002281	SB	101	22.81	6.81
5	511016002257	SB	101	22.57	6.64
5	441016007003	MON	101	70.03	6.60
5	511016002257	SB	101	22.57	6.55
5	441010103644	MON	101	36.44	6.52
5	511660006258	SB	166	62.58	6.39
5	511016002281	SB	101	22.81	6.26
5	360170000521	SCR	17	5.21	6.21
5	510330000536	SB	33	5.36	6.01
5	490414000075	SLO	41	0.75	5.90
5	490464102049	SLO	46	20.49	5.83
5	511920000626	SB	192	6.26	5.77
5	511924000198	SB	192	1.98	5.75
5	441014102823	MON	101	28.23	5.52
5	511924000133	SB	192	1.33	5.51
5	511920000383	SB	192	3.83	5.45
5	360170000521	SCR	17	5.21	5.06
5	511010002548	SB	101	25.48	5.03
5	441010103644	MON	101	36.44	5.01
5	512464101695	SB	246	16.95	4.85
5	511544103214	SB	154	32.14	4.65

Priority	Culvert System Number	County[47]	Route	Postmile	Cross-Hazard Prioritization Score
5	511016003096	SB	101	30.96	4.53
5	511016003085	SB	101	30.85	4.51
5	511544100631	SB	154	6.31	4.47
5	511500000135	SB	150	1.35	4.04
5	511924000883	SB	192	8.83	4.00
5	491018006099	SLO	101	60.99	3.22
5	511924001743	SB	192	17.43	3.20
5	512460000856	SB	246	8.56	3.08
5	511924001744	SB	192	17.44	3.05
5	511014002629	SB	101	26.29	2.97
5	360010001986	SCR	1	19.86	2.90
5	360010002491	SCR	1	24.91	2.28
5	360010002433	SCR	1	24.33	1.87
5	360010002593	SCR	1	25.93	0.00

TABLE 11: PRIORITIZATION OF ROADWAYS FOR
DETAILED CLIMATE CHANGE ADAPTATION ASSESSMENTS

Priority	County[48]	Route	From Postmile / To Postmile	Carriageway[49]	Average Cross-Hazard Prioritization Score[50]
1	MON	156	156 R0.339 / 156 R1.109	P	59.84
1	SLO	1	1 14.752 / 1 15.119	S	59.62
1	MON	156	156 R0.342 / 156 R0.944	S	55.71
1	MON	1	1 14.715 / 1 20.936	P	53.18
1	MON	1	1 2.82 / 1 13.699	P	53.18
1	MON	1	1 28.065 / 1 28.833	P	53.18
1	MON	1	1 51.175 / 1 52.409	P	53.18
1	MON	1	1 53.839 / 1 58.782	P	53.18
1	MON	1	1 63.071 / 1 63.071	P	53.18
1	MON	1	1 69.665 / 1 71.456	P	53.18
1	MON	1	1 71.74 / 1 73.143	P	53.18
1	MON	1	1 94.134 / 1 96.099	P	53.18
1	MON	1	1 96.36 / 1 97.562	P	53.18
1	MON	1	1 97.6 / 1 98.349	P	53.18
1	SCR	1	1 36.411 / 1 37.45	P	53.18
1	SLO	1	1 14.752 / 1 15.115	P	53.18
1	SLO	1	1 15.202 / 1 15.316	P	53.18
1	SLO	1	1 49.01 / 1 50.121	P	53.18
1	SLO	1	1 55.074 / 1 56.252	P	53.18
1	SLO	1	1 58.248 / 1 63.772	P	53.18
1	SLO	1	1 R65.218 / 1 R67.291	P	53.18
1	SB	166	166 64.421 / 166 73.008	P	50.65
1	SB	166	166 64.3 / 166 64.796	S	50.54
1	SB	166	166 65.146 / 166 65.273	S	50.54
1	SB	166	166 69.073 / 166 69.183	S	50.54
1	MON	198	198 18.379 / 198 25.786	P	50.47
1	VEN	33	33 57.504 / 33 1.943	P	50.47
1	SLO	58	58 52.808 / KER 58 0.001	P	50.44
1	SLO	58	58 D1.351 / KER 58 2.7	P	50.44
1	MON	101	101 51.233 / 101 53.104	S	36.29
1	MON	101	101 53.362 / 101 54.653	S	36.29
1	MON	101	101 57.085 / 101 60.397	S	36.29
1	MON	101	101 R7.955 / 101 R15.467	S	36.29

[48] MON = Monterey, SB = Santa Barbara, SBT = San Benito, SCR = Santa Cruz, SLO = San Luis Obispo
[49] Caltrans' alignment codes designate the carriageway on divided roadways: "P" always represents northbound or eastbound carriageways whereas "S" always represents southbound or westbound carriageways. Undivided roadways are always indicated with a "P".
[50] The average of the cross-hazard prioritization scores amongst all the abutting small segments on the same route sharing a common priority level that were aggregated to form the longer segments listed in this table.

Priority	County[48]	Route	From Postmile / To Postmile	Carriageway[49]	Average Cross-Hazard Prioritization Score[50]
1	SB	101	101 11.761 / 101 12.421	S	36.29
1	SB	101	101 3.643 / 101 R5.3	S	36.29
1	SLO	101	101 51.441 / 101 59.909	S	36.29
1	SLO	101	101 63.74 / 101 67.282	S	36.29
1	MON	101	101 51.225 / 101 53.105	P	36.27
1	MON	101	101 53.359 / 101 54.787	P	36.27
1	MON	101	101 57.079 / 101 60.399	P	36.27
1	MON	101	101 R8.168 / 101 R15.464	P	36.27
1	SB	101	101 12.014 / 101 12.136	P	36.27
1	SB	101	101 3.646 / 101 R5.297	P	36.27
1	SLO	101	101 51.456 / 101 59.909	P	36.27
1	SLO	101	101 63.738 / 101 67.241	P	36.27
1	SLO	46	46 29.761 / 46 40.883	S	34.74
1	SLO	46	46 51.427 / 46 52.834	S	34.74
1	SLO	46	46 29.761 / 46 40.623	P	34.57
1	SLO	46	46 50.852 / 46 55.106	P	34.57
2	SLO	41	41 43.85 / 41 47.971	P	33.14
2	SLO	46	46 55.106 / 46 58.303	P	31.48
2	SLO	46	46 R17.797 / 46 R21.969	P	31.48
2	SB	154	154 R11.38 / 154 16.947	P	31.48
2	MON	101	101 53.104 / 101 53.362	S	30.70
2	MON	101	101 60.397 / 101 66.402	S	30.70
2	MON	101	101 R15.467 / 101 R25.778	S	30.70
2	MON	101	101 R25.809 / 101 R28.756	S	30.70
2	SB	101	101 3.057 / 101 3.643	S	30.70
2	SB	101	101 32.839 / 101 33.864	S	30.70
2	SB	101	101 R8.273 / 101 8.876	S	30.70
2	SLO	101	101 59.909 / 101 63.74	S	30.70
2	SLO	101	101 67.282 / 101 R7.955	S	30.70
2	MON	68	68 0 / 68 0.224	P	30.60
2	SB	166	166 59.861 / 166 64.421	P	30.49
2	SLO	166	166 73.008 / 166 74.718	P	30.49
2	MON	101	101 53.105 / 101 53.359	P	30.47
2	MON	101	101 60.399 / 101 66.398	P	30.47
2	MON	101	101 R15.464 / 101 R25.754	P	30.47
2	MON	101	101 R25.811 / 101 R28.761	P	30.47
2	SB	101	101 11.404 / 101 12.014	P	30.47
2	SB	101	101 3.059 / 101 3.646	P	30.47
2	SLO	101	101 59.909 / 101 63.738	P	30.47
2	SLO	101	101 67.241 / 101 R8.168	P	30.47

Priority	County[48]	Route	From Postmile / To Postmile	Carriageway[49]	Average Cross-Hazard Prioritization Score[50]
2	MON	25	25 0 / 25 1.119	P	30.32
2	SBT	25	T 25 13.973 / T 25 26.059	P	30.32
2	SB/SLO	33	33 1.943 / 33 4.872	P	30.31
2	MON	198	198 9.157 / 198 18.379	P	30.30
2	MON/SBT	146	146 1.999 / T 146 10.19	P	30.25
2	SBT	146	T 146 12.71 / T 146 15.152	P	30.25
2	SLO	1	1 15.119 / 1 15.196	S	29.36
2	MON	1	1 25.146 / 1 28.065	P	29.21
2	MON	1	1 28.833 / 1 30.724	P	29.21
2	MON	1	1 32.347 / 1 33.401	P	29.21
2	MON	1	1 39.087 / 1 39.724	P	29.21
2	MON	1	1 39.801 / 1 42.463	P	29.21
2	MON	1	1 48.737 / 1 50.631	P	29.21
2	MON	1	1 58.83 / 1 60.197	P	29.21
2	MON	1	1 62.434 / 1 63.071	P	29.21
2	MON	1	1 63.071 / 1 67.968	P	29.21
2	MON	1	1 T91.534 / 1 93.716	P	29.21
2	SLO	1	1 15.115 / 1 15.195	P	29.21
2	SLO	1	1 56.843 / 1 57.815	P	29.21
2	SLO	1	1 72.697 / 1 74.237	P	29.21
2	SB	217	217 0.881 / 217 2.028	S	27.22
3	SLO	1	1 15.196 / 1 15.202	S	23.94
3	SB	217	217 0.566 / 217 0.76	P	20.21
3	SB	217	217 1.001 / 217 2.24	P	20.21
3	SLO	46	46 40.623 / 46 50.852	P	20.00
3	SLO	46	46 58.303 / 46 60.849	P	20.00
3	MON	68	68 0.224 / 68 0.368	P	19.23
3	SBT	25	T 25 56.08 / 25 0	P	19.22
3	MON	101	101 54.787 / 101 57.079	P	18.85
3	MON	101	101 R25.754 / 101 R25.811	P	18.85
3	MON	101	101 R28.761 / 101 51.225	P	18.85
3	SB	101	101 12.136 / 101 12.581	P	18.85
3	SB	101	101 32.836 / 101 33.516	P	18.85
3	SLO	101	101 46.871 / 101 51.456	P	18.85
3	MON	101	101 54.653 / 101 57.085	S	18.56
3	MON	101	101 R25.778 / 101 R25.809	S	18.56
3	MON	101	101 R28.756 / 101 51.233	S	18.56
3	SB	101	101 38.779 / 101 44.838	S	18.56
3	SB	101	101 8.876 / 101 9.086	S	18.56
3	SLO	101	101 46.873 / 101 51.441	S	18.56

Priority	County[48]	Route	From Postmile / To Postmile	Carriageway[49]	Average Cross-Hazard Prioritization Score[50]
3	SLO	46	46 40.883 / 46 46.02	S	18.55
3	SLO	46	46 50.852 / 46 51.427	S	18.55
3	MON	1	1 13.699 / 1 14.715	P	18.50
3	MON	1	1 20.936 / 1 22.474	P	18.50
3	MON	1	1 34.88 / 1 35.46	P	18.50
3	MON	1	1 38.677 / 1 39.087	P	18.50
3	MON	1	1 50.631 / 1 51.175	P	18.50
3	MON	1	1 52.409 / 1 53.839	P	18.50
3	MON	1	1 68.962 / 1 69.129	P	18.50
3	MON	1	1 71.456 / 1 71.74	P	18.50
3	MON	1	1 93.716 / 1 94.134	P	18.50
3	SLO	1	1 13.211 / 1 13.402	P	18.50
3	SLO	1	1 15.195 / 1 15.202	P	18.50
3	SB	246	246 R33.822 / 246 R34.601	P	16.25
3	SB	154	154 R7.086 / 154 R11.38	P	16.24
3	MON	41	41 47.971 / 41 50.429	P	16.02
3	MON	41	41 R16.968 / 41 27.975	P	16.02
3	MON	41	41 R41.515 / 41 R42.172	P	16.02
3	SB	154	154 R8.103 / 154 R8.134	S	15.73
3	MON	198	198 R0.102 / 198 1.092	P	15.57
3	SLO	33	33 4.872 / 33 4.945	P	15.47
3	SLO	166	166 R50.884 / 166 59.861	P	15.34
4	SLO	229	229 6.373 / 229 9.16	P	15.25
4	SLO	41	41 27.975 / 41 29.987	P	15.25
4	SLO	41	41 31.313 / 41 35.502	P	15.25
4	SLO	41	41 38.924 / 41 R41.515	P	15.25
4	MON	198	198 1.092 / 198 9.157	P	15.18
4	MON	198	198 R0 / 198 R0.102	P	15.18
4	SCR	17	17 5.454 / 17 5.871	P	11.91
4	SCR	17	17 5.455 / 17 6.81	S	11.91
4	MON	25	25 1.119 / T 25 13.973	P	11.24
4	SBT	25	T 25 26.059 / T 25 R31.223	P	11.24
4	SBT	25	T 25 48.152 / T 25 49.546	P	11.24
4	SBT	25	T 25 R52.401 / T 25 56.08	P	11.24
4	MON	1	1 22.474 / 1 24.167	P	10.96
4	MON	1	1 30.724 / 1 32.145	P	10.96
4	MON	1	1 35.46 / 1 37.738	P	10.96
4	MON	1	1 48.495 / 1 48.737	P	10.96
4	MON	1	1 60.459 / 1 61.987	P	10.96
4	MON	1	1 67.968 / 1 68.335	P	10.96

Priority	County[48]	Route	From Postmile / To Postmile	Carriageway[49]	Average Cross-Hazard Prioritization Score[50]
4	MON	1	1 69.129 / 1 69.665	P	10.96
4	SLO	1	1 13.402 / 1 14.096	P	10.96
4	SLO	1	1 14.248 / 1 14.752	P	10.96
4	SLO	1	1 15.316 / 1 15.351	P	10.96
4	SLO	1	1 32.551 / 1 32.82	P	10.96
4	SLO	1	1 34.26 / 1 34.713	P	10.96
4	SLO	1	1 52.642 / 1 53.219	P	10.96
4	SLO	1	1 54.753 / 1 55.074	P	10.96
4	SLO	1	1 56.252 / 1 56.843	P	10.96
4	SLO	1	1 57.815 / 1 58.248	P	10.96
4	MON	1	1 R88.841 / 1 R90.188	S	10.63
4	SLO	1	1 32.55 / 1 32.824	S	10.63
4	SLO	1	1 R36.167 / 1 R36.846	S	10.63
4	MON	101	101 66.402 / 101 70.856	S	8.45
4	SB	101	101 11.566 / 101 11.761	S	8.45
4	SB	101	101 28.086 / 101 32.839	S	8.45
4	SB	101	101 33.864 / 101 38.779	S	8.45
4	SB	101	101 9.086 / 101 10.018	S	8.45
4	SB	101	101 R0.114 / 101 R0.504	S	8.45
4	SB	101	101 R5.3 / 101 R6.984	S	8.45
4	SLO	101	101 37.847 / 101 46.873	S	8.45
4	MON	101	101 66.398 / 101 70.858	P	7.98
4	SB	101	101 28.105 / 101 32.836	P	7.98
4	SB	101	101 33.516 / 101 R36.646	P	7.98
4	SB	101	101 38.776 / 101 44.839	P	7.98
4	SB	101	101 9.13 / 101 10.021	P	7.98
4	SB	101	101 R5.297 / 101 R7.137	P	7.98
4	SB	101	101 R8.273 / 101 9.011	P	7.98
4	SLO	101	101 37.863 / 101 46.871	P	7.98
4	MON	183	183 9.325 / 183 9.26	P	6.61
4	MON	183	183 R8.469 / 183 R7.651	P	6.61
4	SCL	152	152 R16.519 / 152 R16.577	P	5.74
4	SCL	152	152 R16.901 / 152 R16.941	P	5.74
4	SCL	152	152 R18.338 / 152 R18.342	P	5.74
4	SCL	152	152 R18.384 / 152 R18.46	P	5.74
4	SCL	152	152 R18.652 / 152 R18.752	P	5.74
4	SBT	156	T 156 4.409 / T 156 R11.139	P	5.65
4	SBT	156	T 156 R11.408 / T 156 R18.429	P	5.65
4	SCR	9	9 7.061 / 9 7.837	P	4.02
4	SCR	9	9 8.065 / 9 8.495	P	4.02

Priority	County[48]	Route	From Postmile / To Postmile	Carriageway[49]	Average Cross-Hazard Prioritization Score[50]
5	SBT	156	T 156 R11.139 / T 156 R11.408	P	2.75
5	SBT	25	T 25 49.546 / T 25 R52.401	S	2.30
5	SCR	9	9 7.837 / 9 8.065	P	1.56
5	SCR	9	9 8.495 / 9 13.03	P	1.56
5	SBT	25	T 25 46.567 / T 25 48.152	P	1.31
5	SBT	25	T 25 49.546 / T 25 R52.401	P	1.31
5	SBT	25	T 25 R31.223 / T 25 35.086	P	1.31
5	SB	154	154 R5.923 / 154 R7.086	P	1.21
5	SLO	41	41 11.513 / 41 R16.968	P	1.20
5	SLO	41	41 29.987 / 41 31.313	P	1.20
5	SLO	41	41 35.502 / 41 38.924	P	1.20
5	SLO	41	41 14.105 / 41 15.803	S	1.20
5	SLO	41	41 15.96 / 41 R16.104	S	1.20
5	SB	246	246 30.28 / 246 R33.822	P	0.91
5	SCR	9	9 9.62 / 9 9.435	S	0.66
5	MON	1	1 33.868 / 1 34.389	P	0.62
5	SLO	1	1 63.772 / 1 R65.218	P	0.62
5	SLO	1	1 R36.17 / 1 36.91	P	0.62
5	SLO	1	1 R67.291 / 1 70.126	P	0.62
5	SB	246	246 31.599 / 246 32.109	S	0.54
5	SB	246	246 33.31 / 246 R33.511	S	0.54
5	SLO	46	46 R12.065 / 46 R17.797	P	0.50
5	SLO	1	1 34.262 / 1 R34.925	S	0.41
5	SCR	236	236 0.092 / 236 0.181	P	0.20
5	SB /SLO	166	166 R34.53 / 166 R50.884	P	0.18
5	SLO	58	58 45.2 / 58 52.808	P	0.01

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