2019
State Highway System Management Plan

May 16, 2019

Prepared by
California Department of Transportation
in accordance with Streets and Highways Code 164.6

Executive Summary

State Highway System Management Plan

The 2019 State Highway System Management Plan (SHSMP) presents a performance driven and integrated management plan for California's State Highway System (SHS). SHS needs, investments, and resulting performance projections for the 10-year period spanning July 2019 – June 2029 are presented in this Plan. The SHSMP is organized to align with the California Department of Transportation (Caltrans) Strategic Management Plan.

About the SHSMP

The SHSMP integrates the maintenance, rehabilitation and operation of the SHS into a single management plan that implements state and federal asset management requirements with new resources from Senate Bill (SB) 1.

The SHSMP operationalizes the California Transportation Asset Management Plan (TAMP) using California Transportation Commission adopted asset classes, performance measures and targets pursuant to California SB 486. The 2019 SHSMP builds on the performance driven framework introduced in 2017, and strengthens integration with the TAMP.

The SHSMP uses objective analysis to focus investments on measured condition and performance objectives. The historic asset-based funding approach has been replaced by a performance driven methodology that provides greater local flexibility to achieve multiple objectives within a single project. The new management methodology allows Caltrans to better integrate multi-modal transportation options into traditional rehabilitation work to provide a cost-effective way to expand mode choice and reduce transportation related emissions.

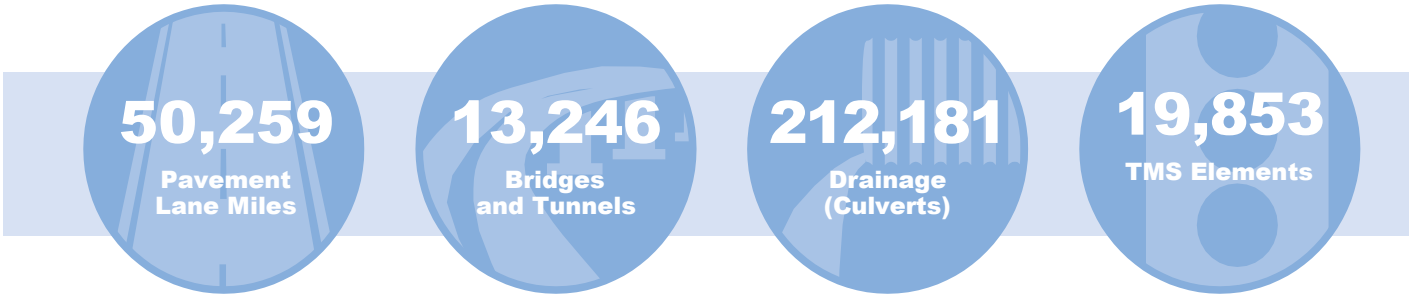
State and Federal Requirements

Under California statutes, Caltrans is the state agency responsible for planning, developing, maintaining and operating the legislatively-designated SHS and a variety of supporting infrastructure. The SHSMP satisfies the requirements of the Streets and Highway Code section 164.6 for a 10-Year State Highway Operation and Protection Program (SHOPP) Plan and a 5-Year Maintenance Plan.

Assembly Bill (AB) 515 amended California Government Code Section 164.6 to require Caltrans to prepare a State Highway System Management Plan. The SHSMP is also consistent with the asset management requirements in the federal Fix America's Surface Transportation (FAST) Act and federal Performance Management regulations.

California's State Highway System

The SHS includes a wide variety of physical assets, including the four primary assets as shown:



Inventory and Conditions for State Highway System Assets

A breakdown of the baseline SHS Inventory and Condition for assets defined in the TAMP is presented below. These quantities represent the most current and best available information at the time of report preparation.

Performance Objective	Inventory	Good	Fair	Poor	
Primary Asset Classes					
Pavement	50,259 Lane Miles	55.7%	43.2%	1.1%	
Bridges and Tunnels	251,190,698 Square Feet	65.9%	30.8%	3.3%	
Drainage	20,984,702 Linear Feet	69.2%	21.0%	9.8%	
Transportation Management Systems	19,853 Each	67.4%	N/A	32.6%	
Supplementary Asset Classes					
Drainage Pump Plants	291 Each	11.3%	29.6%	59.1%	
Highway Lighting	94,724 Each	40.1%	14.5%	45.4%	
Office Buildings	2,679,281 Square Feet	43.4%	29.3%	27.3%	
Overhead Sign Structures	15,837 Each	73.9%	22.1%	4.0%	
Safety Roadside Rest Areas	86 Locations	34.9%	36.0%	29.1%	
Transportation Related Facilities	4,027,759 Square Feet	22.9%	14.5%	62.6%	
Weigh in Motion Scales	141 Stations	19.9%	48.2%	31.9%	

Performance Management

The SHSMP includes a Needs Assessment to achieve the established performance targets and an Investment Plan to guide SHS and related infrastructure management.

The Needs Assessment is an aggregation of numerous analyses that fully defines our existing inventory or deficiency, condition or performance targets, existing pipeline of work, a gap analysis and cost estimate to close the gaps. Collectively these steps are referred to as Performance Management and are a requirement of the Moving Ahead for Progress in the 21st Century Act (MAP-21) and Fixing America's Surface Transportation Act (FAST Act).

Managing SHS Needs

The 10-year Needs Assessment identifies a $90.4 billion total need to maintain the existing SHS (Table A).

The estimated SHOPP need is slightly reduced from the 2017 SHSMP. A combination of factors has contributed to this, including condition improvements in pavement resulting from a significant investment increase from SB 1, maturity in asset management practices, and improved condition assessment methods and data.

Prior to the passage of Senate Bill 1, available transportation funding for the SHS was about 25% of the identified annual need. With additional funding from SB1, annual funding relative to need has more than doubled to 56%.

Investment Plan

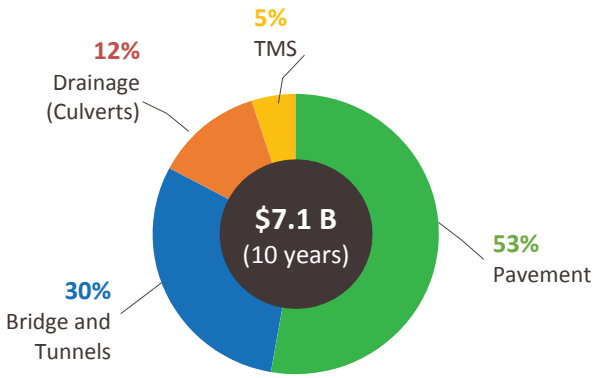
The maintenance programs focusing on pavement, bridge and tunnel, drainage (culvert), and transportation management system projects have received additional funding from SB 1 and are now fairly well resourced. The SHOPP has a $3.6 billion annual shortfall that imposes a constraint that requires transportation objectives to be prioritized for funding. The constrained funding proposal is presented in the SHSMP as an Investment Plan.

The SHSMP Investment Plan considers factors such as existing conditions, system performance, pipeline of projects, legal mandates, consequences of inaction, environmental stewardship, and funding reservations to arrive at the proposed allocation of funding. A breakdown of the recommended Maintenance and SHOPP Investment Plans for the 10-year period is shown below.

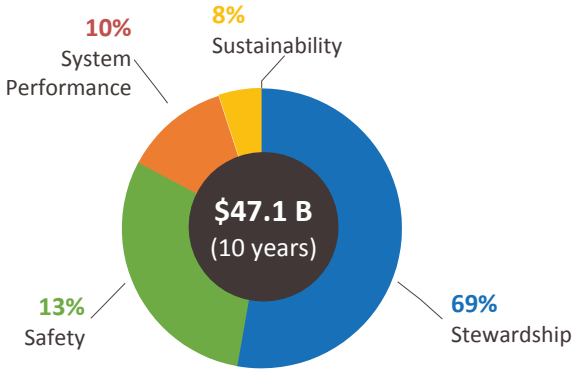
Table A.
10 Year Needs Assessment and Investment Plan

Program	10 Year Needs ($B)	10 Year Investment ($B)
Maintenance Program	$7.1	$7.1
SHOPP (Rehabilitation/Operations)	$83.3	$47.1
Total	**$90.4**	**$54.2**

Maintenance Investment Plan

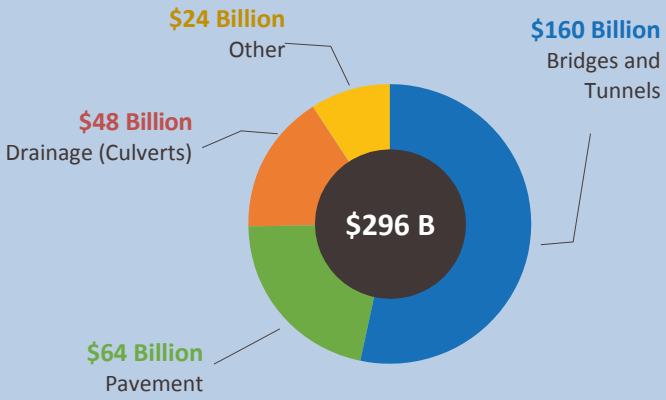


SHOPP Investment Plan



Value of Primary Assets on the SHS

Investments in the SHS over time have created a highway network with an estimated replacement cost of $296 billion. A breakdown of major system component replacement value is shown here, where the replacement value is calculated using the inventory quantity multiplied by the unit replacement cost.



Projected 10-Year Performance Accomplishments

With the available funding and anticipated deterioration over the next ten years, Caltrans expects to be able to complete maintenance and rehabilitation work as shown in the performance outcomes chapter of this Plan. Table B highlights combined expected accomplishments from the Maintenance and SHOPP programs for the four primary asset classes. This table quantifies project-level outputs expected across the spectrum of treatments by condition category. Quantities have been rounded for presentation.

Table B.
Estimated 10 Year Performance Accomplishments (2019 2029)

Asset Class	Good Condition (Preventive Maintenance)	Fair Condition (Maintenance and SHOPP)	Poor Condition (Maintenance and SHOPP)
Pavement	13,000 Lane Miles	30,000 Lane Miles	700 Lane Miles
Bridges and Tunnels	27.0 million Square Feet	31.3 million Square Feet	4.3 million Square Feet
Drainage (Culverts)	N/A	2.5 million Linear Feet	788,000 Linear Feet
TMS	810,000 Maintenance checks/repairs	N/A	9,700 Replacements 2,600 New Elements

This plan recommends investment in supplementary asset classes at levels below what is necessary to achieve the Desired State of Repair (DSOR) due to funding constraints.

The passage of SB1 has provided much needed transportation system funding. Improved asset management strategies and a focus on project delivery will result in visible improvement to the transportation system in California over time. Significant work has been done to implement new programs and ramp up project delivery for this new transportation funding normal.

Projected 10-Year Condition

With the available funding, Caltrans expects that the condition of the four primary asset classes will improve over the Plan period. Caltrans is on track to meet SB 1 targets by 2027, as shown in Table C. These targets are aligned with targets set forth in the TAMP, as shown in Table D. By meeting TAMP targets, Caltrans will surpass SB 1 targets.

Table C.
SB 1 Targets for 2027

Asset Class	SB 1 Target
Pavement	98% Good or Fair Condition; 90% level of service (LOS) achieved for maintenance of potholes, spalls, and cracks
Bridges	Fix an additional 500 bridges
Culverts	90% Good or Fair Condition
TMS	90% Good Condition

As presented in Table C, SB 1 includes a performance requirement to fix not less than an additional 500 bridges over a 10 year period ending in 2027. Projects that improve the condition of the bridge from a lesser condition to a better condition, mitigate seismic or scour vulnerabilities, or replace bridge rail not meeting current federal crash test standards are counted towards this goal. Prior to the passage of SB 1, Caltrans was fixing an average of 126 bridges per year. For the purpose of counting towards the additional 500 bridges which should be fixed, Caltrans is reporting only those in excess of the baseline of 126 bridges.

Table D lists the targets established in the TAMP and provides the projected condition for the four primary asset classes at the end of the Plan period relative to baseline conditions.

Table D.
Transportation Asset Management Plan Targets for 2027

Asset Class		Good	Fair	Poor	Projected 10 Year Condition Relative to Baseline
Pavement	Class 1	60%	39%	1%	Fair pavement conditions are expected to improve gradually for all pavement classes over the Plan period. In all classes, the amount of poor condition pavement is expected to reach targets and maintain those levels over the Plan period.
	Class 2	55%	43%	2%	
	Class 3	45%	53%	2%	
Bridges and Tunnels		83.5%	15%	1.5%	The number of poor condition bridges is expected to be reduced over the Plan period, achieving the target conditions by 2027 and maintaining through 2029. Fair condition bridges are also expected to improve over the Plan.
Drainage (Culverts)		80%	10%	10%	Culvert inspection is expected to be completed over the Plan period. Culvert condition is expected to gradually improve over the Plan period, achieving targets by 2027 and maintaining through 2029.
TMS		90%	N/A	10%	TMS inventory is expected to grow over the Plan period. The condition is expected to improve gradually over the Plan period and is expected to achieve the performance targets by 2027 and maintaining through 2029.

Changing the Way We do Business

The 2019 SHSMP carries forward the major changes implemented with the 2017 SHSMP. These changes collectively improved the management of the State Highway System, focused activities on performance in alignment with Caltrans' Strategic Management Plan, and provided structural changes and transparency to improve the management of our assets. In addition, Caltrans carried out a Lean 6 Sigma effort in 2017 with a focus on improving business processes for project nomination and development. As a result, project-level decision-making was shifted from a centralized headquarters function to the districts. This shift empowers the districts to better address regional priorities and respond to the unique needs of their constituents.

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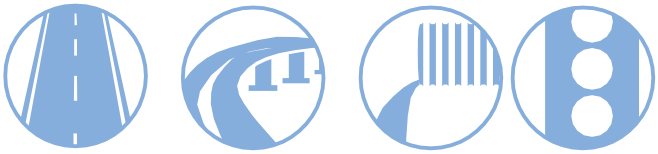

1 Introduction

The 2019 State Highway System Management Plan (SHSMP) presents a performance-based framework that guides decision-making and priorities for maintenance, preservation, rehabilitation, and reconstruction investments on the State Highway System (SHS).

It continues the same framework established in the 2017 SHSMP, which replaced a legacy asset-based funding approach. The SHSMP performance-based approach represents a fundamental change in how Caltrans spends transportation funds for major capital improvements necessary to preserve and protect the SHS.

The SHSMP spans a 10-year period from July 2019 through June 2029, and provides more flexibility in achieving multiple objectives within a single project. This improved framework allows Caltrans to better integrate multimodal transportation options into traditional rehabilitation work to provide a cost-effective way to expand mode choice and reduce transportation-related emissions. It enables Caltrans to make better-informed investment decisions, balance competing priorities, evaluate long-term performance outcomes, promote transparency, and communicate to stakeholders the value of investments in transportation infrastructure.

1.1 Overview

The SHSMP applies a performance management framework to the SHS, integrates maintenance and rehabilitation activities, and aligns investments with the *Caltrans Strategic Management Plan 2015-2020*[1]. The SHSMP defines the inventory and condition of assets, establishes condition targets, determines the magnitude of condition gaps, develops cost estimates to close the gaps, and defines a constrained investment plan for the State Highway Operation and Protection Program (SHOPP) and the Maintenance Program.

The SHSMP addresses a majority of the asset management requirements from the *2018 California Transportation Asset Management Plan (TAMP)*[2]. The SHSMP goes beyond the TAMP requirements to implement a performance-driven approach for the SHOPP and the Maintenance Program. All project planning, initiated after July 2017, is based on SHSMP performance objectives. This ensures that projects that begin the planning process will collectively accomplish enough work to achieve the performance targets established by Senate Bill (SB) 1, Road Repair and Accountability Act[3]. The SHSMP addresses key requirements set forth in state and federal statutes.

1.2 Making Progress

Caltrans has made structural changes to how funding is distributed within SHOPP programs. The silo-based funding approach in place for decades has been replaced with a performance-driven allocation methodology. This methodology facilitates more comprehensive project solutions by combining numerous assets into a corridor-type project. It provides the opportunity to develop projects that minimize negative impacts to users with economies of scale for traffic control and environmental costs. The new structure of the SHOPP has led to earlier collaboration with local partners and opportunities to find mutually beneficial project opportunities to avoid potentially overlapping work, enhance efficiency, and maximize the effectiveness of available funding.

The *2017 State Highway System Management Plan*[4] implemented fundamental changes in the way Caltrans manages available funding by focusing on measured condition and performance objectives. Under the provisions of the SHSMP, performance and funding targets are provided to each Caltrans district, empowering them to combine performance accomplishments together in cost-effective projects that are less disruptive and better align with local partners' work. The SHSMP methodology allows Caltrans to

[1] Caltrans, "Caltrans Strategic Management Plan 2015-2020", 2015, http://www.dot.ca.gov/perf/library/pdf/Caltrans_Strategic_Mgmt_Plan_033015.pdf
[2] Caltrans, "2018 California Transportation Asset Management Plan", http://www.dot.ca.gov/assetmgmt/
[3] Senator Beall, "Road Repair and Accountability Act of 2017", (Senate Bill 1), 2017, https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1
[4] Caltrans, "2017 State Highway System Management Plan", 2017, http://www.dot.ca.gov/assetmgmt/

better integrate multimodal transportation options into traditional rehabilitation work to provide a cost-effective way to expand mode choice and reduce transportation-related emissions.

The SHSMP provides unprecedented transparency in the presentation of the current conditions and performance of the system, project stream, deterioration rates, repair costs, and targets used to develop the Needs Assessment in Chapter 2. The 10-year Investment Plan, in Chapter 4, clearly shows where available funds are being invested and the expected condition and performance outcomes of those investments.

Caltrans has integrated SHOPP and Maintenance Program investment decisions for pavement, bridges, culverts, and Transportation Management System (TMS) units to realize efficiencies in the combination of these resources. These four asset classes represent a significant portion of the SHS maintenance and rehabilitation investments in California. The California Transportation Commission (Commission) adopted these four as focus areas, in the ongoing implementation of asset management. The integrated presentation provides a clear understanding of how these funding programs work together to bring a continuum of asset management throughout their life cycle.

1.3 Federal, State, and Departmental Requirements

The SHSMP implements key requirements set forth in State and Federal statutes, organizing activities and performance in a framework aligned with Caltrans' strategic objectives. It applies principles of performance management for each asset class to develop optimum performance need for the asset subject and then further define the expected performance targets. Total needs of individual asset classes as well as that of the highway system reflect contributions of both the SHOPP and Maintenance Program to asset condition and overall system performance.

Performance Management

A strategic approach where one uses the baseline inventory and performance of an objective, predicts the future inventory and performance of the objective via performance models, and quantifies performance gaps which need to be addressed to achieve performance targets.

Performance Measure

A quantitative basis to assess progress of an objective towards its performance targets. Caltrans uses a three-state performance measure which is composed of the percentage of the inventory with a good, fair, and poor performance for the objective. As an example, Caltrans uses the percentage of good, fair, and poor lane-miles relative to the pavement inventory as the performance measure for the pavement objectives.

Performance Metric

A quantifiable criterion which is used to determine whether the performance of the objective is good, fair, or poor. As an example, Caltrans uses roughness and cracking for all pavements, rutting for asphalt pavements, and faulting for concrete pavements as the performance metrics.

Federal Requirements

Moving Ahead for Progress in the 21st Century (MAP-21) Act[5] and Fixing America's Surface Transportation Act (FAST Act)[6] outline federal asset management requirements addressed in the SHSMP. MAP-21 requires states to adopt national asset management performance measures to establish

[5] Rep. Mica, John L., (23 U.S.C. 101(a)(2), MAP-21 § 1103) Moving Ahead for Progress in the 21st Century Act, 2012, https://www.gpo.gov/fdsys/granule/USCODE-2011-title23/USCODE-2011-title23-chap1-sec101

[6] Fixing America's Surface Transportation Act, 2015, https://www.gpo.gov/fdsys/pkg/PLAW-114publ94/pdf/PLAW-114publ94.pdf

nationwide consistency for pavement and bridge condition reporting. These performance measures use a condition scale (good, fair, and poor) to quantify pavement lane miles or bridge deck area condition. The Automated Pavement Condition Survey (APCS) and bridge Element Level Inspection (ELI) data incorporate these condition assessment requirements into Caltrans' practice.

State Requirements

The *2019 SHSMP* is an integrated management plan that defines specific quantifiable accomplishments, goals, objectives, costs, and performance measures and targets as required by the California Streets and Highway Code (SHC), Section 164.6[7], for the SHOPP 10-Year Plan and the 5-Year Maintenance Plan. The SHC requires Caltrans to update this plan every two years. These requirements were amended to combine these two plans under Assembly Bill (AB) 515[8].

Under California statutes, Caltrans is the state agency responsible for planning, developing, maintaining, and operating the legislatively-designated SHS and its variety of supporting infrastructure (highway maintenance stations, safety roadside rest areas, and drainage facilities, among others). Similarly, the SHC assigns various state highway funding and project approval responsibilities to the Commission. Together and in partnership with a wide variety of local, regional, and federal transportation oversight agencies, the private sector, Caltrans, and the Commission, direct highway system preservation activities and projects to support a robust asset management approach as required by SB 486[9].

Departmental Requirements

The SHSMP organizes key activity areas or objectives into categories that generally align with Caltrans' Strategic Management Plan. This structure provides clarity on the specific strategic goals Caltrans is working to accomplish, along with transparency of the level of needs and investments in each of the strategic areas.

[7] California Streets and Highway Code, Section 164.6, 2017, https://leginfo.legislature.ca.gov/faces/billCompareClient.xhtml?bill_id=201720180AB515
[8] Assemblyman Frazier, Assembly Bill 515, 2017, https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB515
[9] Senator DeSaulnier, Senate Bill 486, 2014, https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB486

1.4 The California State Highway System

Caltrans is the state agency responsible for planning, developing, maintaining, and operating the legislatively-designated SHS. The SHS includes a wide variety of physical assets. Highway infrastructure assets, within state highway boundaries, include 50,259 lane miles of pavement; 13,189 bridges and 57 tunnels; 212,181 culverts; and 19,853 TMS assets. The most significant assets on the SHS, in terms of their cost and extent, are pavement and bridges. However, many other assets are needed to support mobility and improve safety. In many cases, replacement or rehabilitation of roads and bridges includes replacement or upgrades to other supplementary assets as depicted in Figure 1-1. For instance, the cost of reconstructing or replacing a bridge includes the cost of guardrail; pavement projects often include upgrades to associated traffic and safety assets. Where applicable, costs associated with these supplementary assets are included in the cost of maintaining pavement and bridges.

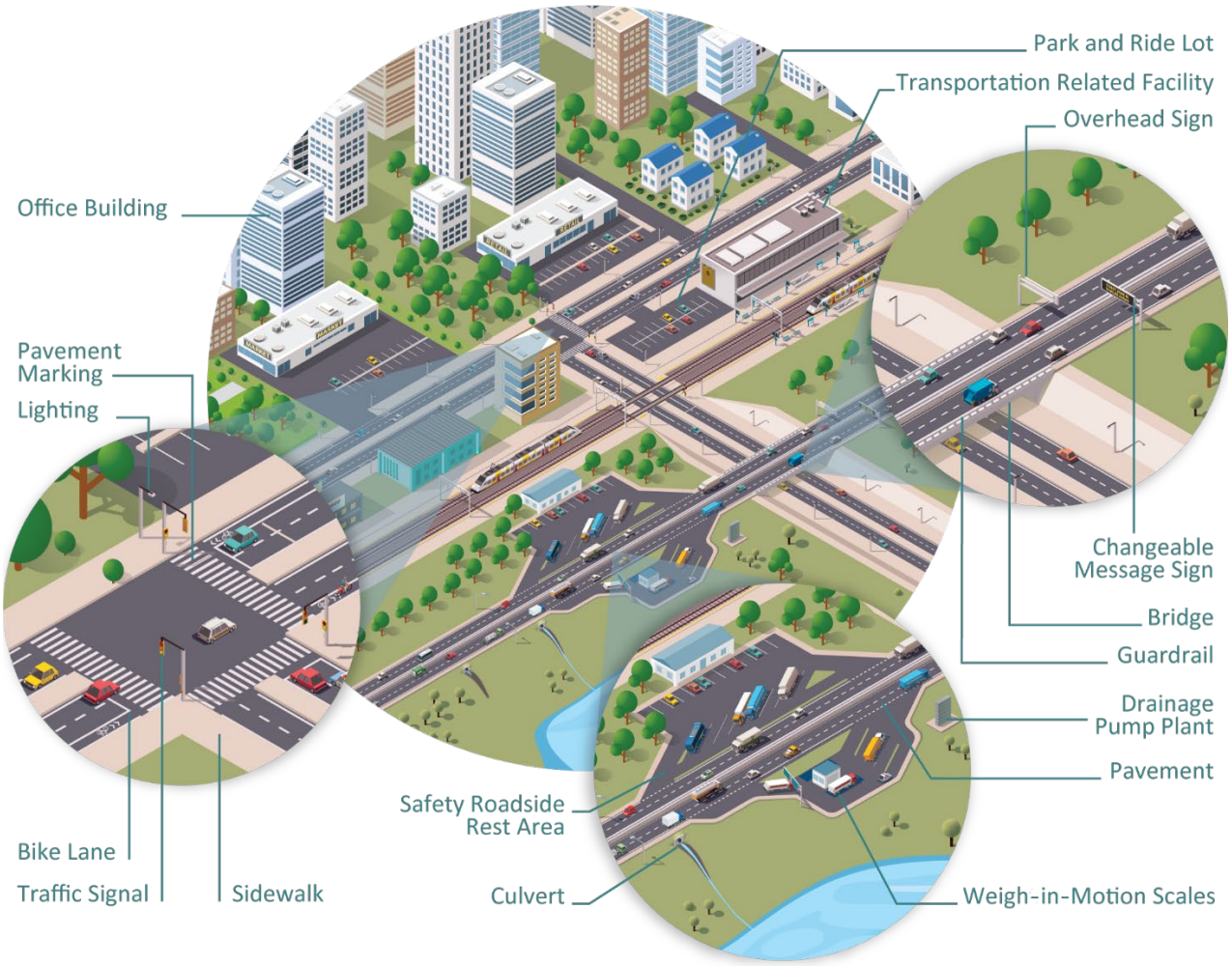

Figure 1-1. Typical Highway Assets

Additional support facilities, such as maintenance stations, equipment shops, and transportation materials laboratories and testing facilities, are also included as SHS assets. Many system components, built in the 1950s, 1960s, and early 1970s, have reached or are reaching the end of their service life. Asset deterioration is accelerating at a faster rate than in previous decades, because of age and traffic demands, often requiring extensive rehabilitation and even full reconstruction. The vast extent of the SHS is illustrated in Figure 1-2.

Figure 1-2. State Highway System

1.5 Strategies for Maintaining the State Highway System

Caltrans strives to preserve the condition of the SHS in the most economical means possible through carefully planned preservation strategies (i.e., preventive maintenance, corrective maintenance, and minor rehabilitation) and rehabilitation or replacement when necessary. Caltrans manages the SHS condition by performing the right treatment at the right time through a combination of three approaches: Field Maintenance Crews, Major Maintenance projects, and SHOPP projects. Each approach plays a key role in the overall management and preservation of the SHS, as shown in Figure 1-3.

Figure 1-3. Approaches to Maintain the State Highway System

Field Maintenance Crews

Caltrans Field Maintenance Crews regularly address the day-to-day demands of the SHS. These field activities are the first line of defense in Caltrans' SHS maintenance, and are reactionary in nature. The Field Maintenance Crews collectively perform many aspects of ongoing maintenance of highways and assets on the SHS. Crews address minor maintenance, repairs, and preservation work. This typically includes pothole repair, crack sealing, cleaning of drains, servicing lighting and signs, structural painting, minor facility repairs, irrigation repairs, and more. Crews also provide rapid response to repair minor accident damage.

Preventive maintenance is applied to assets in good condition and some fair condition assets when appropriate, with the goal of maintaining their condition. For example, a bridge preventive maintenance activity is the painting of steel structures. Field maintenance strategies are important tools for extending asset service life in a cost-effective manner.

Major Maintenance Projects

Highway Maintenance (HM) projects help further prolong the life of existing infrastructure. These projects include preventive and corrective maintenance strategies that exceed the scope of what Field Maintenance Crews typically manage. Corrective maintenance typically applies to assets in fair condition; however, it can also be applied to some assets in poor condition, with the goal of restoration to good condition. For example, one pavement corrective maintenance activity is crack sealing. Since deterioration (degradation of materials over time) can accelerate the longer the asset is in fair condition, the timely application of corrective maintenance can often prevent the need for more costly treatments later. Caltrans executes HM projects through contracts. HM work, designed to extend the life of physical assets, delays rehabilitation or replacement of assets, and is performed on pavement, bridges, culverts, facilities, TMS, and more. HM projects, which may be preventive or corrective in nature, include thin pavement overlays, bridge joint seals, and culvert repairs. This category of projects repairs but does not upgrade or replace facilities.

SHOPP Projects

When field maintenance and more extensive HM project activities are no longer cost-effective or viable, Caltrans considers asset rehabilitation or replacement. Rehabilitation or replacement, which applies to assets in both fair and poor condition, is typically funded through the SHOPP. SHOPP projects are more complex capital construction projects that use private construction contractors obtained through a competitive bidding process. These projects, which may involve complex upgrades, overhaul infrastructure nearing the end of its lifespan. They may involve extensive planning and design, environmental permitting and even right-of-way acquisition. Rehabilitation and replacement activities are performed on pavement, bridges, culverts, buildings, overhead signs, lights, roadside elements, Safety Roadside Rest Areas (SRRA), and more. The SHOPP invests available funds to implement safety improvements, rehabilitate or replace physical assets, improve the operation of the highways, improve system resiliency, and mitigate transportation-related environmental impacts. The SHOPP includes 32 Performance Objectives as described in this document. The Commission has direct responsibility to adopt SHOPP projects and to approve all scope, schedule, and costs changes to adopted projects. Furthermore, the Commission sets asset performance targets to ensure SHOPP investments are achieving desired statewide transportation outcomes.

Additional Strategies

In addition to SHOPP and Maintenance Programs, there are other funding programs that address additional SHS needs. Beyond Asset Management's objective of taking care of existing SHS assets, there are SHS needs for upgrading and expanding facilities to accommodate increased freight movement, broader economic growth, population increases, new transportation technologies, and evolving land use patterns. These are beyond the scope of SHOPP and Maintenance Programs and are instead addressed through a variety of other funding programs, such as FAST Act, the State Transportation Improvement Program (STIP), state transportation bond programs, local transportation tax measures, and other funding programs. These programs all invest in the SHS, as well as in local roads, and they sometimes address SHS preservation needs

at the same time. As projects are developed and constructed through these other funding programs, it is essential the project development process incorporates life cycle and asset management considerations. Projects should be as efficient and cost-effective as possible to maintain, preserve, and when the time comes, rehabilitate assets on the SHS.

Each of these programs plays key roles and works together in the overall management of the SHS. Using the three-pronged approach to asset preservation, Caltrans can make timely repairs at the right time to extend the useful life of the assets at the lowest possible long-term cost and to delay future rehabilitation and replacement activities.

Benefits of Preventive Maintenance

The combination of these three approaches allows Caltrans to effectively preserve the highway infrastructure in the most cost-effective manner. Caltrans Field Maintenance Crews carry out work to address minor needs before they grow into major and more expensive repairs. HM contracts are initiated to carry out work at the right time to extend the useful life of assets at the lowest possible long-term cost and to delay future rehabilitation or replacement activities. And finally, SHOPP capital improvement projects are used to invest in major asset rehabilitation or replacement projects when the end of an asset's useful life has been reached. This tiered approach maximizes transportation preservation investments.

Preventive maintenance is the most cost-effective means of protecting the State's infrastructure investment; these activities focus on keeping good condition assets in good condition. Caltrans recommends strategies to slow deterioration and extend pavement, bridge, and drainage life in fair or good condition. Figure 1-4 presents the benefits of preventive maintenance.

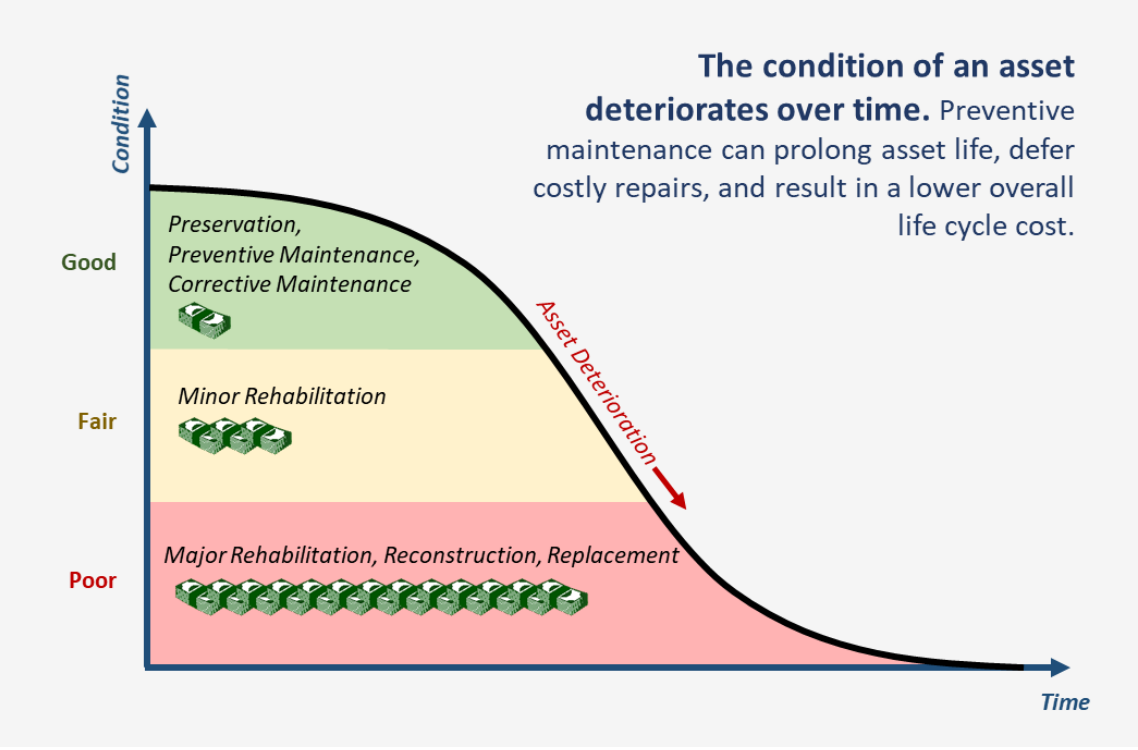

Figure 1-4. Benefits of Preventive Maintenance

1.6 Performance-Based Asset Management Approach

The SHSMP is built from a performance-based asset management approach comprising of several key analysis steps. These steps define the inventory and condition of assets, establish condition targets, determine the magnitude of condition gaps, develop cost estimates to close the gaps, and define a constrained investment plan. This analytical process is organized into the three major steps shown below. The following chapters present each of these steps in greater detail. Additional chapters cover Program Objectives, Life Cycle Planning, and Risk Management.

Performance-Based Asset Management Approach

Needs Assessment

Conduct a performance management analysis to determine the total needs, unconstrained by funding. Estimate the costs necessary to close all condition and performance gaps.

Revenue and Financial Projections

Determine funding and resources available over the 10-year SHSMP period.

Investment Plan and Performance Outcomes

Define how available funding is recommended to be allocated, prioritize where available resources should be focused to keep highways functioning with constrained funding. Estimate the performance metrics anticipated to be achieved, given the defined Investment Plan.

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2 Needs Assessment

The California Streets and Highway Code (SHC) requires the development of a State Highway System (SHS) Needs Assessment to define program areas and costs associated with achieving condition and performance targets.

The Needs Assessment provides a picture of the SHS total needs and is not constrained by currently available funding. The majority of the SHS needs is determined through a gap analysis completed as part of the performance management implementation.

The Needs Assessment is the first in a series of steps in a performance management analysis framework. In this context, "needs" can be defined as the gap in performance between the current condition (i.e., distribution of good, fair, and poor condition) and a future Desired State of Repair (DSOR) condition. The SHSMP defines needs over a 10-year period, spanning July 2019 through June 2029. These needs are addressed through a combination of SHOPP capital investment projects, Highway Maintenance projects, and work carried out by Caltrans Field Maintenance Crews.

The total needs to be addressed through maintenance and rehabilitation work are determined through a gap analysis. Preventive maintenance needs are also considered in the gap analysis. These are associated with activities that focus on keeping good condition assets in good condition for as long as possible.

2.1 Needs Assessment Approach

The Needs Assessment approach comprises of a series of five key steps, as described in Figure 2-1. This process begins by establishing an inventory of assets, determining current and future projected conditions, calculating gaps relative to performance targets, and concluding with the calculation of the total cost in closing the gap. While this approach is readily applied to performance objectives associated with physical assets and their state of repair, the same approach is applied to the other performance objectives that focus on needs beyond the condition of physical assets.

Figure 2-1. Steps to Carry Out the Needs Assessment

STEP 1 – Asset Inventory

Establish an asset inventory or deficiency level.

The inventory comprises the count or quantity of individual assets or deficiencies, reported in units of measure appropriate to the asset type. Caltrans quantifies pavement inventory by lane miles, bridges by square feet of deck area, drainage in linear feet, and TMS by each unit.

STEP 2 – Baseline and Projected Condition

Establish the baseline and projected future condition of each objective.

For each asset in the inventory, the condition is determined for the baseline (or current) condition as well as a projected future condition at the end of the 10-year Plan period. The future condition at the end of the 10-year Plan period is typically projected for two scenarios: (1) future condition in the absence of any project, which is also known as a do-nothing or free-fall scenario, and (2) future condition with only pipelined projects. The three condition descriptors used are good, fair, and poor. Criteria for determining asset condition are unique to the type of asset.

STEP 3 – Target Condition

Establish targets to achieve desired state of repair.

Caltrans establishes performance targets that represent the desired condition (good, fair, poor) of the asset inventory at the end of the performance plan period. A combination of federal and state statutes (MAP-21, SB 1), Commission guidelines, and Caltrans practices guide the target setting process. The targets are documented in the TAMP and the SHSMP and approved by the Commission.

STEP 4 – Performance Gaps

Perform a gap analysis between projected and performance targets.

Caltrans performs a gap analysis to quantify the difference between the projected condition with pipelined projects and the target DSOR condition at the end of the 10-year Plan period. Pipelined projects are projects programmed in the current SHOPP or Project Initiation Document (PID) workplan, or other work underway resulting in a change in condition from the baseline. The resulting change is assumed to be realized when the contract is advertised.

STEP 5 – Cost to Close Performance Gaps

Estimate the cost to close performance gaps.

From the fair and poor gap quantities, the cost associated with closing these gaps can be calculated using the unit costs associated with poor and fair treatment strategies.

Figure 2-2 summarizes the gap analysis steps and illustrates an example where the projected condition for both poor and fair assets will fall short of targets.

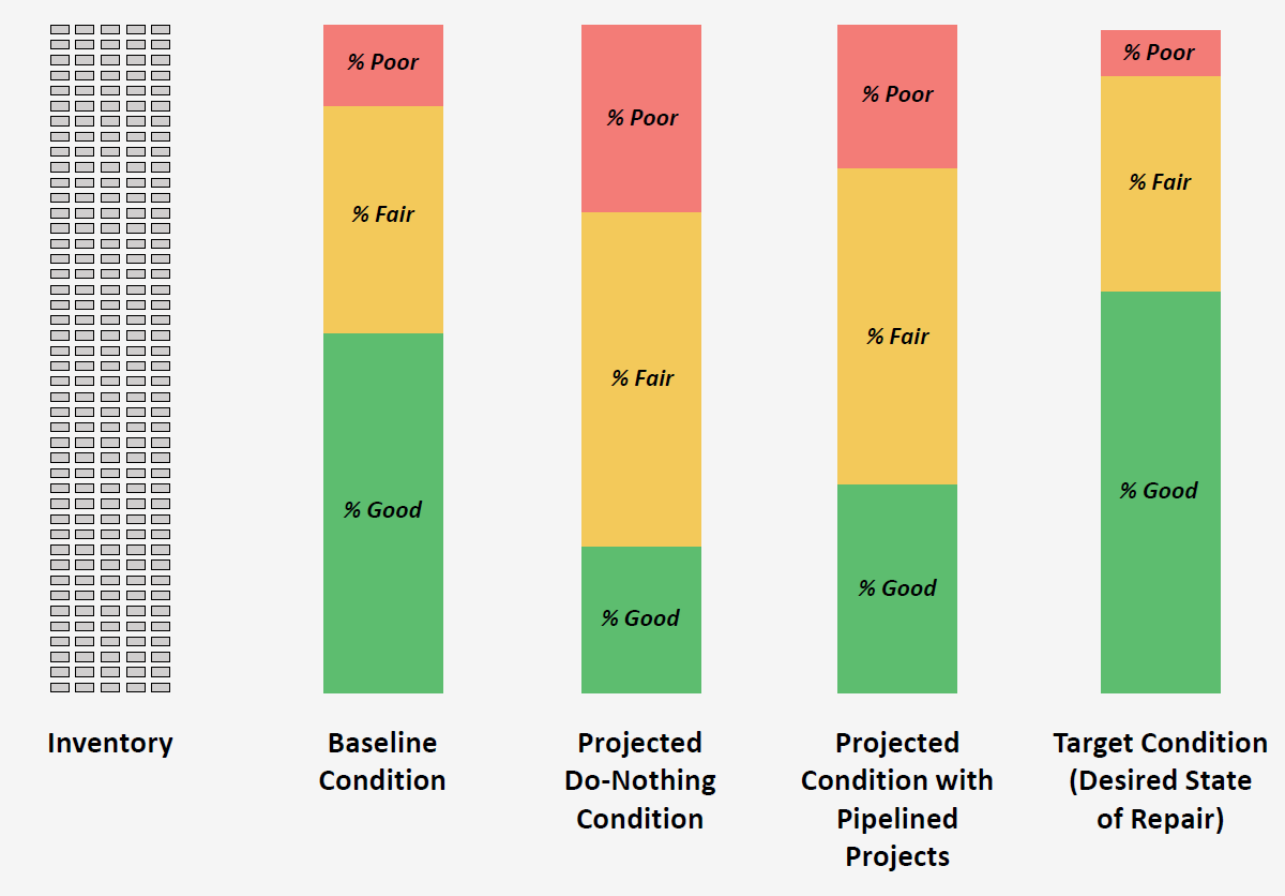


Figure 2-2. Gap Analysis

2.2 Performance Management Framework

Performance objectives are established to quantify and measure the most significant elements of work that Caltrans addresses through SHOPP and maintenance activities.

These elements are important because of their relative asset valuation, strategic priority, or statutory or legal mandate. These 32 Performance Objectives address the needs of physical highway infrastructure assets (pavement, bridges), deficiencies (safety, storm water mitigation), as well as unplanned needs (emergency response). The categorization of performance objectives by strategic goal and performance management model type is presented in Table 2-1. Chapter 5 of this Plan provides detailed discussion of each Performance Objective.

Strategic Framework

Caltrans builds the Needs Assessment analysis upon a strategic framework of 32 Performance Objectives organized by four primary Strategic Goals:

- **Safety**: Minimize fatalities, serious injuries, and severity of accidents for all modes of transportation.
- **Stewardship**: Minimize long-term costs of ownership, maintain or improve the condition of physical assets.
- **Sustainability:** Minimize impacts to environment and communities, improve transportation system resiliency.
- **System Performance:** Increase mode choice, provide reliable travel times, improve goods movement and minimize delay associated with congestion.

Performance Management Models

The SHSMP defines three performance management models that support the development of future need projections over the 10-year Plan period:

- Physical Asset Model
- Deficiency Model
- Reservation Model

The Physical Asset Model defines the methods and parameters needed to characterize how the condition of a physical asset, such as a bridge, will degrade over time. The Deficiency Model is used to measure progress towards addressing elements or locations identified through statutory, legal, or strategic goal-driven requirements. To anticipate work likely needed because of natural disaster and other unplanned events that impact the SHS, Caltrans uses the Reservation Model. While many of the performance objectives are related to physical highway infrastructure assets and can be characterized using a physical asset model, two additional models are needed to characterize unique circumstances. Further explanation of how these models apply to the Performance Objective is presented in Chapter 5.

Table 2-1. Framework for Categorizing SHS Needs

SHS Needs by Strategic Goal and Model Type			
Performance Objectives	**Physical Asset Model**	**Deficiency Model**	**Reservation Model**
Safety			
Bridge Rail Replacement and Upgrade	✓		
Collision Severity Reduction		✓	
Roadside Safety Improvements		✓	
Safety Improvements			✓
Stewardship			
Bridge and Tunnel Health	✓		
Drainage Pump Plants	✓		
Drainage Restoration	✓		
Lighting Rehabilitation	✓		
Major Damage (Emergency Opening)			✓
Major Damage (Permanent Restoration)			✓
Office Buildings	✓		
Overhead Sign Structures Rehabilitation	✓		
Pavement Class I	✓		
Pavement Class II	✓		
Pavement Class III	✓		
Relinquishments			✓
Roadway Protective Betterments		✓	
Safety Roadside Rest Area (SRRA) Rehabilitation	✓		
Transportation Related Facilities	✓		
Water and Wastewater Treatment at SRRAs	✓		
Sustainability			
ADA Pedestrian Infrastructure		✓	
Advance Mitigation			✓
Bridge Scour Mitigation		✓	
Bridge Seismic Restoration		✓	
Roadside Rehabilitation	✓		
Storm Water Mitigation		✓	
System Performance			
Bridge Goods Movement Upgrades	✓		
Commercial Vehicle Enforcement Facilities	✓		
Operational Improvements		✓	
Sign Panel Replacement	✓		
Transportation Management Systems	✓		
Weigh-In-Motion Scales	✓		

Physical Asset Model

The *Physical Asset Model* is founded on the principle of deterioration. Deterioration is the physical degradation of an asset because of a combination of factors, including age, construction materials, environment, accidental damage, and traffic load. A set of deterioration rates (good-to-fair and fair-to-poor) are determined for each asset type to account for expected future conditions. Deterioration rates, expressed as an annual percentage rate, are used to quantify the proportion of the asset inventory that will degrade from good-to-fair and fair-to-poor condition states. The analysis has both a system preservation (fair-to-good) and rehabilitation/ replacement (poor-to-good) goal to ensure a balanced management approach. Figure 2-3 illustrates the cycle of physical asset deterioration and improvements.

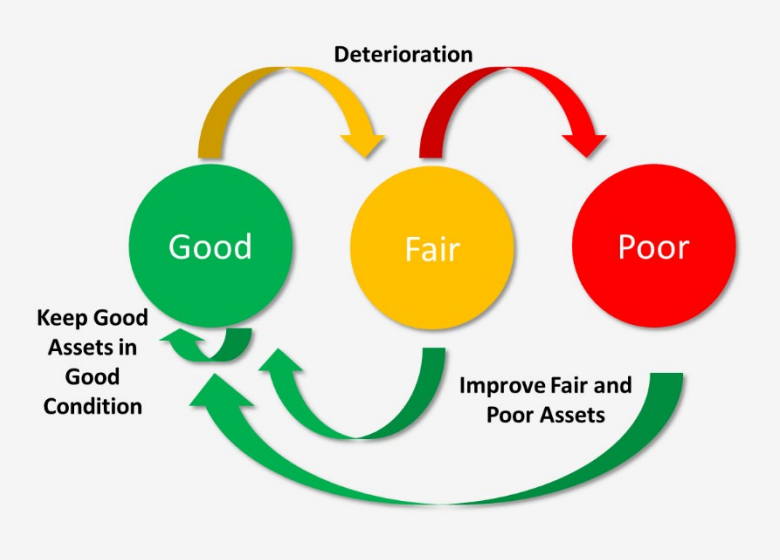


Figure 2-3. Deterioration and Improvement Cycle for Physical Assets

Deficiency Model

The *Deficiency Model* is applied to objectives where work is needed to improve or correct issues on highway infrastructure assets identified through state or federal mandates, legal settlements, updated design codes and engineering practices, or similar motivating factors. Examples include mitigating environmental impacts from storm water, enhancing worker safety through modification of roadside elements, and modifying or adding elements to comply with Americans with Disabilities Act (ADA) requirements. These needs do not have a condition breakdown like the physical assets; they are either deficient or not. A gap analysis between the current deficiency and the target is conducted similarly to the physical asset model. Cost estimates to address this need are calculated similarly to the asset model. Where a deficiency exists, it is designated as poor, while deficiencies that have been addressed are designated as good. The fair designation does not apply in the deficiency model.

Reservation Model

The *Reservation Model* is applied to unanticipated or unplanned needs, primarily emergency response activities. Objectives using the reservation model cannot be predicted in terms of the quantity or location of need as location and scope of needs are not known until an event such as a flood or landslide occurs. To effectively manage the SHS, Caltrans establishes a financial reservation to meet these needs when they arise. Reservations do not have an identified inventory, condition, or target. The reservation levels are established based on historical demand in the respective areas.

2.3 Addressing State Highway System Needs

Caltrans uses a combination of three strategies to maintain the SHS: SHOPP, Major Maintenance, and Field Maintenance Crews. These strategies are applied in combination to cover the range of maintenance activities including corrective and preventive maintenance, rehabilitation, and replacement. Table 2-2 summarizes these strategies and their focus, which are described further in this Section.

Table 2-2. Strategies to Address the State Highway System Needs

SHOPP and Maintenance Strategies				
Strategy	**Type of Work**			**Condition Focus**
	Replacement	**Rehabilitation**	**Corrective and Preventive Maintenance**	
SHOPP	●	●		Poor and Fair Condition Assets
Major Maintenance			●	Poor and Fair Condition Assets
Field Maintenance Crews			●	Fair and Good Condition Assets

Work under these three strategies is limited to activities that are consistent with state laws that govern the use of SHOPP or Maintenance funds. Generally, these laws require available funding to be expended on the safety, maintenance, rehabilitation and operation of the existing system. System expansion is not permitted through the SHOPP or Maintenance Programs.

2.4 SHOPP Needs Assessment

SHOPP needs are determined through performance management gap analysis. Assets in poor and fair condition are the primary focus of the SHOPP. The SHOPP uses capital improvement projects for rehabilitation and replacement of highway infrastructure assets. In addition, SHOPP projects address needs identified through deficiency and reservation models. The SHOPP also addresses the needs of the Minor Program and PIDs in project planning phases.

Projects currently programmed in the 2018 SHOPP or in the 2020 PID Work Plan are referred to as "pipelined" projects. Figure 2-4 shows how the pipelined projects and the remaining performance gap are aligned within the ten years of the Plan. The cost of the pipelined projects can be determined with reasonably high confidence, as these projects have either been programmed in the SHOPP or their costs have undergone reviews through the PID process. By contrast, the costs of the needed projects in the last five years have a greater range of uncertainty. The estimated cost of this work is determined by multiplying the quantity of performance units by the average unit cost associated with poor-to-good and fair-to-good treatments.

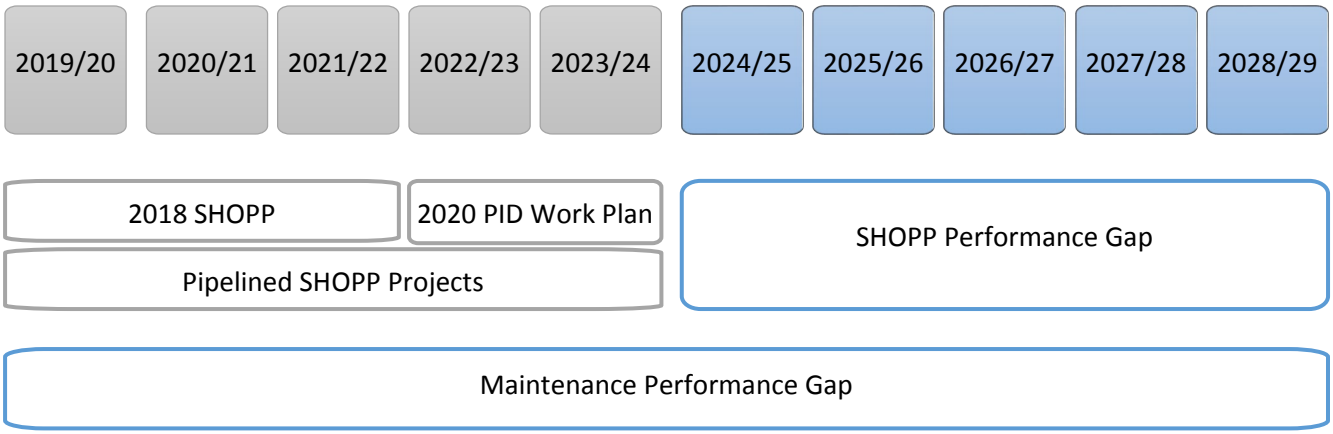


Figure 2-4. Pipeline Projects and Remaining Performance Gap

Table 2-3 summarizes the total cost associated with addressing fair and poor gaps through the SHOPP. This cost estimate is based on a combination of the cost of programmed and committed projects in the first 5 years of the 10-year Plan period, plus the projects needed to close performance gaps in the last five years of the 10-year Plan period.

2.5 Maintenance Needs Assessment

The SHC requires that the Maintenance Needs Assessment include only program activities, "that if not performed, could result in increased SHOPP costs in the future." Maintenance needs are identified through the performance management gap analysis for fair and poor condition asset classes under pavement, bridge and tunnel health, drainage restoration, and TMS. The needs from the gap analysis are then added to the preventive maintenance needs associated with activities primarily focused on good condition assets.

California Streets and Highways Code

"The State Highway System Management Plan … shall identify projected future State Highway Operation and Protection Program costs that would be avoided by increasing maintenance spending."

California Streets and Highways Code, Section 164.6(c), updated by AB 515

Table 2-3 summarizes the SHOPP and maintenance needs for the four primary asset classes, and includes costs associated with inspection forces, Field Maintenance Crews, and Major Maintenance. Chapter 5 includes a more extensive discussion of these assets.

2.6 Summary of SHOPP and Maintenance Needs

A summary of SHOPP and Maintenance needs for the 10-year Plan period are presented the Table 2-3.

Table 2-3. Summary of 10-Year SHOPP and Maintenance Needs

10-Year Total SHOPP and Maintenance Fiscal Needs by Objective***					
Objectives	SHOPP ($M)****			Maintenance ($M)	
	Pipelined Projects	Performance Gap	Sum	Major Maintenance	Field Maintenance Crews
Safety	**$4,181**	**$9,810**	**$13,991**	**-**	**-**
Bridge Rail Replacement and Upgrade	$754	$7,222	$7,976		
Collision Severity Reduction	$894	$380	$1,273		
Roadside Safety Improvements	$744	$958	$1,703		
Safety Improvements	$1,789	$1,250	$3,039		
Stewardship	**$14,801**	**$28,149**	**$42,950**	**$5,357**	**$1,372**
Bridge and Tunnel Health	$1,886	$4,235	$6,121	$1,260	$890
Drainage Pump Plants	$125	$171	$295		
Drainage Restoration	$1,395	$3,211	$4,606	$540	$292
Lighting Rehabilitation	$123	$1,502	$1,625		
Major Damage (Emergency Opening)	$	$2,388	$2,388		
Major Damage (Permanent Restoration)	$1,049	$1,060	$2,109		
Office Buildings	$27	$1,066	$1,094		
Overhead Sign Structures Rehabilitation	$141	$546	$687		
Pavement Class I	$6,174	$4,552	$10,726		
Pavement Class II	$2,865	$3,741	$6,606	$3,557	$190
Pavement Class III	$450	$117	$566		
Relinquishments	$91	$13	$104		
Roadway Protective Betterments	$120	$879	$999		
Safety Roadside Rest Area (SRRAs) Rehabilitation	$115	$1,350	$1,466		
Transportation Related Facilities	$172	$3,102	$3,274		
Water and Wastewater Treatment at SRRAs	$69	$216	$285		
Sustainability	**$2,727**	**$8,255**	**$10,981**	**-**	**-**
ADA Pedestrian Infrastructure	$543	$908	$1,451		
Advance Mitigation	$15	$	$15		
Bicycle Infrastructure	*$320**	**	**		
Bridge Scour Mitigation	$572	$360	$931		
Bridge Seismic Restoration	$615	$2,324	$2,939		
Pedestrian Infrastructure	*$340**	**	**		
Roadside Rehabilitation	$259	$2,682	$2,940		

10-Year Total SHOPP and Maintenance Fiscal Needs by Objective***					
Objectives	SHOPP ($M)****			Maintenance ($M)	
	Pipelined Projects	Performance Gap	Sum	Major Maintenance	Field Maintenance Crews
Storm Water Mitigation	$723	$1,982	$2,705		
Transit Infrastructure	*$30**	**	**		
Performance	**$3,445**	**$8,587**	**$12,032**	**$50**	**$274**
Bridge Goods Movement Upgrades	$958	$5,215	$6,173		
Commercial Vehicle Enforcement Facilities	$27	$759	$786		-
Operational Improvements	$457	$775	$1,231		
Sign Panel Replacement	$140	$859	$999		
Transportation Management Systems	$1,827	$542	$2,369	$50	$274
Weigh-In-Motion Scales	$36	$437	$473		
Sub-Total	**$25,154**	**$54,800**	**$79,954**	**$5,407**	**$1,646**
Minor Program	-	$2,400	$2,400		
PID Program Support	-	$932	$932		
Total	**$25,154**	**$58,132**	**$83,286**	**$5,407**	**$1,646**

Table 2-3 Notes:

(*) The 2018 SHOPP pipeline includes high level estimates of pedestrian, bicycle and transit investments. These costs are integrated into comprehensive projects and are therefore not added as additional costs in the table totals. These estimates rely on typical unit costs and exclude some costs that are difficult to sever from the broader project costs, such as right of way and environmental costs.

(**) A complete inventory of sidewalk and bikeway features is currently under development. Once this existing inventory is complete it will be incorporated into future plans. Refer to page 5-3 for more information.

(***) The total SHOPP Investment Plan differs from the Fund Estimate as a result of various adjustments. The Sub-totals and totals presented in the table may not add due to rounding.

(****) Cost estimates shown in the Pipelined Projects column are based on the best available scope of projects in planning and design and may be subject to change.

In addition:

- Pavement maintenance costs associated with Field Maintenance Crews work are for crack sealing.
- Drainage maintenance costs include State Field Maintenance Crews for assessments, maintenance, repairs, and associated equipment/materials.
- Maintenance performs preventive maintenance checks to keep TMS units functional. Maintenance activities do not change the condition of a TMS unit from poor to good.
- The Maintenance columns in this table reflect the total available funds for the four primary assets. The Maintenance costs in Appendix B, however, reflect the costs associated with only fair to good and poor to good activities and do not include good to good costs.

2.7 Addressing Needs through Other Programs

While Table 2-3 summarizes the total needs associated with achieving the defined condition and performance targets associated with the existing SHS, there are SHS needs addressed through programs outside of the SHOPP, Major Maintenance, and Field Maintenance Crews. These needs, which fall outside the scope of maintenance and preservation activities, are identified through the STIP, Active Transportation Program, Local Partnership Program, Solutions for Congested Corridors Program, Trade Corridor Enhancement Program, Transit and Intercity Rail Capital Program, and the Self Help Counties Coalition. Other transportation system improvement needs are identified by Regional Transportation Planning Agencies and Caltrans in regional and interregional improvement plans funded through the STIP and local transportation funding sources. Given the distributed sources of funding, it is difficult to place a specific dollar value on the value of needs being addressed by these sources. A significant portion of these funds will likely be focused on the SHS. The Commission will approve these projects on an annual basis, therefore, specific dollar figures for the SHS cannot be determined over the SHSMP 10-year planning horizon. Where data is available, condition improvements and related performance gains resulting from work through these other programs are quantified and reflected through the SHSMP analyses.

3 Revenue and Financial Projections

California's transportation funding for the SHS is derived from a variety of sources. The majority of state and federal transportation funding is collected through fuel taxes. Revenues flow into a set of transportation-related accounts for California.

At the state level the major accounts related to asset management are the State Highway Account (SHA) and the Road Maintenance and Rehabilitation Account (RMRA) established in 2017 through SB 1. These accounts are used to fund maintenance, operations, and capital projects including asset management-related activities. SHOPP and HM jointly fund maintenance, preservation, rehabilitation, and replacement projects, and all are intended to maintain or improve asset condition. The SHSMP Financial Plan connects Caltrans' objectives and targets to investment strategies and project delivery programs. The Financial Plan summarizes current and future funding sources and uses, and outlines the financial constraints under which Caltrans operates. Achieving the targets will depend on future revenues available for maintenance, repair, rehabilitation, and replacement of assets.

3.1 State Highway System Funding

The Federal Highway Trust Fund (Trust Fund), SHA, and RMRA are the main funding sources for the SHOPP and the STIP. For a comprehensive overview of transportation funding and programming in California, refer to Caltrans' annual report *Transportation Funding in California (2017)*[10].

Federal funding is provided through the Federal Highway Administration (FHWA) from federal fuel taxes. Each state collects a federal excise tax of 18.4 cents per gallon of gasoline, and 24.4 cents per gallon of diesel fuel, and remits the revenue to the federal government for deposit into the Trust Fund. Funding is then provided to states for highway and mass transportation (transit) programs. Federal transportation acts outline the uses and distribution of these resources. In addition to federal fuel taxes, both the SHOPP and the Maintenance Programs receive a portion of their funding from a state excise tax on gasoline, which is currently 18 cents per gallon. Figure 3-1 and Figure 3-2 are 10-year funding summaries of Federal Funding and SHA, including RMRA estimated to be available from 2019-2029 fiscal years based on the 2018 STIP Fund Estimate (FE)[11] and RMRA funding.

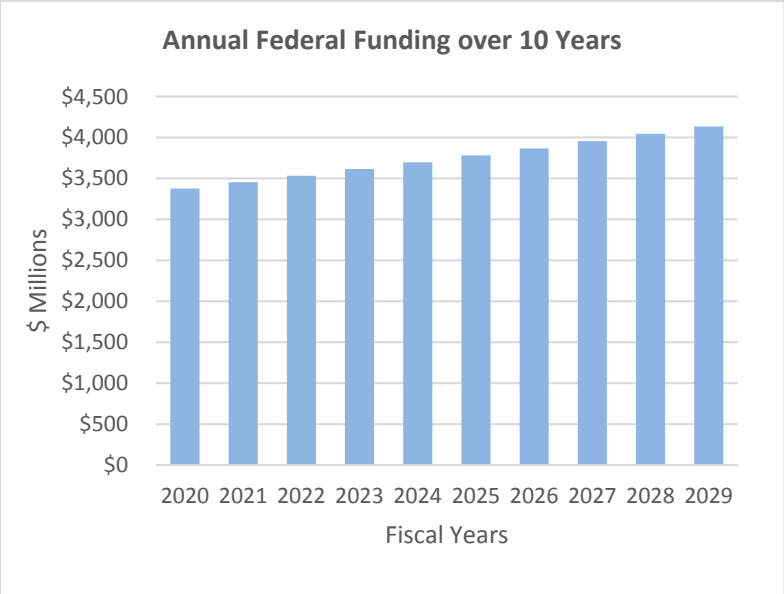


Figure 3-1. 10-Year Federal Funding Summary

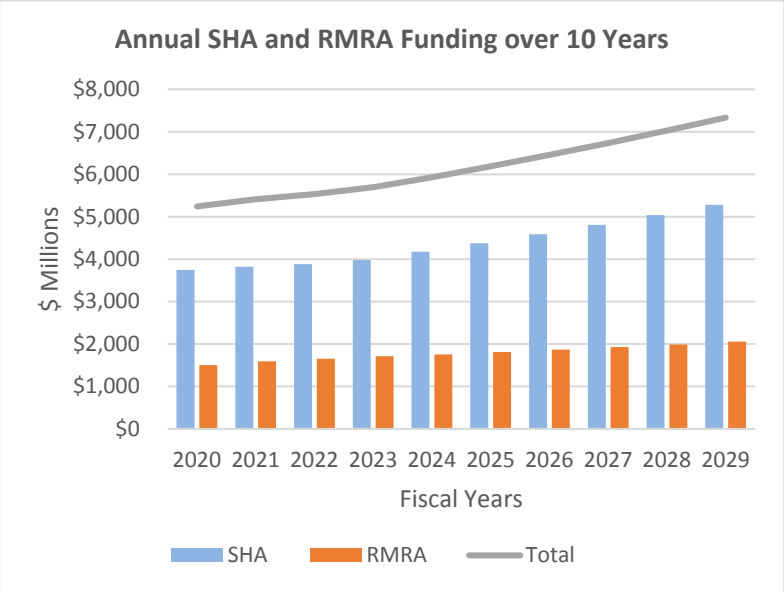


Figure 3-2. 10-Year SHA and RMRA Funding Summary

[10] Caltrans, *Transportation Funding in California (2017)*, http://www.dot.ca.gov/hq/tpp/offices/eab/fundchrt.html
[11] Caltrans, 2018 State Transportation Improvement Program Fund Estimate, http://www.dot.ca.gov/hq/transprog/ctcliaison.htm

3.2 SHOPP Funding

The 2018 STIP FE provides the basis of the SHOPP capacity of $22 billion over the five-year FE period. SHOPP capacity represents the total value of projects that can be funded each year, and includes construction, right-of-way, and support. Because of SB 1, the base excise tax was increased by 12 cents per gallon beginning November 1, 2017. The resulting revenue increase is being deposited into the RMRA for specific use in the SHOPP. After allocations to other programs, the remaining RMRA balance dedicated to the SHOPP and Maintenance Programs is approximately $18.9 billion over 10 years. SB 1 also requires the base excise tax to be indexed to inflation, using the California Consumer Price Index (CCPI), annually, beginning in July 2020. With the passage of SB 1, projected annual funding for the SHOPP is expected to increase to approximately $5.3 billion. Over the next decade, it is anticipated that SB 1 will increase revenue for the SHOPP, providing over $47 billion over the 10-year period. Figure 3-3 provides the projected annual SHOPP target capacity for the next 10 years. The first four years are based on the STIP FE, adopted by the Commission on August 16, 2017, and the next six years are a projection of the future STIP FE.

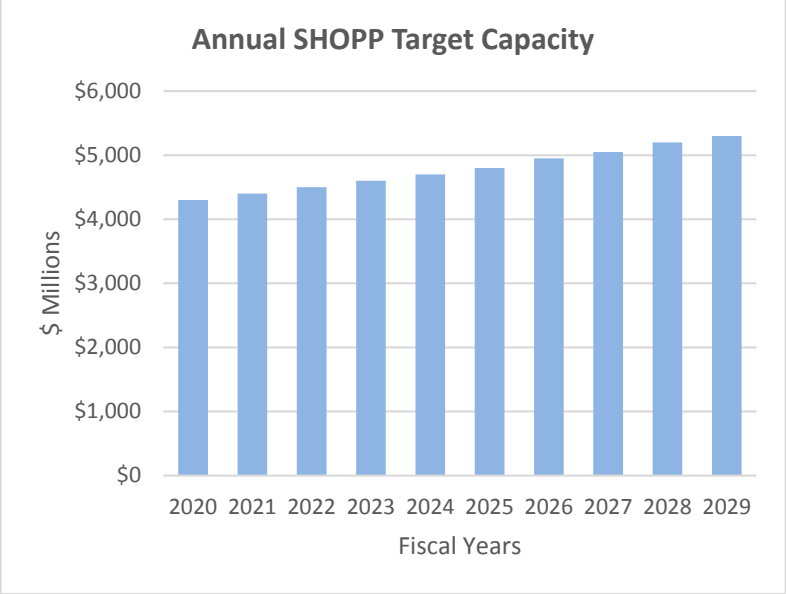


Figure 3-3. 10-Year Annual SHOPP Target Capacity

Challenges to SHOPP Funding

Various risks exist that may impact the forecasted program capacity for the SHOPP and STIP, including:

Federal Highway Act Expiration: On December 4, 2015, the FAST Act was signed into law. The FAST Act is projected to provide California with authorization of approximately $19.4 billion for the federal-aid highway program from federal fiscal years 2016 to 2020. The 2018 FE, which covers 2018-19 through 2022-23, is expected to be handled through continuing resolutions by Congress. However, without a new Act or continuing resolution, there is no assurance of consistent federal funding.

Corporate Average Fuel Economy (CAFE) Standards: In 2012, the National Highway Traffic Safety Administration and the Environmental Protection Agency (EPA) issued a joint final rule, establishing new standards to regulate model year 2017 through 2021 passenger cars and light trucks. The new standards' intent is to continue to improve vehicle fuel economy and reduce greenhouse gas emissions. More fuel-efficient vehicles impact transportation funding.

Alternative Fuel Vehicles: As alternative fuel vehicles add complexity to the existing tax structure by diversifying fuel types and gaining greater market share over gasoline and diesel, the state will need to

continue to explore a tax structure to account for all fuel types to maintain appropriate fuel tax revenue levels.

Cost Escalation

The SHSMP incorporates escalated project cost estimates to account for expected cost increases in future year projects. These cost increases result from a combination of inflationary factors, as well as supply and demand of materials and services. The cost to address SHS needs depends highly on cost escalation percentages used. For SHSMP capital project cost projections, an annual cost escalation rate of 4.2 percent is used, consistent with the historical trend of the Price Index for Selected California Construction Items[12], as shown in Figure 3-4. This escalation rate was established as the basis for calculations in the *2018 State Transportation Improvement Program Fund Estimate*[13], adopted by the Commission in August 2017, and is used in all current Caltrans project development cost projection calculations.

Escalation is applied only to future needs because the costs for projects that are programmed or in a formal planning work plan are already escalated. In the calculations presented in the Needs Assessment and Investment Plan chapters, costs are escalated to the midpoint of the last five years, which is seven and a half years into the 10-year Plan period. This cost projection approach is consistent with escalation procedures established in the *Interim State Highway Operation and Protection Program Guidelines*[14], adopted by the Commission in June 2017.

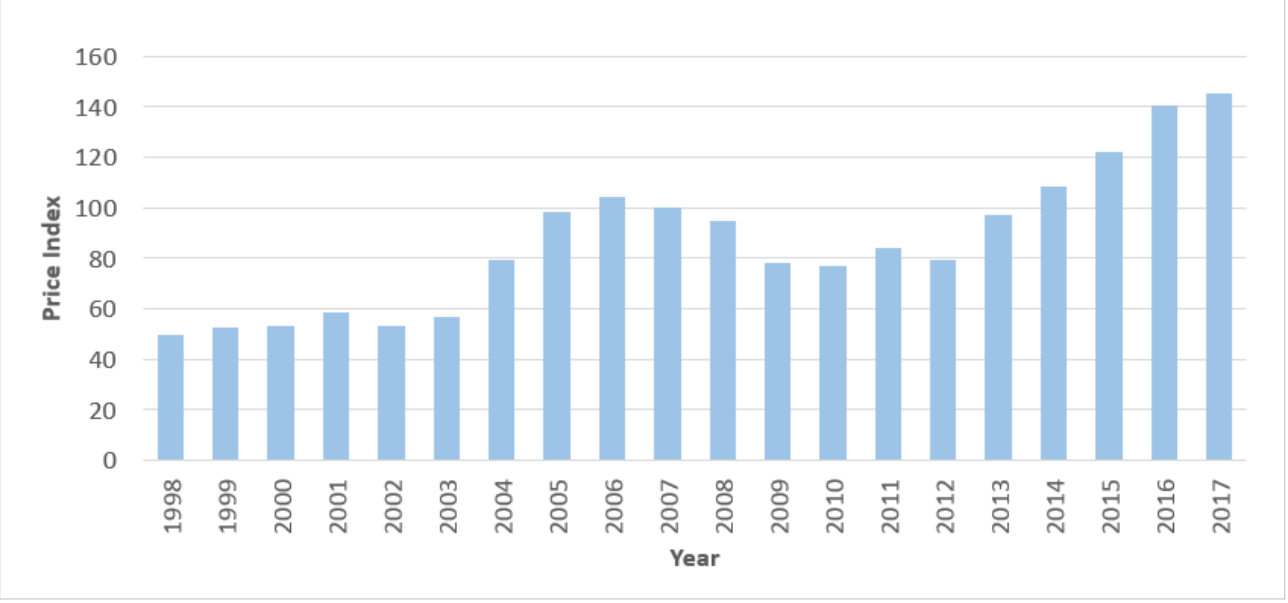


Figure 3-4. Annual Cost Escalation Rate Based on 20-year Price Index

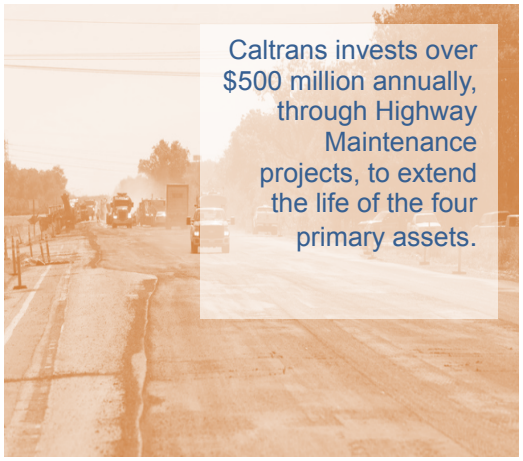
[12] Caltrans, Price Index for Selected California Construction Items, http://www.dot.ca.gov/des/oe/hist-price-index.php
[13] Caltrans, 2018 State Transportation Improvement Program Fund Estimate, https://budgets.onramp.dot.ca.gov/downloads/budgets/files/FINAL%202018%20STIP%20FE%20Book.pdf
[14] California Transportation Commission, Interim State Highway Operation and Protection Program Guidelines, Adopted June 2017, Amended October 2017, http://www.catc.ca.gov/programs/shopp/docs/Interim_SHOPP_Guidelines_101817.pdf

3.3 Maintenance Funding

The Maintenance Program budget comprises Major Maintenance and Field Maintenance Crews. Major Maintenance includes preventive and corrective maintenance activities achieved through HM projects. Field Maintenance Crews are state forces that address minor maintenance, repairs, and preservation work.

Major Maintenance

HM projects are selected by evaluating the asset condition at a route-specific level. This approach is needs-based and considers key factors including: asset age, climate and geographic location, Average Daily Traffic, and projected deterioration. HM projects provide great value and extend the service life of assets at the lowest possible long-term cost.



Highway Maintenance project selection balances the short-term needs of the system, long-term goals and available resources. HM projects, which extend the service life of assets, are the primary SHOPP cost avoidance mechanism in the Maintenance Program.

The SHS needs are assessed in a systematic manner (e.g., using the pavement management system) which includes analysis of these highway deficiencies and their potential solutions. Program advisors review proposed projects and select those which maximize maintenance investments.

Figure 3-5 shows the estimated annual HM funding for the SHSMP, for the four primary asset classes.

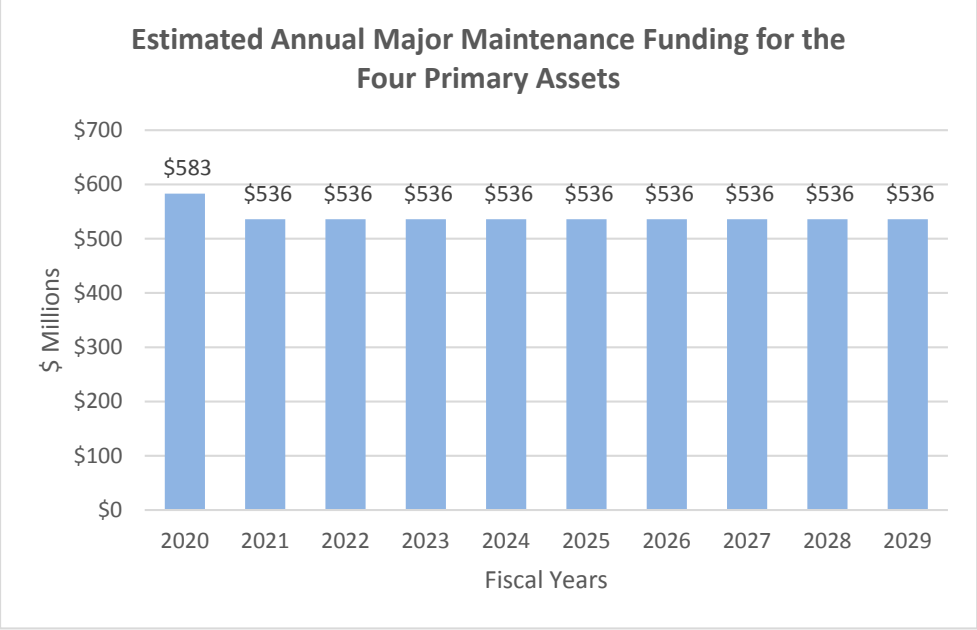


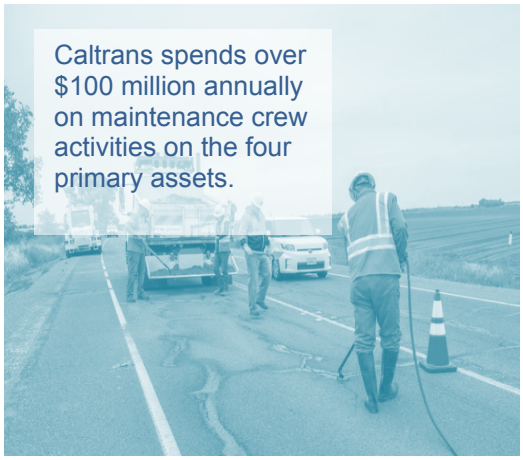
Figure 3-5. Estimated Annual Highway Maintenance Funding for the Four Primary Assets

Field Maintenance Crews (State Forces)

The Maintenance Program has examined its practices on how it allocates resources for field maintenance activities. This is especially valuable given the present and expected future funding, which could place considerable constraints on maintaining the system.

Development under way to improve these practices will be shaped by considering Level of Service (LOS), condition of assets, and performance while balancing mandated activities and historic demands on maintenance resources (snow, emergency response, customer service requests, etc.) with a commitment to system preservation.

Figure 3-6 shows estimated funding for Caltrans Field Maintenance Crews for the four primary assets.



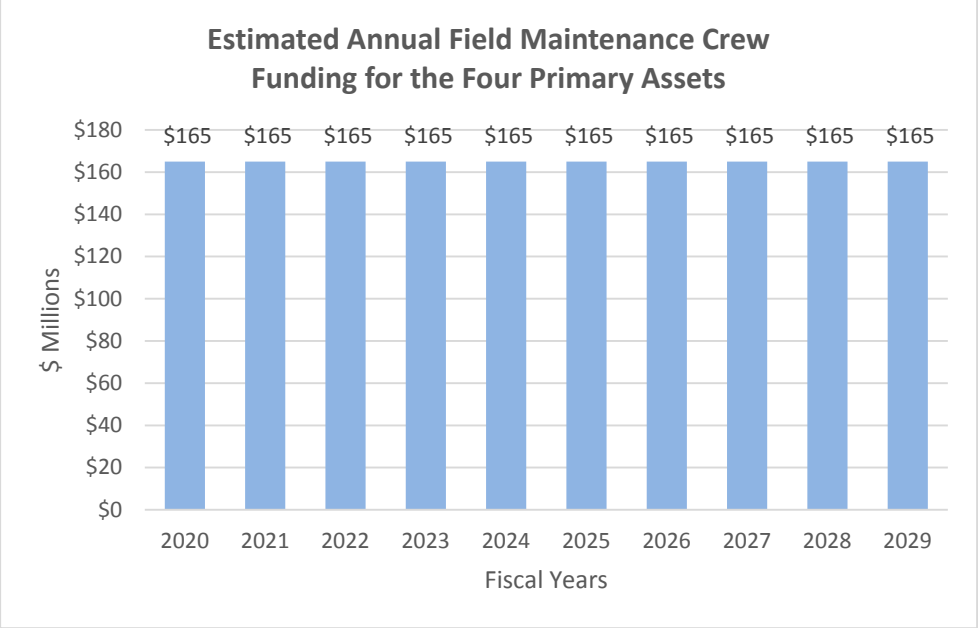


Figure 3-6. Estimated Annual Field Maintenance Crew Funding for the Four Primary Assets

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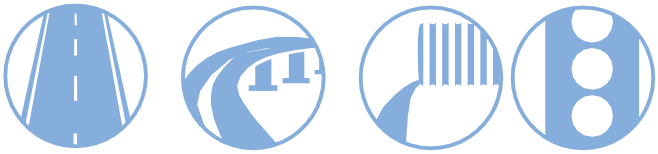


4 Ten-Year Investment Plan & Performance Outcomes

Over the 10-year SHSMP period, analysis shows the total cost of needs for maintaining the SHS exceed available funding and resources.

Key assets such as pavement, bridge, drainage, and TMS are maintained to achieve target performance levels established through the TAMP, and investment trade-off decisions are made for other SHS assets and objectives.

The Investment Plan considers how Caltrans will achieve strategic alignment with safety, stewardship, system performance, and sustainability objectives through the allocation of available funding.

4.1 Investment Strategies

Investment strategies developed through the TAMP established the guiding principles that govern overall investment decision-making. Caltrans uses these strategies in combination with Maintenance program-specific strategies to achieve performance targets. Generating an asset management investment strategy involves assessing various funding scenarios designed to achieve and sustain a desired state of repair and deliver the program efficiently. These strategies incorporate asset modeling, treatments, and impacts, as well as risks and financial constraints.

Many factors influence the magnitude of investments made towards maintaining the SHS. In some cases, investment levels are governed by law or the outcome of court settlements. In other cases, investments are dictated by terms of permits or policy-driven requirements for expenditures on specific activities. Beyond these requirements, consequences of not funding certain objectives are a major consideration. Investment decisions are informed by evaluating various investment scenarios that consider long-term life cycle costs, risk, and performance.

The SHSMP ensures that short and long-term resource allocation decisions are based on data and analysis, including consideration of engineering, life cycle cost, and risk analysis, with investment strategies being developed to best manage assets with limited funding available and anticipated future funding. The five primary strategies, adapted from the TAMP, used to guide SHOPP and Maintenance investment decision-making, are presented in Table 4-1.

Table 4-1. SHOPP and Maintenance Investment Strategies

Investment Strategies	
Strategy	**Description**
Fix It First	• Prioritize maintenance, rehabilitation, and safety improvements over capacity expansion. • Focus on the right treatment at the right time to preserve or improve condition at optimum time and cost.
Leverage Investments	• Support the full range of Caltrans strategic goals. • Make progress towards multiple goal areas with each SHOPP investment. • Employ innovative and emerging technologies to realize efficiencies in design, construction, and maintenance activities.
Focus on Selected Asset Classes	• Focus on the most important assets on the SHS, as measured by vehicle-miles traveled and by asset value. • Pavement, bridge, drainage, and TMS assets represent a significant portion of SHS maintenance and rehabilitation investments.
Address Environmental Stewardship Priorities	• Reduce environmental impacts through sustainable treatment strategies. • Reduce impacts to air and water quality through best management practices.
Integrate All Transportation Modes for All Users	• Design accessible transportation infrastructure to support all modes for all users and address ADA requirements. • Ensure investments make progress towards broad transportation goals. • Include enhancements to pedestrian, bicycle, and transit infrastructure in multi-objective projects to leverage more efficiency.

Each of the five strategies play a vital role in establishing statewide investments to achieve SHSMP performance targets. For example, Caltrans is continuously striving to identify and adopt innovative and emerging technologies to realize efficiencies in design, construction, and maintenance activities. Caltrans invests approximately $25 million annually in research[15] with outcomes and products that have the potential to improve SHOPP and Maintenance practices (e.g., construction materials, treatment strategies, information technologies, etc.), leveraging available funds, and reducing life cycle costs.

Underlying the investment strategies are performance targets and projections, life cycle planning, risk management analysis, and anticipated funding and cost of future work. The performance gap analysis, informed by life cycle planning, helps define the SHS investment needs. Life cycle plans use the estimated cost of future work to establish network level strategies for managing assets. Available funding is a constraint for performance modeling, allowing Caltrans to more accurately predict future scenarios. Risk management tempers the analysis, adjusting potential outcomes based on positive and negative risks. While these asset management processes help to inform investment planning, it is these strategies that make the technical details meaningful at a network level and help communicate the message of preserving asset condition and making progress towards the goals in the Caltrans Strategic Management Plan.

4.2 SHOPP Investment Plan

The SHOPP Investment Plan, presented in Table 4-2, establishes funding levels for each performance objective. Funding levels for each performance objective are established through trade-off analysis, which considers investment strategies, Caltrans strategic goals, statutory and funding constraints, and transportation priorities. The resulting investment allocation across objectives represents an optimal balance of these factors, while assuring key performance targets are met.

The investment level in each performance objective is determined by many factors. These factors include programmed work, current condition, judicial or legislatively-mandated funding levels, consequences of inaction, past investment levels, and preservation needs versus rehabilitation consideration. Investment level establishment also considers the investment's impact on the system, existing pipeline of work, expected deterioration rates, and expected growth in inventory. With investment levels established for each performance objective at the statewide level, a comprehensive SHOPP Investment Plan is developed that sets performance targets and funding constraints for each of Caltrans' 12 districts. The SHOPP Investment Plan development process is shown in Figure 4-1.

[15] Caltrans, Fiscal Year 2016-17 Annual Research Program Highlights, http://www.dot.ca.gov/research/docs/DRISI_AnnualReport_FY16_17_Web.pdf

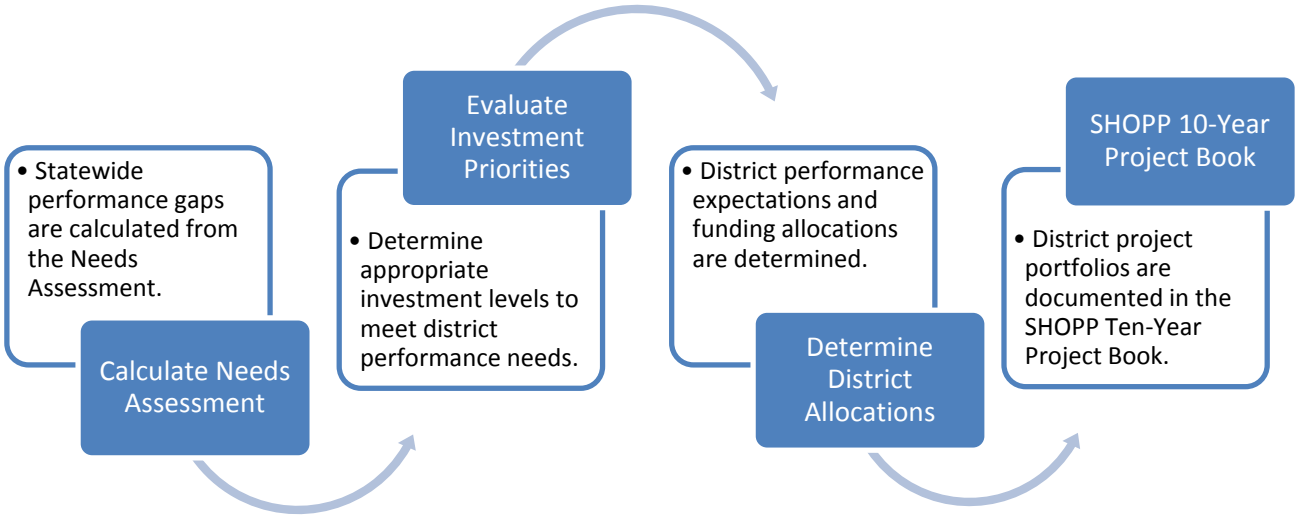


Figure 4-1. Development of the SHOPP Investment Plan

Investment levels for each objective are converted to performance expectations and proportioned out to each of the Caltrans districts. District-level funding is based on outstanding performance gaps, independent of historic district funding levels. District-level funding for each performance objective is calculated using the investment level for the performance objective and the calculated performance gap in each district. Headquarters formalizes the 10-year performance expectations and associated funding allocations with each of the districts. Caltrans districts then use this information to develop multi-year project portfolios that collectively address the performance expectations within given funding constraints. The funding need for each asset type is calculated using average statewide unit costs but vary significantly through various regions and asset types. It is expected that through multi-objective project planning and efficiencies found in environmental and design processes, the districts can deliver on performances expectations and meet transportation system needs. These district project portfolios are updated to continually balance performance and available funding, and are published in the SHOPP 10-Year Project Book on the Caltrans Asset Management website[16]. District-proposed projects advance through formal planning processes for programming in the SHOPP. This approach ensures that the project portfolios proposed in future SHOPP cycles are consistent with statewide goals and objectives and align with TAMP and SHSMP targets.

[16] Caltrans, SHOPP Ten-Year Project Book, http://www.dot.ca.gov/assetmgmt/cpp.html

4.3 Maintenance Investment Plan

The Maintenance Investment Plan represents the funding and resources needed to support preventive maintenance activities for the four primary asset classes under pavement, bridge and tunnel health, drainage restoration, and TMS, and assure that the 10-year TAMP performance targets can be achieved efficiently. These investments are applied across the two preventive maintenance focused strategies: Major Maintenance and Field Maintenance Crews. Investment levels are established for each of the four assets with an overarching goal to maintain good assets in good condition, while addressing fair condition assets where effective. The 5-Year Maintenance Investment Plan including SHOPP avoidance is shown in Appendix C.

Table 4-2 presents Major Maintenance and Field Maintenance Crews funding levels for the four primary assets. It is important to note investments in these four areas represent only a portion of Caltrans' overall maintenance investment and activities. Maintenance resources are applied to many of the other performance objectives listed in Table 4-2. Furthermore, Maintenance addresses several other activities (guardrail repair and graffiti removal) not listed in Table 4-2.

4.4 Summary of SHOPP and Maintenance Investment Plans

Table 4-2 presents the funding associated with the performance objectives for the combined SHOPP and Maintenance Investment Plans.

Table 4-2. 10-Year SHOPP and Maintenance Investment Plan

SHOPP and Maintenance Investment Plan***					
Objectives	SHOPP ($M)****			Maintenance ($M)	
	Pipelined Projects	Remaining Performance	Sum	Major Maintenance	Field Maintenance Crews
Safety	**$4,181**	**$1,710**	**$5,891**	**-**	**-**
Bridge Rail Replacement and Upgrade	$754	$60	$814		
Collision Severity Reduction	$894	$277	$1,171		
Roadside Safety Improvements	$744	$123	$867		
Safety Improvements	$1,789	$1,250	$3,039		
Stewardship	**$14,801**	**$15,878**	**$30,679**	**$5,357**	**$1,372**
Bridge and Tunnel Health	$1,886	$1,813	$3,699	$1,260	$890
Drainage Pump Plants	$125	$58	$182		
Drainage Restoration	$1,395	$1,010	$2,405	$540	$292
Lighting Rehabilitation	$123	$31	$155		
Major Damage (Emergency Opening)	$	$2,388	$2,388		
Major Damage (Permanent Restoration)	$1,049	$700	$1,749		
Office Buildings	$27	$1,052	$1,080		
Overhead Sign Structures Rehabilitation	$141	$66	$207		
Pavement Class I	$6,174	$4,552	$10,726		
Pavement Class II	$2,865	$3,741	$6,606	$3,557	$190
Pavement Class III	$450	$117	$566		
Relinquishments	$91	$13	$104		
Roadway Protective Betterments	$120	$29	$149		
Safety Roadside Rest Area (SRRA) Rehabilitation	$115	$75	$190		
Transportation Related Facilities	$172	$171	$342		
Water and Wastewater Treatment at SRRAs	$69	$63	$131		
Sustainability	**$2,727**	**$915**	**$3,642**	**-**	**-**
ADA Pedestrian Infrastructure	$543	$27	$570		
Advance Mitigation	$15	$	$15		
Bicycle Infrastructure	*$320**	**	**		
Bridge Scour Mitigation	$572	$158	$730		
Bridge Seismic Restoration	$615	$162	$777		
Pedestrian Infrastructure	*$340**	**	**		
Roadside Rehabilitation	$259	$79	$337		

SHOPP and Maintenance Investment Plan***					
Objectives	SHOPP ($M)****			Maintenance ($M)	
	Pipelined Projects	Remaining Performance	Sum	Major Maintenance	Field Maintenance Crews
Storm Water Mitigation	$723	$490	$1,213		
Transit Infrastructure	*$30**	**	**		
Performance	**$3,445**	**$773**	**$4,218**	**$50**	**$274**
Bridge Goods Movement Upgrades	$958	$	$958		
Commercial Vehicle Enforcement Facilities	$27	$38	$65		
Operational Improvements	$457	$279	$736		
Sign Panel Replacement	$140	$86	$226		
Transportation Management Systems	$1,827	$331	$2,158	$50	$274
Weigh-In-Motion Scales	$36	$40	$76		
Sub Total	**$25,154**	**$19,277**	**$44,431**	**$5,407**	**$1,646**
Minor Program	-	$2,400	$2,400		
PID Program Support	-	$287	$287		
Total	**$25,154**	**$21,964**	**$47,118**	**$5,407**	**$1,646**

Table 4-2 Notes:

(*) The 2018 SHOPP pipeline includes high level estimates of pedestrian, bicycle and transit investments. These costs are integrated into comprehensive projects and are therefore not added as additional costs in the table totals. These estimates rely on typical unit costs and exclude some costs that are difficult to sever from the broader project costs, such as right of way and environmental costs.

(**) A complete inventory of sidewalk and bikeway features is currently under development. Once this existing inventory is complete it will be incorporated into future plans. Refer to page 5-3 for more information.

(***) The total SHOPP Investment Plan differs from the Fund Estimate as a result of various adjustments. The Sub-totals and totals presented in the table may not add due to rounding.

(****) Cost estimates shown in the Pipelined Projects column are based on the best available scope of projects in planning and design and may be subject to change.

4.5 Performance Outcomes

The Investment Plan allocates available funding to specific transportation objectives. These include safety, physical asset condition, system performance, and sustainability goals.

The recommended level of investment in each objective area determines the corresponding accomplishments that can be expected for the investment. Investments may be defined for good, fair and poor condition assets depending on the objectives of the funding programs. Having specific investments addressing physical assets at all levels helps to minimize long-term cost by avoiding a worst first asset

management approach. Table 4-3 details the specific quantity and units of performance expected from each of the funding programs.

Quantities presented in Table 4-3 summarize SHOPP and Maintenance performance accomplishments, combining both pipelined project work and planned work. The pipelined work accounts for all work that results in a change to performance relative to the baseline and may include work completed prior to the 10-year plan period. Maintenance Program activities focus on preventive strategies, keeping good condition assets in good condition.

Table 4-3. Projected 10-Year SHOPP and Maintenance Accomplishments at Recommended Funding Levels

Proposed SHOPP and Maintenance Performance Accomplishments							
Objectives	Unit	SHOPP			Maintenance		
		New	Fair	Poor	Good	Fair	Poor
Safety							
Bridge Rail Replacement and Upgrade	Linear Feet	0	274,988	142,679	-	-	-
Collision Severity Reduction	Fatal and Serious Injury Collisions	-	-	279	-	-	-
Roadside Safety Improvements	Locations	-	-	9,982	-	-	-
Safety Improvements	-	-	-	-	-	-	-
Stewardship							
Bridge and Tunnel Health	Square Feet	0	10,505,388	2,328,314	27,000,000	20,749,942	1,977,214
Drainage Pump Plants	Locations	0	1	119	-	-	-
Drainage Restoration	Linear Feet	5,990	494,698	524,687	-	2,019,575	263,216
Lighting Rehabilitation	Each	12	0	7,076	-	-	-
Major Damage (Emergency Opening)	-	-	-	-	-	-	-
Major Damage (Permanent Restoration)	-	-	-	-	-	-	-
Office Buildings	Square Feet	751,895	0	756,428	-	-	-
Overhead Sign Structure Rehabilitation	Each	6	6	640	-	-	-
Pavement Class I	Lane Miles	0	10,410	271			
Pavement Class II	Lane Miles	0	8,265	283	13,488	10,278	96
Pavement Class III	Lane Miles	0	706	50			
Relinquishments	-	-	-	-	-	-	-
Roadway Protective Betterments	Locations	-	-	25	-	-	-
Safety Roadside Rest Area (SRRA) Rehabilitation	Locations	0	0	11	-	-	-
Transportation Related Facilities	Square Feet	65,326	0	293,978	-	-	-

Proposed SHOPP and Maintenance Performance Accomplishments							
Objectives	Unit	SHOPP			Maintenance		
		New	Fair	Poor	Good	Fair	Poor
Water and Wastewater Treatment at SRRAs	Locations	0	0	47	-	-	-
Sustainability							
ADA Pedestrian Infrastructure	Deficient Elements	-	-	28,438	-	-	-
Advance Mitigation	-	-	-	-	-	-	-
Bridge Scour Mitigation	Square Feet	-	-	1,307,039	-	-	-
Bridge Seismic Restoration	Square Feet	-	-	4,988,083	-	-	-
Roadside Rehabilitation	Acres	0	14	2,059	-	-	-
Storm Water Mitigation	Compliance Units	-	-	6,541	-	-	-
Performance							
Bridge Goods Movement Upgrades	Square Feet	0	1,052,428	3,016,541	-	-	-
Commercial Vehicle Enforcement Facilities	Square Feet	0	9,300	10,425	-	-	-
Operational Improvements	Daily Vehicle Hours of Delay	-	-	16,310	-	-	-
Sign Panel Replacement	Each	269	0	17,634	-	-	-
Transportation Management Systems	Each	2,612	0	9,779	810,000	-	-
Weigh-In-Motion Scales	Stations	1	1	15	-	-	-

4.6 Projected Performance for Four Primary Assets

The Investment Plan presented in Section 4.4 is optimized to assure that performance targets for the four primary asset classes (pavement, bridge, drainage, and transportation management systems) will be achieved by 2027 and maintained through 2029. To monitor progress, Federal and State statutes on asset management require establishing annual targets or benchmarks (future condition projections) from which progress towards longer-term targets can be assessed. The 2018 California TAMP and SB 1 established 10-year performance targets for the four primary asset classes. To measure progress towards meeting the defined performance targets, the Commission adopted an addendum to the SHOPP Guidelines in October of 2017, calling on Caltrans to develop annual benchmarks to measure progress made for each of the four primary asset classes towards achieving the 10-year performance targets by 2027.

Determining Progress Towards Benchmarks

The annual benchmarks are developed using a calculation framework that relies on the initial baseline inventory and condition data, deterioration models, and project-level accomplishments for all work

completed within the 10-year performance period. A four-step calculation is carried out for each year's performance to determine anticipated asset conditions, as summarized in Figure 4-2.

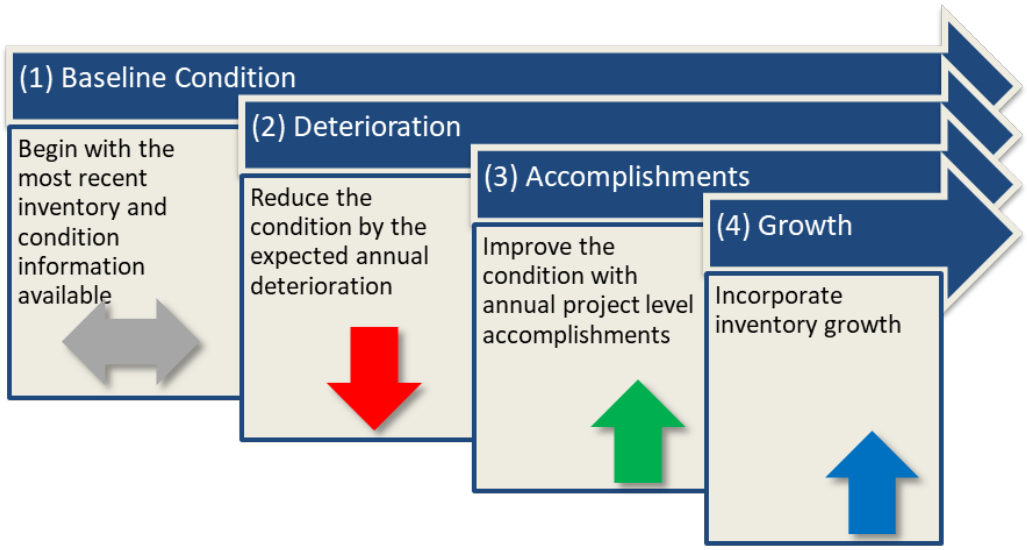


Figure 4-2. Steps in Calculating Benchmark Projections

The benchmarks account for the assets' projected condition at project completion, when the improvements are realized. This is at the end of construction activity and the opening of the highway facility to the traveling public, defined as the Expected Construction Work Complete (ECWC) date. The ECWC is estimated to be 2/3rds the time between the advertised date, or Ready to List (RTL) date, and the Construction Contract Acceptance (CCA) date. An example is presented in Figure 4-3.

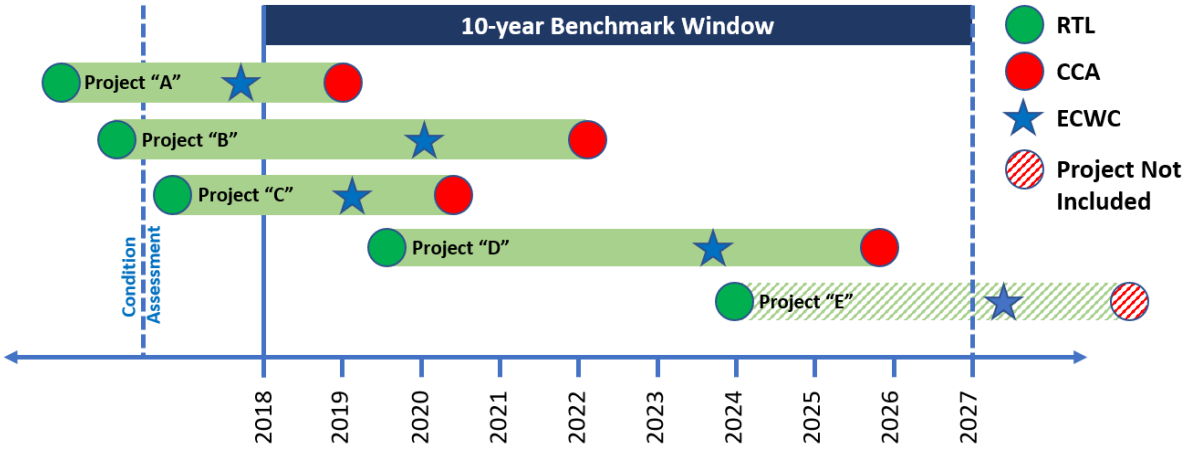


Figure 4-3. Timing of project accomplishments

This approach to condition accounting differs from a project portfolio planning framework, where fiscal balancing requirements necessitate the use of contract execution dates. While this difference in timing introduces a non-uniform lag across projects between planned performance in the SHOPP and performance

realized through the benchmarks, current projections indicate that performance targets for the four primary asset classes (pavement, bridge, drainage, and transportation management systems) will be met.

Quantifying Uncertainty in Performance Projections

The benchmark analysis relies on several project-level variables and assumptions that in aggregate contribute to uncertainties in future performance projections. The combined uncertainties generally become larger in later years of the analysis period as deterioration projections and project-level uncertainties grow. A Monte Carlo uncertainty analysis is employed to provide insight and quantify the degree to which project-level assumptions contribute to overall benchmark uncertainties. Uncertainty bands are expressed in the charts as shaded bands that extend above and below the projected benchmark line in the charts.

Benchmark Projections

Initial benchmarks were presented to the Commission in March 2018[17] and a progress update provided in October 2018[18]. Benchmark projections reflecting performance accomplishments and projected asset inventory conditions as of July 2018 are presented in Figure 4-4 through Figure 4-9.

[17] California Transportation Commission Meeting, Tab 28, March 2018, http://www.catc.ca.gov/meetings/2018/2018-03/Complete_Meeting_Book(911_Pages).pdf
[18] California Transportation Commission Meeting, Tab 24, October 2018, http://www.catc.ca.gov/meetings/2018/2018-10/Complete_Meeting_Book(1266).pdf

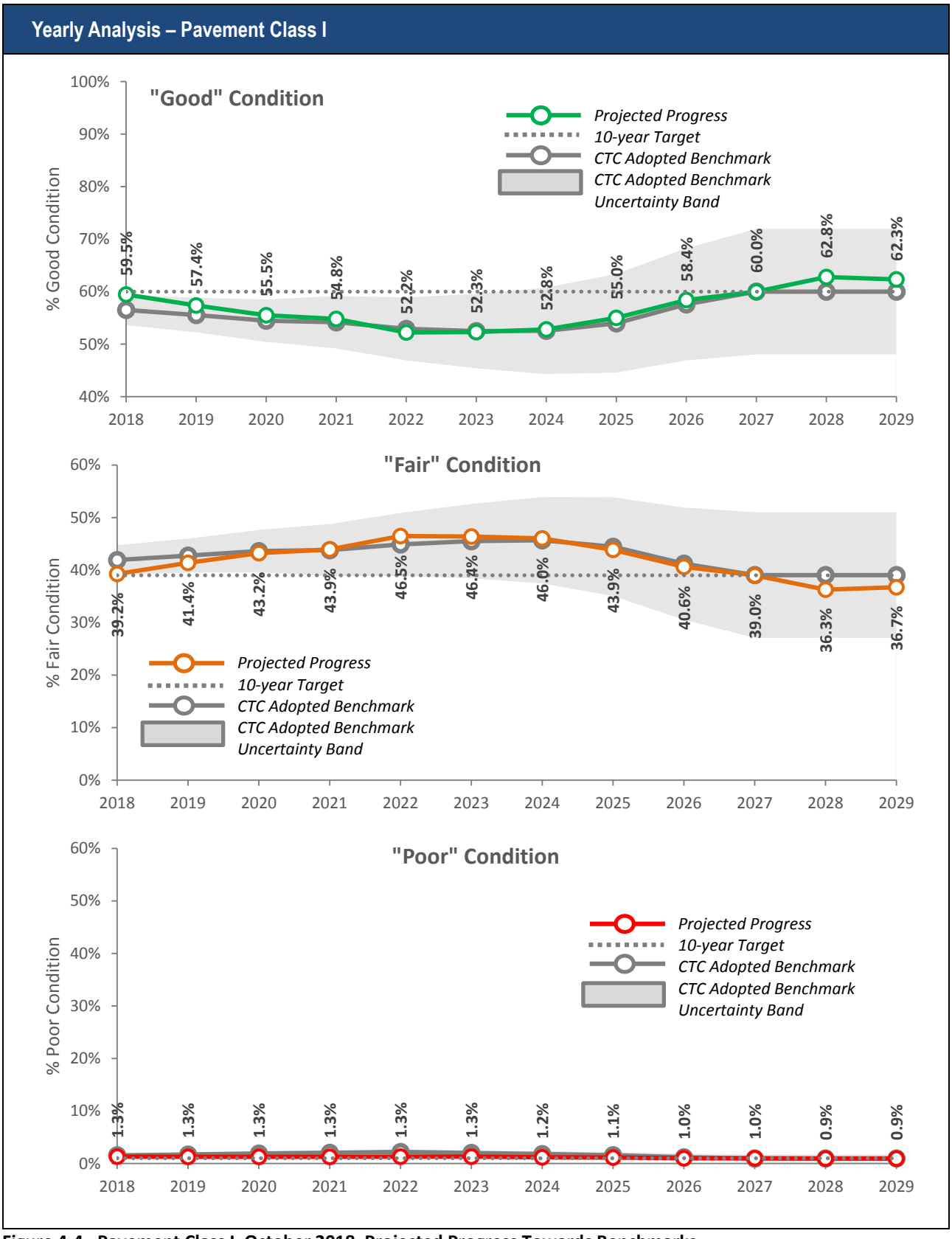


Figure 4-4. Pavement Class I, October 2018, Projected Progress Towards Benchmarks

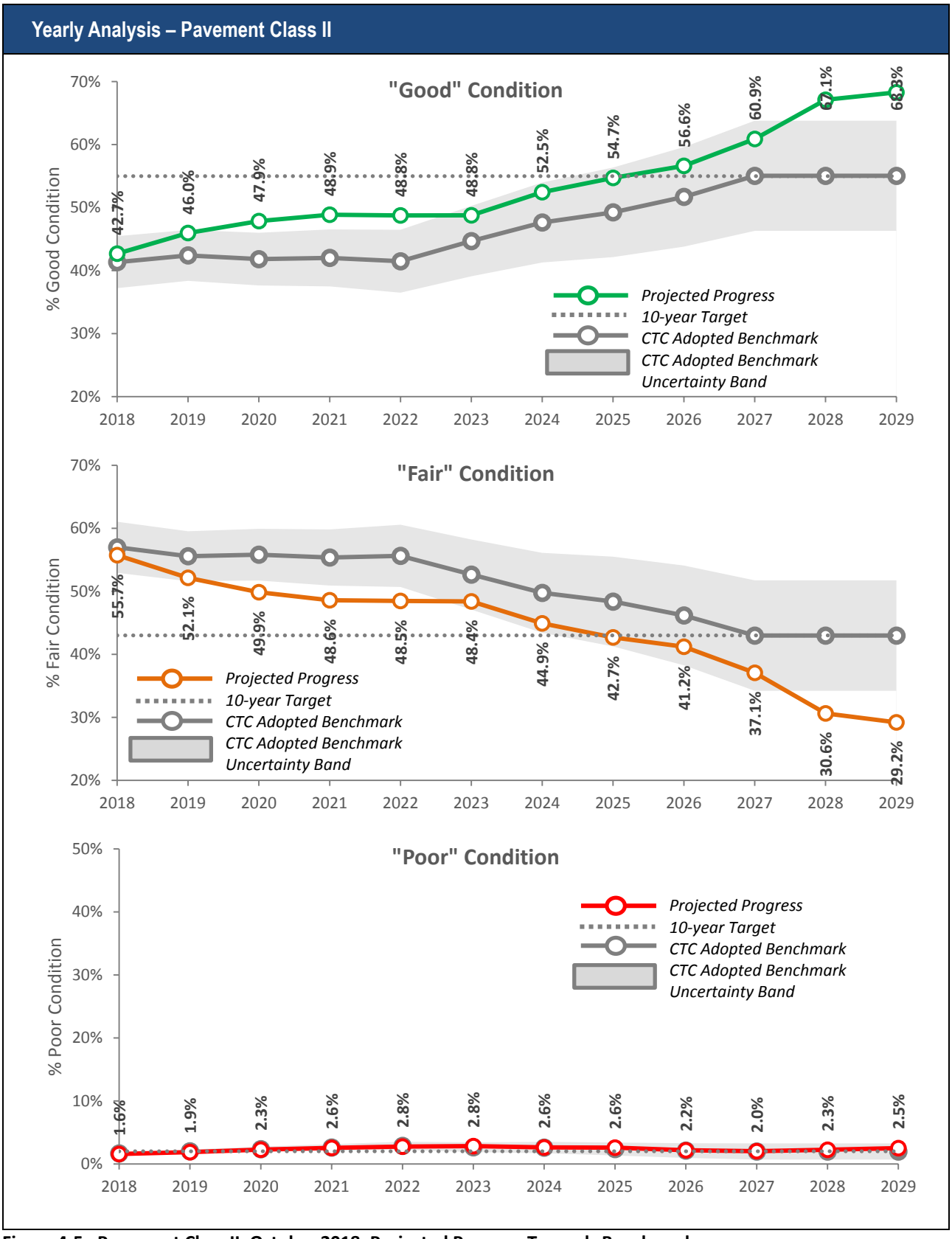


Figure 4-5. Pavement Class II, October 2018, Projected Progress Towards Benchmarks

Figure 4-6. Pavement Class III, October 2018, Projected Progress Towards Benchmarks

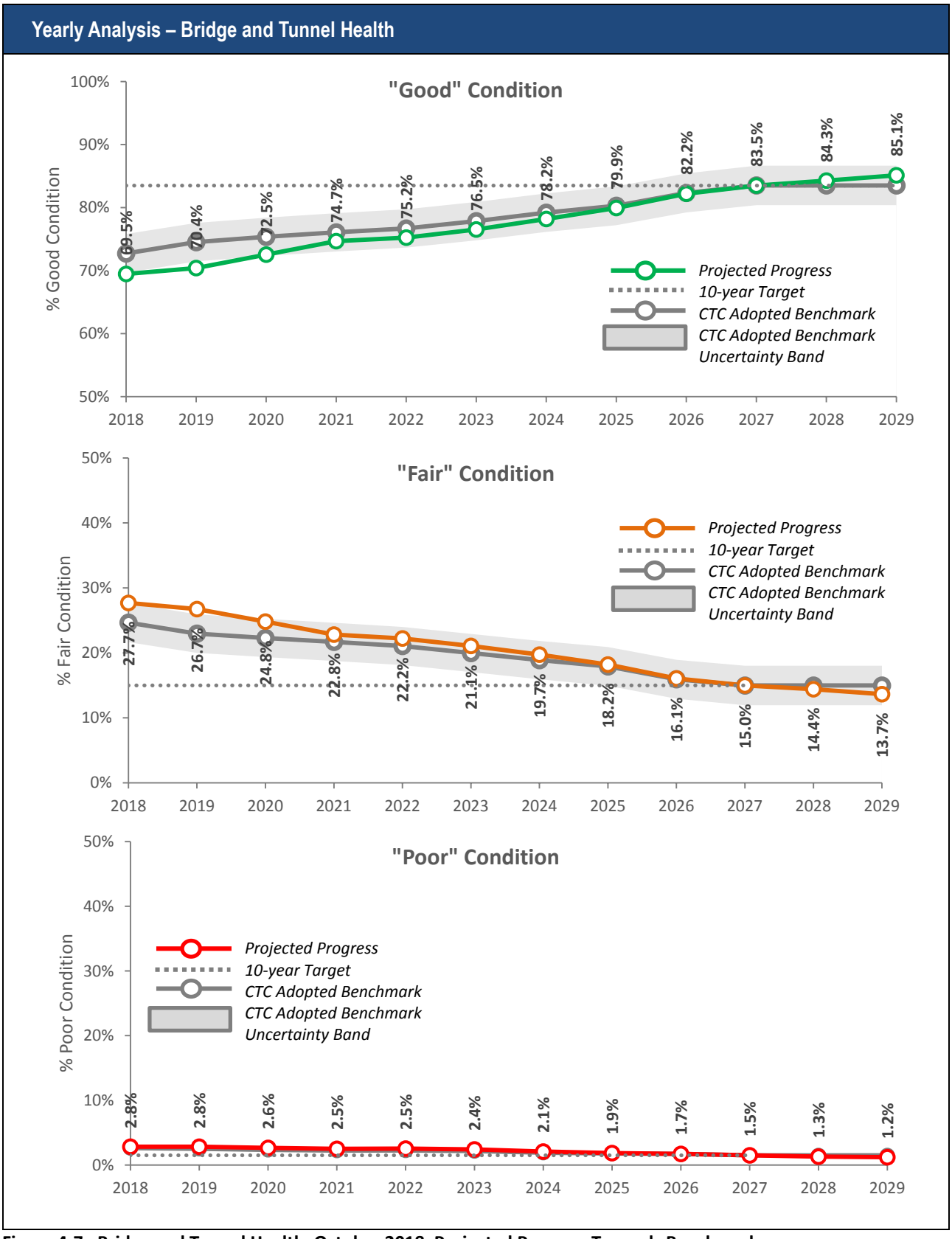


Figure 4-7. Bridge and Tunnel Health, October 2018, Projected Progress Towards Benchmarks

Yearly Analysis – Drainage

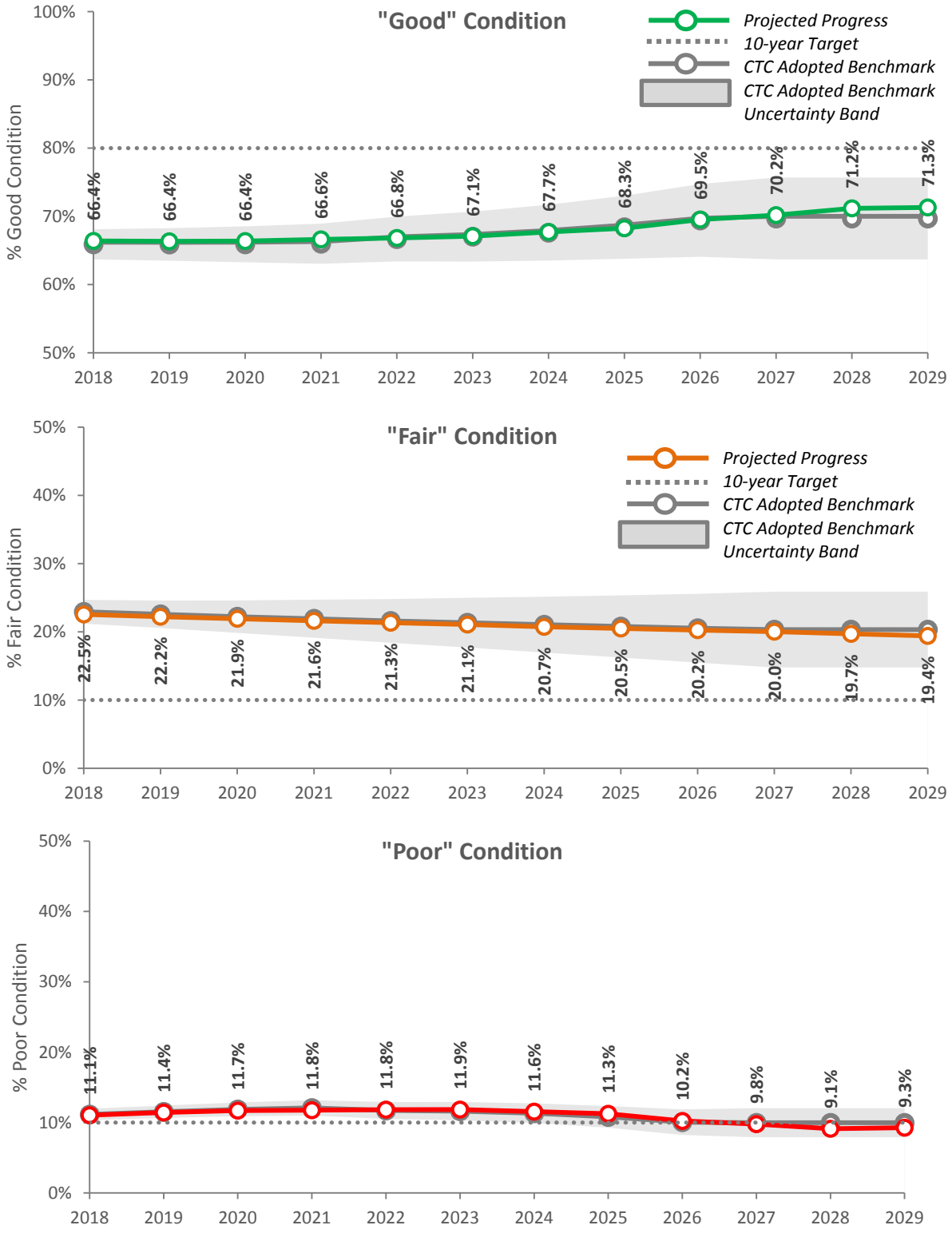


Figure 4-8. Drainage, October 2018, Projected Progress Towards Benchmarks

Yearly Analysis – TMS

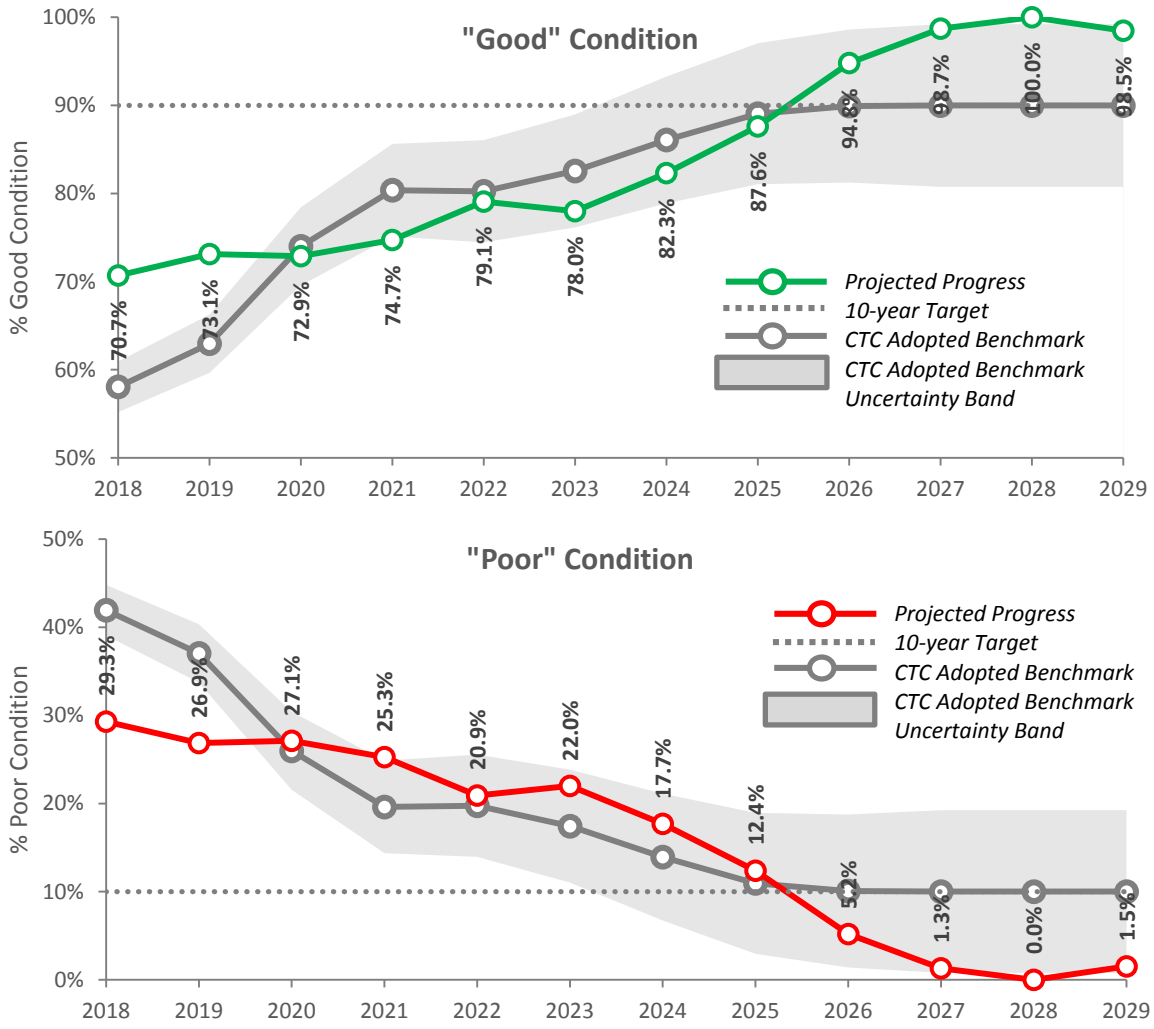


Figure 4-9. Transportation Management Systems, October 2018, Projected Progress Towards Benchmarks

5 Program Objectives

The California Transportation Commission (Commission) adopted four primary asset classes in accordance with California Government Code (CGC). These asset classes, pavements, bridges, culverts, and TMS, were selected because they represent a significant portion of California's annual transportation investments. Assets are also selected in part because of federal legislation which prioritizes safety, pavements, bridges, and those assets related to system performance. In total, the 2019 SHSMP identifies 32 Program Objectives which continue from the 2017 SHSMP.

This Chapter presents the 32 Program Objectives in the same order as shown in Table 2-1. It recognizes that many of these objectives cross over multiple program areas and goals. They are discussed in relation to the performance models used to analyze needs and set performance targets. Three different performance models were used in the analysis: Physical Asset, Deficiency, and Reservation. The key parameters for both Physical Assets and Deficiency Performance Models are shown below. Additional details for each Program Objective can be found in Appendix B, Performance Management Summary Sheets.

- Overview
- Performance Metrics
- Inventory and Condition/Inventory of Deficiencies
- Performance Targets
- Other Performance Management Parameters
- Typical Treatments

5.1 Cross-Cutting Focus Areas

The primary focus of the SHSMP is to maintain the condition and safety of the SHS. While doing this, Caltrans considers other key cross-cutting focus areas identified throughout Caltrans policies and guidance and includes them in appropriate projects carried out through the 32 Program Objectives. These cross-cutting focus areas are considered and included at the project level, where feasible, and help Caltrans achieve broader strategic goals. The cross-cutting focus areas are as follows:

Complete Streets Activities

Complete Streets activities include a broad range of transportation system improvements that provide safe access to all modes of transportation. Complete Streets objectives can be carried out on numerous asset classes including highways, transportation-related facilities, bikeways, pedestrian and transit facilities.

Environmental Stewardship Activities

Caltrans provides transportation for the people of California while striving to minimize the environmental impact of the system. Though many environmental resources are considered during the project delivery process, several cross-cutting objectives that fall under the environmental stewardship category would benefit from early, multidisciplinary consideration.

Freight Activities

Caltrans uses a variety of programs to improve mobility including freight mobility, which is a Department priority. A number of SHOPP objectives address freight needs, for example improving vertical clearance of bridges, truck climbing lanes, and reducing wear and tear on truck components with operational improvements.

System Resiliency and Climate Change Activities

System resiliency activities include proactive treatments that strengthen or protect the existing transportation system components from natural or man-made threats. Historically, the SHOPP has funded resiliency activities such as sea walls that protect coastal highways, slope erosion protection, bridge seismic retrofits, and vessel protection systems. As the global climate changes and weather patterns become more extreme, this cross-cutting objective has expanded to include mitigation of sea level rise, and flood mitigation.

Cross Cutting: Complete Streets

Overview

A Complete Street is a transportation facility planned, designed, constructed, operated, and maintained to provide safe mobility for all users, including bicyclists, pedestrians and transit riders. Complete Streets shifts the focus of transportation policy from vehicle movement as the primary goal toward the movement of people traveling.

Caltrans' Complete Streets Policy, originally adopted in 2008 (Deputy Directive 64-R2)[19], requires Caltrans to provide for the needs of travelers of all ages and all abilities on the SHS. Caltrans views all projects on the SHS as opportunities to improve safety, access, and mobility for all travelers, including bicyclists and pedestrians.

Complete Streets is legislated in the California Road Repair and Recovery Act (Chapter 2, 2030(f)), which states: "To the extent beneficial, cost effective, and practicable in the context of facility type, right-of-way, project scope, and quality of nearby alternative facilities, and where feasible, the department and cities and counties receiving funds under the program shall incorporate complete street elements into projects funded by the program, including, but not limited to, elements that improve the quality of bicycle and pedestrian facilities and that improve safety for all users of transportation facilities." Caltrans' Strategic Management Plan states that by 2020 the annual number of Complete Streets projects should be increased by 20 percent.

Elements of Complete Streets

Complete Streets comprise a variety of pedestrian, bicycle, and transit facilities that vary depending on location and facility type. For Caltrans, these are typically state highways that function as Main Streets. Other facilities present significant opportunities to improve safety for bicyclists and pedestrians, such as freeway on- and off- ramps, improvements to roads that parallel freeways, freeway over- and under-crossings, and controlled-access toll highways and bridges. With approximately 1,000 miles of California

[19] Caltrans, Complete Streets Policy, Deputy Directive 64-R2, 2008, http://www.dot.ca.gov/hq/tpp/offices/ocp/docs/dd_64_r2.pdf

freeways supporting bicycle travel, shoulders that accommodate bicyclist travel are needed. Freeway segments in coastal districts and in Southern California are significant routes for both bicycle commuters and a high number of tourists from around the world.

More common Complete Streets elements include sidewalks, crosswalks, and bikeways as well as bicycle and pedestrian striping, signage, signalization, and ADA elements. For more information on identifying appropriate Complete Streets features for various contexts on the SHS, see the Division of Transportation Planning's *Complete Streets Elements* webpage[20].

Caltrans has made significant progress in expanding the integration of Complete Streets elements on the transportation network. For example, the 2018 SHOPP at the time of its adoption included more than 180,000 linear feet of sidewalks and crosswalks, 2,200 pedestrian safety features such as refuge islands, 640 linear miles of bicycle lanes and lane improvements, 130 linear miles of shoulder improvements, 400 bicycle features such as bicycle-tolerable drainage grates, and 280 transit features such as bulb-outs.

Initiatives to Improve Integration of Complete Streets

Maintaining and improving transportation facilities for bicyclist, pedestrians and transit users are included in safety and mobility focused projects. Caltrans has implemented several improvements related to

[20] Caltrans, Division of Transportation Planning, Complete Streets webpage, 2018, http://www.dot.ca.gov/transplanning/ocp/complete-streets.html

Complete Streets in the SHOPP and has others under development. The following bullets highlight these initiatives:

- **Establishment of policy** – Caltrans has established policy related to Complete Streets evaluations for the State Highway System. This policy has been implemented and every SHOPP project is required to evaluate the feasibility and practicality of including bicycle, pedestrian and transit features. This evaluation is documented in project level planning documents.
- **Bicycle and Pedestrian Safety** – Caltrans has implemented pilot programs looking specifically at bicycle and pedestrian safety. These programs have already resulted in numerous safety improvements being implemented.
- **SHOPP Structure Changes** – In 2017, as part of Asset Management implementation required under Senate Bill 486, Caltrans fundamentally changed the way SHOPP funds are allocated. This change eliminated asset-based silos in lieu of more comprehensive transportation solutions. Additionally, SHOPP funding decisions were transferred to local Districts that better understand local constituents needs. Collectively these changes have provided significantly more flexibility to incorporate bicycle, pedestrian and transit features in SHOPP projects.
- **Software Improvements** – Beginning with the 2018 SHOPP, Caltrans implemented new software that tracks project-level accomplishments included in multi-objective projects, allowing project level accomplishments to be summarized across the SHOPP.
- **Bicycle and Pedestrian Inventory** - Efforts to capture the current inventory of bicycle and pedestrian facilities is currently underway. The goal is to complete this inventory and assess the condition of these assets for immediate inclusion in the Asset Management implementation efforts. Establishing the inventory is a foundational building block for good asset management. Once the existing inventory is established, Caltrans plans to work with local partners to identify high priority gaps in the system. When completed, Caltrans will be able to quantify the costs associated with addressing these needs.
- **Design Guidance** - Caltrans has also developed design resources in our Complete Streets Center of Excellence and conducted outreach to educate our design engineers on bicycle, pedestrian and transit best practices.
- **Active Transportation Project Nomination** - Caltrans developed and submitted 14 Active Transportation Projects (ATP) for the newly created ATP Program included in Senate Bill 1. These were good projects that were vetted by local districts and stakeholders, however none of these projects were selected by the California Transportation Commission for funding.

The activities noted above summarize some of the key initiatives Caltrans has implemented or is working on that will improve Caltrans' overall management of the SHOPP and leverage other funding programs to accomplish Complete Streets work. There are many competing priorities contained within the SHOPP, and striking the appropriate balance of investments to address all the needs is a constant challenge. Caltrans is committed to making improvements in our management of Complete Streets features on the State Highway System and incorporating bicycle, pedestrian and transit features when feasible.

Cross Cutting: Environmental Stewardship

Overview

Caltrans provides transportation for the people of California while striving to minimize the environmental harm and integrating the transportation system into California's environment. Caltrans seeks opportunities to incorporate environmental enhancements into its roadway improvement projects. Such opportunities may include, but are not limited to, green infrastructure; remediating fish passage barriers; historic architectural elements to bridges; or enlarging culverts to make the State's highways more permeable to wildlife. Many environmental resources and laws are considered during the project delivery process. However, Caltrans is striving to consider environmental factors earlier in the project planning and nomination processes through more informed decision making and earlier coordination with state and federal resource agencies. Several cross-cutting objectives in the environmental stewardship category would benefit from early, multidisciplinary consideration before projects are scoped and programmed.

Fish Passage

Culverts and bridges over waterways can alter the natural streambed elevation over time. Caltrans has identified a number of locations where transportation facilities are limiting the natural migration of certain fish species. When working on these facilities, Caltrans is required to eliminate fish migration barriers. These activities are eligible for SHOPP funding as part of any rehabilitation or replacement project.

Wildlife Crossings

Larger mammals attempting to cross highways, railroad tracks, or other similar transportation facilities may pose a safety risk to vehicle operators and the animals. Constructing wildlife crossings may be appropriate in cases where the potential for impact with horses, bears, deer, or other large animals pose an above average safety risk to the driving public. Additionally, improving SHS permeability and providing crossing opportunities for other wildlife, particularly threatened and endangered species, is good environmental stewardship and is aligned with Caltrans' Strategic Management Plan, the FAST Act, and state and federal environmental laws. Constructing wildlife connectivity into transportation projects can benefit project delivery by reducing permitting timelines and offsite mitigation requirements. Additionally, it is good practice to avoid new impacts to wildlife connectivity and migration by favoring the installation of more permeable infrastructure, such as selecting Midwest Guardrail System over concrete median barriers or incorporating crossing features when a roadway is being widened or a new facility is being constructed. Careful consideration should be given to projects located in rural areas, along streams and rivers, and areas with open space. Project features that promote safe wildlife passage can include directional fencing to

existing bridges and culverts; escape ramps; larger culverts; longer bridges that fully span a waterway; large overpasses; animal detection and warning systems.

Other Environmental Stewardship Activities

Caltrans also strives to avoid environmental impacts by considering the natural environment during project planning. Examples of good environmental stewardship include siting projects to avoid and minimize impacts to environmental resources, avoiding wetlands, sites with hazardous waste or contamination issues, threatened and endangered species, cultural sites, historic architectural elements to bridges, tribal lands, and others. Caltrans recommends including environmental planners on all project planning teams to facilitate the identification of environmental features along a corridor and recommend strategies to avoid these resources while implementing planned projects.

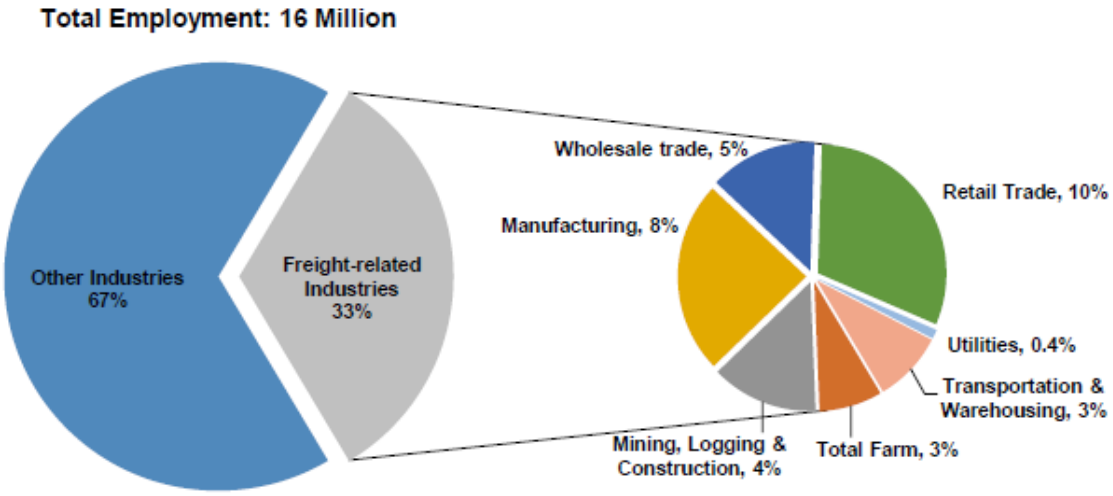
The previous 2017 SHSMP had identified an objective for Hazardous Waste Mitigation to address federal and state regulatory requirements applicable to specific maintenance stations and Caltrans-owned properties. 47 locations were identified for mitigation and were included as a component of 6 multi-objective projects totaling $87.5 million. These projects were programmed and are currently in various phases of development.

Cross Cutting: Freight

Overview

Caltrans uses a variety of programs to improve freight mobility. Several SHSMP objectives address freight needs, for example improving vertical clearance of bridges, building truck climbing lanes, and reducing wear and tear on truck components through pavement improvements.

California is the nation's largest gateway for international trade and domestic commerce. As shown in Figure 5-1, freight-related industries accounted for more than 5 million jobs in 2014.



Data source: State of California Employment Development Department, Labor Market Information Division

Figure 5-1. California Industry Employment Composition, 2014

California's freight transportation vision is reflected in the California Freight Mobility Plan (CFMP)[21] completed in 2014. An Addendum was completed in 2018 to address new requirements under the FAST Act to enable California to receive National Highway Freight Program funding (NHFP).

[21] Caltrans, "California Freight Mobility Plan", 2014, http://dot.ca.gov/hq/tpp/offices/ogm/CFMP/Dec2014/CFMP_010815.pdf

California's Freight Vision Strategic Goals:

Economic Competitiveness	Improve the contribution of the California freight transportation system to economic efficiency, productivity, and competitiveness.
Safety and Security	Improve the safety, security and resilience of the transportation system.
Freight System Infrastructure Preservation	Improve the state of good repair of the freight transportation system.
Environmental Stewardship	Avoid and reduce adverse environmental and community impacts of the freight transportation system.
Congestion Relief	Reduce costs to users by minimizing congestion on the freight transportation system.
Innovative Technology and Practices	Use innovative technology and practices to operate, maintain, and optimize the freight transportation system efficiency while reducing its environmental and community impacts.

The CFMP is updated every five years, as required by federal and state law. Caltrans is in the early stages of working with various stakeholders to solicit input for the next CFMP update. The FAST Act transforms the National Freight Policy provisions of MAP-21 into a new program that funds freight-related projects. It authorizes a five-year total of $6.2 billion for the program nationwide. The FAST Act created two new freight programs: (1) NHFP and (2) FASTLANE Grants. FAST Act requires the CFMP to include a Freight Investment Plan (FIP), which is the list of projects as adopted by the Trade Corridor Enhancement Program (TCEP) which combined the SB 1 TCEP with NHFP. Caltrans is working closely with all regional agencies, under the direction of California State Transportation Agency (CalSTA) to develop the FIP. These projects are required to align with the federally designated National Highway Freight Network (including the Critical Urban and Rural Freight Corridors to be cooperatively designated by Caltrans and Metropolitan Planning Organizations (MPOs)). The FIP will aid Caltrans in meeting the goals and objectives that guide the CFMP.

Complementing the CFMP is the interagency California Sustainable Freight Action Plan (CSFAP) published in July 2016. The CSFAP includes a long-term 2050 vision and guiding principles for California's future freight transport system along with targets for 2030. The objectives of the plan are laid out in Governor's Executive Order B-32-15, which seeks to improve freight efficiency, transition to zero-emission technologies, and increase competitiveness of California's freight system. California freight transport system's transition to

zero emission technologies is essential to support the state's economic development in coming decades, while reducing harmful pollution that impacts many California communities.

In collaboration with CalSTA, Caltrans established the California Freight Advisory Committee (CFAC) in response to guidance provided in MAP-21. The CFAC consists of cross-section representatives from public and private sectors freight stakeholders, including representatives of ports, shippers, carriers, freight-related associations, the freight industry workforce, Caltrans, and local governments. The CFAC is a platform for freight industry leaders to share and provide input for local, regional, state, and national freight initiatives.

Cross Cutting: System Resiliency and Climate Change

Overview

System resiliency activities include proactive treatments that strengthen or protect existing transportation system components from natural or man-made threats. Historically, the SHOPP has funded resiliency activities such as sea walls that protect coastal highways, slope erosion protection, bridge seismic retrofits, flood protection, and vessel protection systems. As the global climate changes and weather patterns become more extreme, this cross-cutting objective has expanded to include mitigation to sea level rise and flood mitigation.

Climate change and extreme weather events are increasingly gaining attention worldwide as one of the greatest challenges facing modern society. California and the nation's changing climate have led to increases in wildfires, increased temperatures, droughts, changing precipitation patterns, sea level rise and increased storm surge. These stressors have already impacted the SHS and are projected to increase in duration and frequency in the future.

Reduce Greenhouse Gas Emissions

SHOPP activities are geared primarily at rehabilitation and operational improvements to the existing highway system. In general, SHOPP activities generate emissions through the manufacturing of materials and emissions from construction and maintenance activities. Air quality is listed as a cross-cutting objective to ensure air impacts are considered during all project phases. SHOPP eligible activities include the use of recycled materials, use of "greener" equipment, facilitating walk, bike and transit modes of travel, and improving the efficiency of highway facilities. Greenhouse Gas (GHG) emissions are the leading contributor to climate change and associated impacts. Figure 5-2 shows the breakdown of California emissions by economic sector as presented by the Air Resources Board 2016 Inventory[22].

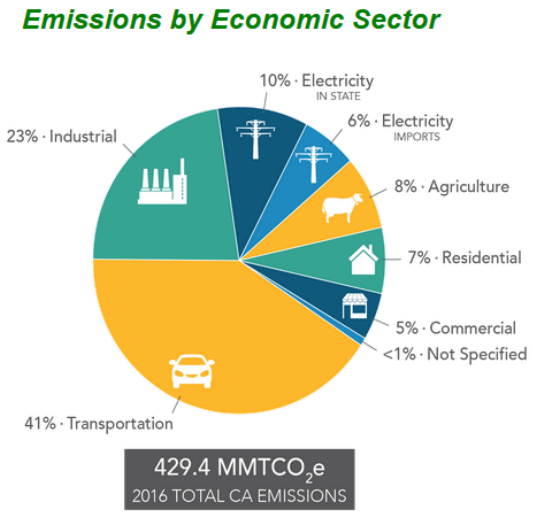


Figure 5-2. 2016 Total CO_2 California Emissions

[22] California Air Resources Board, 2016, https://www.arb.ca.gov/cc/inventory/data/data.htm

Numerous executive orders and legislative bills have been passed to reduce emissions statewide. Standards to reduce GHG emissions were initially established under AB 32 – California's Global Warming Solutions Act of 2006, which sets the GHG emission target to 1990 levels by 2020. Additional legislation was passed in 2016, SB 32, which established GHG emission reduction targets of 40 percent below 1990 levels by 2030. SB 32 was preceded by Executive Order (EO) B-30-15[23], which also mandated state agencies "take climate change into account in their planning and investment decisions and employ full life-cycle accounting to evaluate and compare infrastructure investments and alternatives."

SB 1 allocated $20 million in grant funding for local and regional planning agencies for climate change adaptation planning. The funding was available for three grant cycles, Fiscal Year (FY) 2017-18 ($7 million), FY 2018-19 ($7 million), and the current FY cycle 2019-20 ($6 million). Caltrans oversees the funding allocation and helps grant recipients to ensure successful adaptation planning implementation.

In 2012, Governor Brown issued EO B-16-12[24], directing state government agencies to help accelerate the consumer market for Zero-Emission Vehicles (ZEV) in California. The EO called for 1.5 million ZEVs in California by 2025 and established several milestones on the pathway toward this target. In October 2016, the Governor's Office released its updated ZEV Action Plan, setting new strategies and targets to help accelerate the adoption of zero-emission technologies in California. Consistent with the Governor's ZEV Action Plan, Caltrans programmed 14 projects in the 2018 SHOPP that included a component to install publicly-accessible, fast-charging DC stations for electric vehicles at 40 Caltrans-owned locations. These projects, which include work unrelated to ZEV, have a total cost of $54.7 million.

In January 2016, Caltrans' executive management issued a memo to include project-level performance data, including GHG emissions, in the SHOPP. While climate change has been incorporated and considered in Caltrans California Environmental Quality Act (CEQA) documents since 2010, Caltrans expanded

[23] Governor's Office, Executive Order B-30-15, 2015, https://www.ca.gov/archive/gov39/2015/04/29/news18938/
[24] Governor's Office, Executive Order B-16-12, 2012, https://www.ca.gov/archive/gov39/2012/03/23/news17472/

consideration of GHG emissions during the PID process in 2016. In addition, Caltrans modified its project performance tracking to enable the consideration of project- level GHG emissions.

Implementation of Adaptation Measures

Given the ongoing and expected increased impacts of climate change to the SHS, Caltrans is proactively integrating climate change adaptation into its practices. Caltrans is conducting vulnerability assessments[25] in all 12 districts to identify SHS segments vulnerable to sea level rise, storm surge, coastal erosion, changes in precipitation, increasing temperatures, and wildfire. Vulnerability assessments are the foundation toward a risk-based approach to address climate change adaptation concerns. Extensive data collection from external sources was necessary to ensure accurate mapping of vulnerabilities for each stressor.

Vulnerability assessments identify SHS segments where the need for adaptation measures will be integrated, based on the collected data outcomes. Upon completion of the vulnerability assessments, Caltrans will develop adaptation plans for all 12 districts. Each faces its own set of challenges regarding future climate projections and potential weather-related disruptions. The adaptation plans will incorporate identified vulnerabilities and district specific geography, and transportation needs, such as redundant routes, freight corridors, population hubs, among other considerations. As district information is developed, activities will be considered for inclusion in projects.

While these vulnerability assessments will help guide future practices and strategies, Caltrans has already put in place or is evaluating new practices to address climate change. For example, Caltrans has a design policy that requires consideration of sea level rise and tidal flow for bridge projects where appropriate. For projects where landslides or related ground failures resulting from coastal erosion are a factor, Caltrans considers the potential long-term impacts on these climate change based hazards when evaluating design and/or alignment alternatives. With the increase in wild fire occurrences throughout the state in recent years, Caltrans is now evaluating the use of alternative construction materials in fire prone areas.

Implementation of climate change elements into asset management performance objectives will ensure consistent inclusion of risk-based climate concerns in multi-objective SHOPP projects. While there are no fiscal performance goals or targets associated with the consideration of climate change impacts on infrastructure (GHG reduction and adaptation to enhance resiliency), these aspects are expected to be considered and/or incorporated within all projects as required by EO B-30-15 and SB 1 Section 2030(e). There is also a Caltrans guidance which requires considering, where applicable, a range of sea-level rise scenarios for the years 2050 and 2100 during the planning and project development phases of construction projects.

[25] Caltrans, Vulnerability Assessments, http://www.dot.ca.gov/transplanning/ocp/vulnerability-assessment.html

5.2 Safety

Goals and Objectives

Safety activities are carried out to reduce fatalities and injuries and to minimize the number and severity of accidents for all modes of transportation. Engineered safety activities improve the safety of the transportation system for all modes. Caltrans' ongoing commitment to transportation safety requires continual SHS monitoring for changing conditions or use patterns that would necessitate engineered safety solutions. As these situations are identified, improvements are carried out through both the SHOPP and the Maintenance Programs as appropriate for the specific circumstances.

Performance outcomes of certain 2017 SHSMP Safety Objectives were revised from reducing the total number of injury collisions to reducing the number of fatal and serious injury collisions. This revision aligns with the federal performance management rule (PM1). For the Highway Safety Improvement, Bridge Rail Replacement and Upgrade, and Collision Severity Reduction, it is estimated the State will reduce fatalities by three percent and serious injuries by one and a half percent annually in the next 10 years. Safety is one of our primary objectives and can be carried out on projects in any program area. Individual accomplishments for these objectives are discussed in more detail in the following pages.

Examples of Safety Activities Carried out to Improve the Safety of the Transportation System

- Installation of center dividing barriers
- Upgrading bridge rails to meet current standards
- Installing guardrail
- Protection for bicyclists and pedestrians through protected bicycle lanes and pedestrian signals
- Installing crosswalks
- Worker protection activities
- Placement of rumble strips
- Installing signals
- Geometric changes to the SHS
- Construction of bicycle and pedestrian facilities

Safety: Bridge Rail Replacement and Upgrade

Overview

The Bridge Rail Replacement and Upgrade objective includes improvement or replacement of bridge rails that do not meet federal crash standards for the posted roadway speed or that have deteriorated conditions or damage from other causes.

Performance Metrics

Bridge rails are assessed under federal crash standards for crashworthiness for posted roadway speeds. Table 5-1 describes the performance metrics for determing condition for good, fair, and poor Bridge Rail Replacement and Upgrade.

Table 5-1. Bridge Rail Replacement and Upgrade Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Rail crashworthy for roadway posted speed
Fair	Rail crashworthy up to 45 mph and the roadway posted speed exceeds 45 mph
Poor	Rail not crashworthy regardless of speed

Inventory and Conditions

There are 13,246 bridges on the SHS with over 8.6 million linear feet of bridge rail. Bridge Rail inventory data is recorded and/or updated during biennial routine bridge inspections. Bridge rail type and posted roadway speed are entered in the bridge management system using the Structures Maintenance Automated Report Transmittal (SMART) database. All bridges on the SHS are included in the inventory except for the Bay Area Toll Authority and Golden Gate Transportation District bridges and bridges built and maintained under Public Private Partnerships. Table 5-2 presents inventory and conditions, as of March 2018, for Bridge Rail Replacement and Upgrade.

Table 5-2. Bridge Rail Replacement and Upgrade Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	Inventory	Good	Fair	Poor	
Bridge Rail Replacement and Upgrade (linear feet)	**8,605,742**	**62.3%**	**32.4%**	**5.3%**	

Performance Targets

Table 5-3 presents the statewide asset performance targets for Bridge Rail Replacement and Upgrades.

Table 5-3. Bridge Rail Replacement and Upgrade Desired State of Repair

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Bridge Rail Replacement and Upgrade (linear feet)	**100.0%**	**0.0%**	**0.0%**	

Other Performance Management Parameters

Several other parameters are required in performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

Bridge Rail Replacement and Upgrade has no deterioration model and will only be reassessed when federal crash standards are revised.

Unit costs are based on an analysis of historical data composed of the capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction cost includes structure costs and an applied factor to account for associated roadway items, traffic handling, mobilization, supplemental work and contingencies.

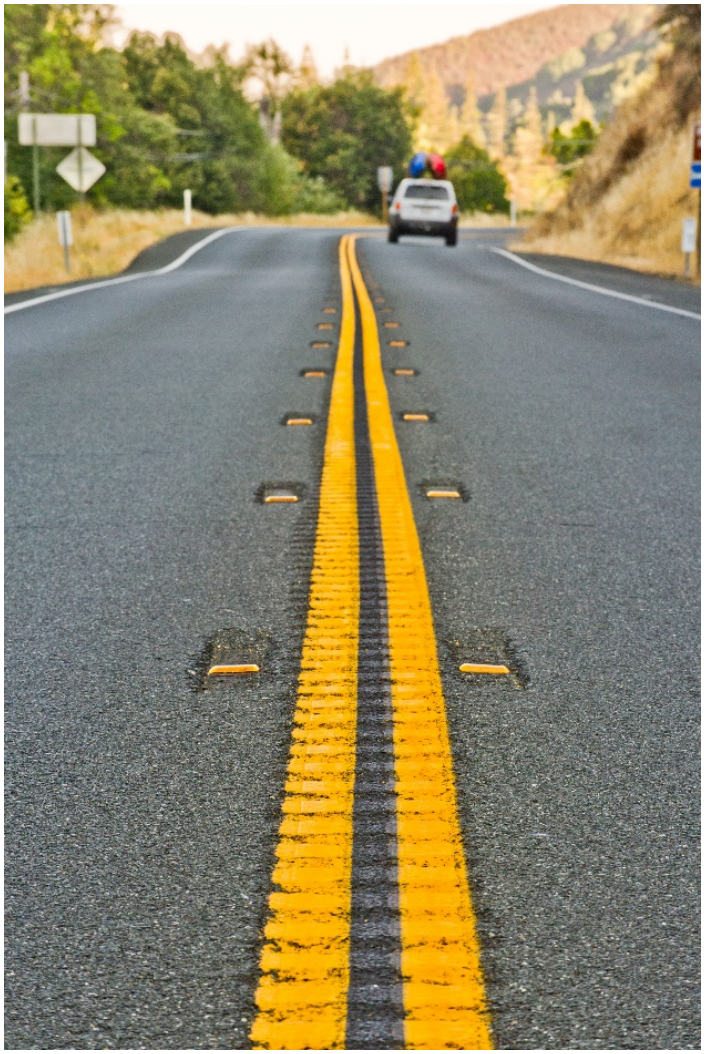
Typical Treatments

The SHOPP funds projects that primarily address replacement or upgrade of bridge rails by treatments that meet current roadside safety hardware device standards, as described in the American Association of State Highway and Transportation Officials (AASHTO) Manual for Assessing Safety Hardware (MASH). Other types of bridge rail upgrade projects could require bridge widening to meet current shoulder width standards, as described in the Caltrans Highway Design Manual (HDM)[26].

In some cases, widening a bridge deck to meet current shoulder standards or widening the existing sidewalk to meet current ADA standards may also require additional superstructure and substructure modifications which are much costlier to build. There are some scenarios in which existing rail is included in bridge structural wall elements (i.e., masonry arch culverts) and upgrading the railing requires a full bridge replacement project.

[26] Caltrans, Highway Design Manual, 6th Edition July 2, 2018, http://www.dot.ca.gov/design/manuals/hdm.html

Safety: Collision Severity Reduction



Overview

The Collision Severity Reduction objective, a component of the State Highway Safety Improvement Program (HSIP), is designated for those improvement types in which collision history may not be a required criterion. These improvement types are proactive, targeted to reduce the potential for traffic collisions or reduce the severity of traffic collisions. The project must be consistent with California's Strategic Highway Safety Plan (SHSP). Projects are implemented to create a "forgiving quality" for the roadsides. The idea of creating safer roadsides for highways and the design for safety concepts have been incorporated in the Caltrans' HDM.

One program goal is to keep the vehicles on the road. However, should a vehicle leave the road, it is desirable to provide an area clear of fixed objects adjacent to the roadway to provide a recovery zone. Where practical, Caltrans removes, relocates, makes breakaway, shields or delineates fixed objects along the roadside.

Caltrans' influence on reducing fatalities and serious injuries is on improving infrastructure. Approximately 34 percent of crashes can be attributed to infrastructure. The other two causes of road collisions are attributed to vehicle problems and driver error.

Performance Metrics

The condition designations for collision severity reduction are based on a deficiency model. A deficiency that still exists is designated as poor, while deficiencies that have been addressed through an applied safety countermeasure are designated as good. The fair designation does not apply in the deficiency model. Table 5-4 describes the performance metrics for determining good, fair, and poor Collision Severity Reduction.

Table 5-4. Collision Severity Reduction Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	**Deficiency has been addressed through an applied safety countermeasure**
Fair	**N/A**
Poor	**Deficient**

Inventory of Deficiencies

In 2016, there were 1,416 fatal collisions and 3,940 serious injury collisions reported on the SHS. The Collision Severity Reduction deficiency, as of 2016, is presented in Table 5-5.

Table 5-5. Collision Severity Reduction Inventory and Condition of Deficiencies

Inventory of Deficiencies				
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**
Collision Severity Reduction (Fatal and Serious Injury Collisions)	**5,356**	**0.0%**	**N/A**	**100.0%**

Performance Targets

The Collision Severity Reduction program performance target is to proactively reduce fatalities by 3 percent and serious injuries by 1.5 percent annually. This target equates to improving the deficiency or poor condition by 6.4 percent over 10 years. Table 5-6 presents the statewide asset performance targets for Collision Severity Reduction.

Table 5-6. Collision Severity Reduction Performance Targets

Desired State of Repair				
Objective (unit of measure)	**Good**	**Fair**	**Poor**	
Collision Severity Reduction (Fatal and Serious Injury Collisions)	**6.4%**	**N/A**	**93.6%**	

Other Performance Management Parameters

Several other parameters are required in performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP and potentially maintenance and other contributions.

Unit costs for Collision Severity Reduction are based on an analysis of historical cost data composed of the capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction includes work associated with the construction of safety improvement elements, traffic handling, mobilization, supplemental work, and contingencies.

Typical Treatments

The SHOPP primarily funds safety improvement projects targeted to reduce the potential for traffic collisions or reduce collision severity. The safety treatments needed may include improving highway geometry, enhancing roadway surface friction, applying roadway shoulder treatment, installing/upgrading guardrail and crash cushions, installing rumble strips, providing enhanced shoulder or in-lane delineation and markings for sharp curves, and rock fall mitigation.

Safety: Roadside Safety Improvements

Overview

The Roadside Safety Improvement's primary goals are to reduce roadside worker fatalities to zero and reduce employee injury rates by minimizing the frequency and duration of highway worker exposure to traffic.

Roadside Safety Improvements are an effective means to improve worker safety and reduce fatality and injury rates as determined by site specific factors. These improvements provide comprehensive solutions for worker safety issues by reducing or eliminating recurrent maintenance activities which reduces the frequency and duration of worker exposure to traffic. Improving highway worker safety also improves safety for travelers on the SHS by eliminating collision hazards.

Following are the Roadside Safety Improvement activity objectives, referred to as S.A.F.E.R:

Site - Improve safety by locating features in safe locations.

Accessible - Provide safe worker access to the roadside and highway features.

Facilitate - Accommodate mechanized maintenance activities and understand equipment constraints.

Eliminate - Implement design decisions that eliminate the maintenance activity and the need for workers on foot adjacent to the travel way.

Relocate - Minimize the need for recurrent damage repair by relocating equipment and irrigation systems out of the clear recovery zone and away from traffic.

Roadside safety concepts are required to be addressed and included on all SHS roadway improvement projects. Roadside Safety Improvement projects should be programmed to address deficiencies at locations where no roadway projects are planned. This objective is not to be used for Roadside Safety Improvements included as part of a roadway improvement project.

Performance Metrics

Condition designations for Roadside Safety Improvement locations are based on a deficiency model. Locations where a deficiency still exists, as identified by the Districts, are designated as poor, while locations where deficiencies have been addressed are designated as good. The fair designation does not apply in the deficiency model. Table 5-7 describes performance metrics for determining condition for good, fair, and poor Roadside Safety improvements.

Table 5-7. Roadside Safety Improvements Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Deficiency has been addressed
Fair	N/A
Poor	Deficient

Inventory of Deficiencies

The Roadside Safety Improvements inventory reported by districts, as of 2018, is presented in Table 5-8. The inventory was reduced compared to 2017 SHSMP because of project accomplishments in the last two years.

Table 5-8. Roadside Safety Improvements Inventory of Deficiencies

Inventory of Deficiencies					
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**	
Roadside Safety Improvements (locations)	**18,862**	**0.0%**	**N/A**	**100.0%**	

Performance Targets

Caltrans has established a 10-year goal to address all Roadside Safety Improvement deficiencies including locations where no highway projects are planned. Table 5-9 presents the statewide asset performance targets for Roadside Safety Improvements.

Table 5-9. Roadside Safety Improvements Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Roadside Safety Improvements (locations)	100.0%	N/A	0.0%	

Other Performance Management Parameters

Several other parameters are required in performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

Unit costs are based on an analysis of historical cost data composed of capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction cost is the statewide weighted average of a variety of highway roadside safety assets. This cost includes work associated with the construction, traffic handling, mobilization, supplemental work and contingencies.

Typical Treatments

Major Maintenance funds projects with treatment strategies related to the preservation of roadside elements to maintain and protect the overall integrity of adjacent properties and the environment. During development of these types of projects, Caltrans evaluates roadside safety concepts for inclusion, as appropriate.

The SHOPP funds projects that primarily provide for safe access to facilities that require repetitive maintenance activities and expose workers to traffic. Treatment strategies may include: access gates in right of way fence, light duty vehicle trails, shoulder widening/turnouts, maintenance vehicle pullouts and barriers improvements. Some SHOPP projects are funded to eliminate maintenance worker exposure, such as gore paving. Vegetation control is another type of roadside safety treatment that includes preserving sign visibility, sight distance and minimizing homeless and transient activity. The SHOPP also funds miscellaneous types of work, such as reducing graffiti through clean-up of facilities and equipment.

Safety: Safety Improvements

Overview

The Safety Improvement objective was established in the 2017 SHSMP as a Reservation Model performance objective. Safety Improvements (triggered safety) within HSIP are Caltrans' highest priority. All efforts are made to expedite programming and delivery. When a safety project has been recommended, the project is evaluated for SHOPP eligibility. Safety Improvement projects are based on collision history in which the improvement reduces the number and/or severity of collisions.

HSIP eligible projects must:

- Address an SHSP priority
- Be identified through a data-driven process
- Contribute to a reduction in fatalities and serious injuries

Two different methodologies are used to qualify locations for Safety Improvements in the SHOPP: 1) Traffic Safety Index and 2) Monitoring Programs. Triggered safety improvements must meet Federal HSIP eligibility criteria. In addition, under the HSIP, annual targets are required to track safety progress. For further information regarding methodologies or eligibility requirements, refer to the Caltrans HSIP website.[27]

[27] Caltrans, HSIP website; http://www.dot.ca.gov/trafficops/hsip/

Typical Treatments

Field Maintenance Crews work daily to preserve the safety of our roadways. Typical treatments to improve safety through maintenance include repainting or adding wrong-way pavement arrows, reorienting, relocating, or adding wrong-way sign packages, modifying trailblazing freeway entrance packages, placing edge lines and pavement markers, and upgrading signs with high intensity reflective sheeting.

The SHOPP funds safety projects that include treatments such as new and modification of traffic signals and wet improvement treatments such as high friction surface and open-graded asphalt concrete surface treatments. Other treatment strategies include improving highway geometry, applying roadway shoulder treatments, installing/upgrading guardrail and crash cushions, bicycle and pedestrian safety improvements, and installing rumble strips. SHOPP also funds projects providing enhanced shoulder or in-lane delineation and markings for sharp curves, and projects that address multi-lane cross-median, cross-centerline and wrong-way collisions.

5.3 Stewardship

Goals and Objectives

Stewardship activities are carried out primarily to minimize long-term costs of ownership of physical assets. These activities generally maintain or improve the asset's condition which often improves system reliability and safety at the same time. Stewardship needs continue to increase as the transportation system demand grows and the infrastructure ages. Failure to perform timely stewardship investments in the transportation system increases long-term costs of ownership, reduces the system reliability and safety, and will ultimately take even greater investments to restore the condition in the future.

Examples of Stewardship Activities

- Emergency restoration of damaged infrastructure
- Maintaining pavement, bridges, and culverts
- Applying protective coatings, protection systems, or overlays
- Maintenance and rehabilitation of pedestrian and bicycle facilities
- Maintenance and rehabilitation of SRRA facilities
- Performing maintenance on state-owned maintenance stations, office building, equipment shops, transportation management centers, and labs
- Maintaining and replacing signs and lighting
- Rehabilitation or replacement of pavements, bridges, culverts, buildings, etc.

Stewardship: Bridge and Tunnel Health

Overview

Bridges and tunnels provide road network connectivity, allow pedestrian access, span water bodies and other natural features, pass through mountains, and span rail lines and other highways or local facilities.

New bridges are designed with an expected design life of 75 years, and in practice, many bridges remain in service for much longer. However, bridges and tunnels require periodic maintenance to rehabilitate or replace individual components (such as bridge decks) subject to deterioration resulting in a shorter life than the bridge itself. The most cost-efficient way to maintain a bridge or tunnel's structural integrity is through preservation work prior to the occurrence of significant deterioration. If preservation work on a bridge is deferred, the deterioration may accelerate to the point where more costly repairs are needed. In extreme cases deteriorated conditions may require restricting the loads the bridge can carry or closing the bridge until needed repairs are complete–which can mean costly delays and/or detours for the traveling public. Thus, maintaining bridges in good condition pays off–resulting in the lowest long-term costs both to transportation agencies and road users. Bridges and tunnels in good condition allow access to essential services and have a positive impact on the economy.

The focus of the Bridge and Tunnel Health objective is to identify and address structural needs of SHS bridges and tunnels to maintain their structural integrity. With the implementation of MAP-21 requirements, the bridge health performance measure for bridge health is based on the total deck area, and for tunnel health is based on the total structure's liner area, both rated in good, fair, or poor condition.

Caltrans reports bridge and tunnel asset condition data annually to FHWA as part of the National Bridge Inventory (NBI), an FHWA database that includes data on all bridges and culverts longer than 20 feet on the nation's public roads, and as part of the National Tunnel Inventory (NTI) for all tunnel assets. Bridges with a span shorter than 20 feet are not included in NBI submittals. Caltrans' SHSMP bridge and tunnel inventory also includes railroad and pedestrian bridges and is therefore larger than the NBI inventory which does not include these additional bridges.

Performance Metrics

Caltrans and local agencies follow FHWA NBI and NTI standards for inspecting all California bridges and tunnels. Inventory condition data is based on the most recent Bridge Inspection Reports (bridge and tunnel inspections are typically scheduled every two years) that document condition states of each individual structural element per these federal guidelines. The condition state of appropriate individual elements is then mathematically converted to a condition state (good, fair or poor) of three categories for bridges (deck, superstructure and substructure) and a single condition state for either tunnels or culverts. Good, fair, and poor NBI ratings for bridge condition are shown in Figure 5-3. A calculated value of 7 or greater is classified as being in good condition; 5 or 6 is classified as being in fair condition; and 4 or less is classified as being in poor condition. A bridge in poor condition is considered structurally deficient (SD) by federal guidelines. Thus, if any major component is classified as being in poor condition, the bridge will be considered SD. Being classified as SD does not imply a bridge is unsafe, just that deficiencies have been identified that require maintenance, rehabilitation, or replacement. A graphical depiction of the three bridge components is shown in Figure 5-4.

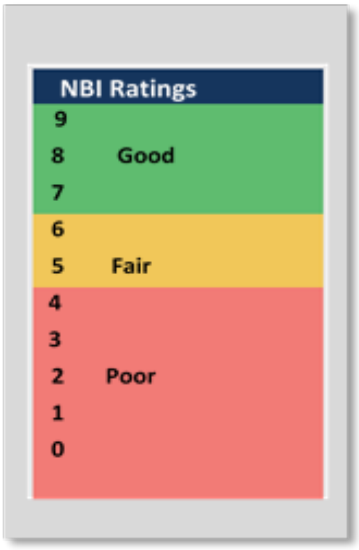


Figure 5-3. NBI Ratings for Bridge Condition

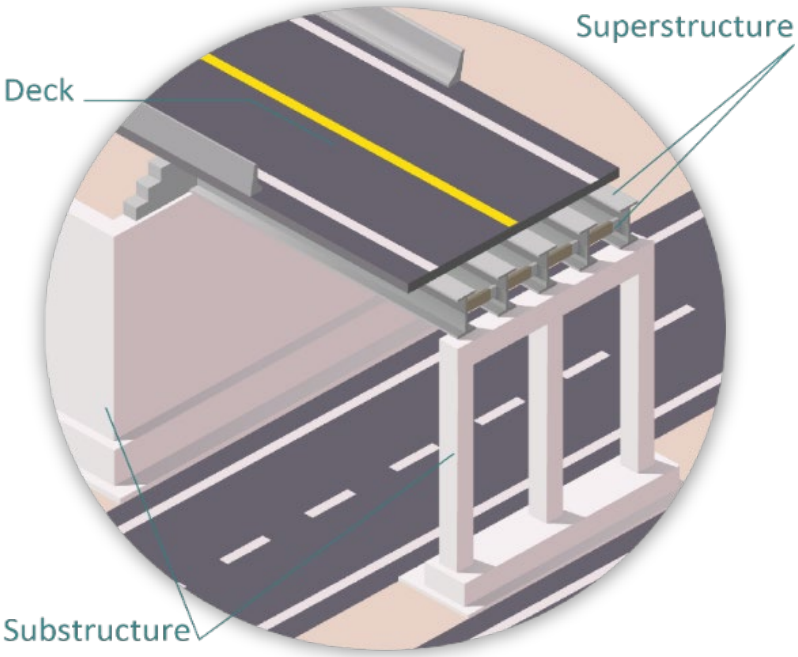


Figure 5-4. NBI Ratings for Bridge Condition and Bridge Components

As a bridge is assigned a condition state for the deck, superstructure, and substructure individually, the lowest of the three ratings determines the overall rating of the bridge. Caltrans maintains all data in the Structures Maintenance and Investigations (SM&I) bridge management system databases. Table 5-10 and Table 5-11 describe the performance metrics that define the criteria for determining condition for good, fair, and poor Bridge and Tunnel Health.

Table 5-10. Bridge Health Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Deck, superstructure, and substructure ratings are all Good, or the culvert rating is Good
Fair	The lowest of the three ratings for deck, superstructure, and substructure is Fair, or the culvert rating is Fair
Poor	The lowest of the three ratings for deck, superstructure, and substructure is Poor, or the culvert rating is Poor

Table 5-11. Tunnel Health Performance Metrics

Performance Metrics	
Condition	**Metrics**
Good	Less than 20% of the elements are classified as deteriorated
Fair	More than 20% of the elements are classified with minor deterioration
Poor	More than 20% of the elements are classified with significant deterioration

Inventory and Conditions

Caltrans is currently responsible for the maintenance of 13,189 SHS bridges totaling over 246 million square feet of bridge deck area. These bridges are an average of 47 years old which typically results in increasing maintenance needs. Caltrans also maintains 57 tunnels totaling over 5 million square feet of liner area. The tunnel liner area is calculated using the surface area of the liner supporting the mountain or roadway above the driving surface.

All SHS bridges and tunnels are included in the inventory, except for Bay Area Toll Authority and Golden Gate Transportation District bridges, and bridges built and maintained under Public Private Partnerships.

In addition to condition classification, maintenance needs are also identified and documented during regular, routine bridge and tunnel inspections, and when applicable, during specialty investigations which include hydraulic, underwater, and fracture critical inspections. These Bridge Inspection Reports document the needs as work recommendations in addition to coding changes to the individual structural elements. The inventory and conditions of Bridge and Tunnel Health, as of March 2018, are presented in Table 5-12.

Table 5-12. Bridge and Tunnel Health Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**	
Bridge and Tunnel Health (square feet)	**251,190,698**	**65.9%**	**30.8%**	**3.3%**	

Performance Targets

Table 5-13 presents the asset performance targets for Bridge and Tunnel Health, as established in the TAMP.

Table 5-13. Bridge and Tunnel Health Performance Targets

Desired State of Repair				
Objective (unit of measure)	**Good**	**Fair**	**Poor**	
Bridge and Tunnel Health (square feet)	**83.5%**	**15.0%**	**1.5%**	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

On an annual basis, a percentage of bridge assets in good condition deteriorates to fair condition, while a percentage of assets in fair condition deteriorates to poor. The deterioration rates for bridges are based on the life cycle of the asset.

Unit costs for bridge health are based on an analysis of historical cost data composed of the capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction cost includes the structure costs and an applied factor to account for associated roadway items, traffic handling, mobilization, supplemental work, and contingencies. It is assumed that all fair assets require preservation or rehabilitation, addressed through a combination of HM Program and SHOPP projects. Those addressed under the HM program are typically preservation activities, while those addressed under the SHOPP typically require more signification rehabilitation. In addition, it is assumed sixty percent of the poor assets would require rehabilitation while the remaining forty percent would require replacement of the existing structure.

Typical Treatments

Bridge maintenance treatments include repairs that require immediate attention and other minor maintenance, including joint repairs, spalls, and paint needs, as well as deck overlays and repairs. When minor defects are not addressed quickly and efficiently, the resulting damage often requires major structural rehabilitation or replacement which not only costs more than preventive maintenance, but can cause significant long-term disruptions to the traveling public. As the bridge inventory increases and continues to age, preventive maintenance strategies are imperative to maintain or improve the structural condition of the inventory and slow the growth of major rehabilitation needs.

The first stage of preventive maintenance is the work performed by bridge Maintenance Field Crews to address minor maintenance repairs that require immediate attention. Bridge preventive maintenance needs beyond the scope of bridge Maintenance Field Crews are combined into maintenance projects completed by contractors. Bridges that have damage or deterioration that can be addressed through preventive maintenance activities, which include bridges in good condition and a portion of the bridges in fair condition, are funded through the Major Maintenance projects or through the SHOPP.

Bridges that have deteriorated structurally or have been damaged by other causes, which include bridges in poor condition and a portion of the bridges in fair condition, are addressed with SHOPP-funded major rehabilitation or replacement activities. When bridges require major rehabilitation or replacement, it is sometimes appropriate to make additional geometric or structural improvements. Such improvements are permissible, however, the primary purpose for the work and treatment strategies shall be to address the condition of the bridge's structural elements.

Since the implementation of the 2017 SHSMP, the federally-mandated Tunnel Inspection Program has been fully implemented and the complete tunnel inventory has been identified and inspected for condition assessments. Based on the current tunnel inventory conditions, it is assumed that tunnel health maintenance needs will typically be preventive maintenance strategies to address minor deterioration.

Stewardship: Drainage Pump Plants

Overview

Drainage Pump Plants' primary objective is to replace or rehabilitate in-place drainage pump plants and related elements that have lost serviceability because of age, wear, or degradation, and reduction of long-term maintenance cost. Upgrades or modifications of the drainage pump plants are included; however, the priority is addressing the poor condition pump plants. The criteria used to define the performance target were to eliminate from the inventory all known poor condition pump plants to ensure efficient operations of the facility.

Performance Metrics

The condition of drainage pump assets is based on the service life of the asset, which is estimated at about 50 years. It is also based on the engineering inspector's assessment of the failure or defects found on the pump plants and the level of mechanical and electrical failures or deficiencies. Each attribute or element of the pump plant is scored, and an overall health score is assigned on a scale of 0 to 100. Table 5-14 describes the performance metrics for determining condition for good, fair, and poor Drainage Pump Plants.

Table 5-14. Drainage Pump Plants Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Overall health score between 80 to 100
Fair	Overall health score between 50 to 79
Poor	Overall health score between 0 to 49

Inventory and Conditions

Drainage Pump Plants, which include the facility structure, pumps, electrical, mechanical, plumbing, and appurtenances, are an integral part of the SHS. The inventory and conditions of Drainage Pump Plants are presented in Table 5-15.

Table 5-15. Drainage Pump Plants Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**	
Drainage Pump Plants (each)	291	11.3%	29.6%	59.1%	

Performance Targets

Table 5-16 presents the statewide asset performance targets for Drainage Pump Plants.

Table 5-16. Drainage Pump Plants Performance Targets

Desired State of Repair				
Objective (unit of measure)	**Good**	**Fair**	**Poor**	
Drainage Pump Plants (each)	80.0%	20.0%	00.0%	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

The deterioration rates for Drainage Pump Plants are based on the service life of the asset, pump and controller types. Specifically, on an annual basis a percentage of assets in good condition deteriorates to fair condition, while a percentage of assets in fair condition deteriorates to poor. Failure of pumping equipment and controls may cause roadway flooding which could result in unacceptable consequences and property damage.

Unit costs for Drainage Pump Plants are based on an analysis of historical data comprised of the capital construction and support cost. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction cost includes work associated with the construction of drainage pump plants, traffic handling, mobilization, supplemental work and contingencies.

Typical Treatments

Field Maintenance Crews address the good or fair pump plants with significant remaining service life. Some typical examples of work treatments done by Field Maintenance Crews are to inspect drainage pump plants and perform minor maintenance work, including cleaning and minor repairing, especially before the seasonal rains begin.

Major Maintenance projects include any work that maintains the SHS pump plants to a safe and useable condition; it does not include reconstruction, major structural deficiencies or other improvements. These projects primarily deal with preventive and corrective maintenance and preservation strategies to maintain the pump plants in good and fair condition. These projects usually do not require additional permanent right of way, change hydraulic capacity, or involve environmental consequences greater than those addressed in a categorical exemption. Some typical treatments in Major Maintenance projects for Drainage Pump Plants include: cleaning to remove excessive debris build-up in the drainage pump building and stairwells and repair of drainage pump electrical and mechanical deficiencies. Typical projects have a two FY cycle for project development, project design, and construction.

SHOPP projects primarily address rehabilitative and replacement remedial work to correct a specific condition, such as restoring drainage pumps from poor to good condition. The priority is on pumps in poor condition. Rehabilitation and replacement of Drainage Pump Plants are typical types of projects. These projects restore the drainage system and repair structural deficiencies in the building housing the drainage pumps.

Stewardship: Drainage Restoration

Overview

The primary objective of Drainage Restoration is to provide for the replacement or in-place rehabilitation of culverts and other highway drainage system elements that have lost serviceability because of age, wear, or degradation. Drainage Restoration is one of the objectives under Drainage Restoration that includes culverts, inlets, outlets, headwalls, endwalls, junction boxes and other major drainage system elements. The other objective is Drainage Pump Plants. Drainage Pump Plants are a separate SHSMP objective and are not included under the Drainage Restoration objective. Upgrades or modifications of culverts and other highway drainage system elements to increase flow or improve drainage alignment are included; however, the priority is in addressing the poor condition culverts. Projects to abandon culverts are also included. The criterion used to define the Drainage Restoration performance target was to minimize all known poor condition culverts from the inventory. The target was set using Commission and Caltrans' program management guidance and engineering judgment.

If a culvert becomes clogged, decays, or fails because of rust or other factors, and no longer conveys water away from the highway, water may then flood the highway or erode highway foundations or adjacent slopes resulting in road washouts and closures. Culverts require periodic maintenance to avoid costly replacement and possible future catastrophic failure. The repairs of catastrophic events are far more expensive than providing adequate funding to maintain and upgrade culverts. Caltrans, using a proactive inspection program, has developed management procedures to measure the drainage systems' health, prioritize potential culvert projects based on condition, cost, and traveler delay, and track maintenance work accomplishments and delivery schedules.

Performance Metrics

The health condition assessment of Drainage Restoration assets is based on a visual inspection of five attributes: waterway adequacy, joints, materials, shape, and culvert alignment. Each attribute is scored, and culvert condition is calculated using a weighted average of attribute scores. Table 5-17 describes the performance metrics for determining condition for good, fair, and poor Drainage Restoration.

Table 5-17. Drainage Restoration Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Overall health score between 80 to 100
Fair	Overall health score between 50 to 79
Poor	Overall health score between 0 to 49

Inventory and Condition

The SHS includes 212,181 culverts, totaling an estimated 20.98 million linear feet as of December 2018, that drain rainwater, drainage channels, streams, and rivers away from highways in a controlled manner.

A typical culvert is a 12-60-inch diameter (or width) pipe or box culvert. Any culvert with structure length that spans 20 feet or longer is classified as a bridge and recorded on the NBI. A diagram showing typical drainage details is presented in Figure 5-5.

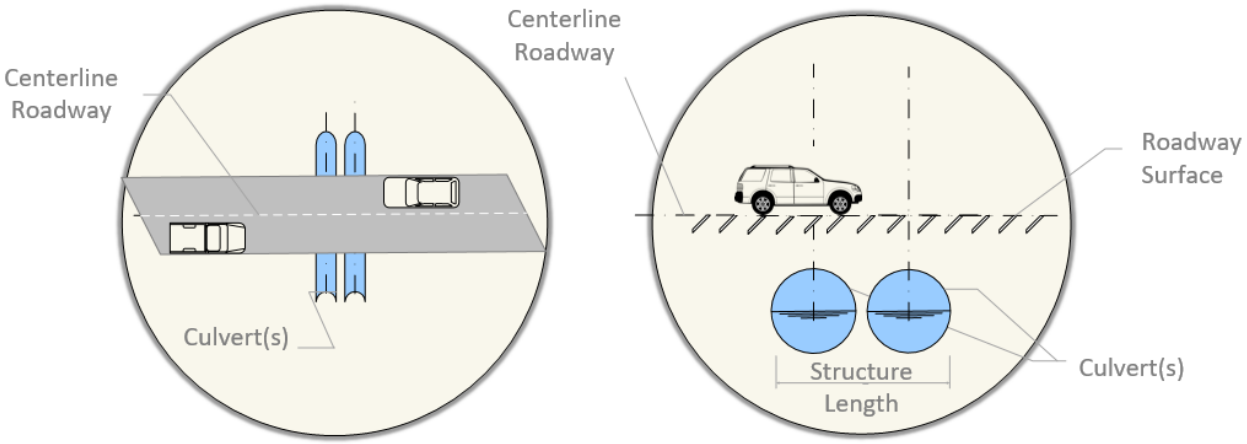


Figure 5-5. Typical Drainage Details

The culvert inventory is complete and has grown by over 1.5 million linear feet between 2017 and 2019. Efforts are continuing to complete the condition assessment. Ongoing culvert inspections have been

inspecting between 8,000 to 12,000 culverts (approximately 1,000,000 linear feet) annually. Inspection production rates are dependent on many factors, including right-of-way constraints, environmental permits, multi-year mitigation permits, and traffic considerations. Caltrans has increased the number of inspections for the purpose of condition assessments and anticipates completion by the end of 2023.

The inventory and conditions of Drainage Restoration, as of December 2018, are presented in Table 5-18. Condition percentages are based on the estimated culvert lengths, pending verification. The average culvert length of 98.9 linear feet is used for locations where the actual culvert length still needs to be verified.

Table 5-18. Drainage Restoration Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	Inventory	Good	Fair	Poor	
Drainage Restoration (linear feet)	20,984,702	69.2%	21.0%	9.8%	

Performance Targets

Table 5-19 presents the statewide asset performance targets for Drainage Restoration.

Table 5-19. Drainage Restoration Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Drainage Restoration (linear feet)	80.0%	10.0%	10.0%	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

Until the remaining SHS culvert assessments have been completed, historical assessment rates and anticipated deterioration rates create an annual increase of approximately 326,000 linear feet (3,300 culverts) in the fair category and an annual increase of 154,000 linear feet (1,560 culverts) in the poor category. It is anticipated that the remaining assessment will be completed by the end of 2023.

Deterioration rates for culverts are based on the asset's service life. Specifically, on an annual basis a percentage of assets in good condition deteriorates to fair, while a percentage of assets in fair condition deteriorates to poor.

Unit costs for Drainage Restoration are based on an analysis of historical cost data composed of the capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction cost includes work associated with construction of drainage system elements, traffic handling, mobilization, supplemental work and contingencies.

Typical Treatments

Field Maintenance Crews focus on minor maintenance work which may include treatment strategies of cleaning and minor repairing of culverts. The work done by Field Maintenance Crews work is also preventive maintenance, addressing good or fair culverts which have significant service life remaining.

Major Maintenance projects include any work that maintains SHS drainage systems to a safe and useable condition; it does not include reconstruction, major structural deficiencies or other improvements. These projects primarily deal with treatment strategies such as preventive and corrective maintenance and preservation strategies to maintain the drainage system in good and fair condition. HM projects usually do not require additional permanent right of way, change hydraulic capacity or involve environmental consequences greater than those addressed in a categorical exemption. The types of projects and treatments used in Major Maintenance include the repair of culverts, such as repairing damaged end treatments, inverts or connections, ramming, or lining the culverts. They may also include erosion and scour issues, installing debris protection systems, and cleaning to remove excessive debris build-up and improve capacity. Typical projects have a two FY cycle for project development, project design, and construction.

SHOPP projects primarily address rehabilitative and replacement work and restore culverts from poor to good condition. The priority is on culverts in poor condition. Treatments are like those under Major Maintenance but are typically much larger in scope of work.

Stewardship: Lighting Rehabilitation

Overview

The Lighting Rehabilitation objective includes rehabilitation and replacement of roadway lighting systems (poles, foundations, luminaires, etc.) that have damage or deteriorated conditions because of aging, weather or other factors. Roadway lighting systems include street lights, lights underneath overpasses, and lights in tunnels.

Lighting systems need to be updated to current technology and/or structural requirements to prevent structural failure, improve operational reliability, and reduce the use of electricity. Caltrans has converted significant portions of the SHS to Light-Emitting Diode (LED) lighting, and we continue to look at adaptive lighting solutions to further reduce power demand. The primary factor for this activity is asset age, since many of the points of deterioration are directly associated with system age. As lighting systems age, metal fatigue can set in, corrosion weakens the pole or base bolts, and wire can deteriorate to the point of insulation failure which will cause electrical failure.

Performance Metrics

The lighting systems' condition is primarily based on age. Age is calculated based on the original installation date of the lighting system. The replacement of the light by LED for tunnel or soffit lighting will change its condition to good. However, only replacing the lights by LED alone for other lighting systems is not considered as overall condition rating upgrade. Table 5-20 describes the performance metrics for determining condition for good, fair, and poor Lighting Rehabilitation.

Table 5-20. Lighting Rehabilitation Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Age of lighting system < 30 years
Fair	30 years ≤ Age of lighting system < 40 years
Poor	Age of lighting system ≥ 40 years

Inventory and Condition

The SHS lighting systems' inventory is maintained in Caltrans Integrated Maintenance Management System (IMMS) and updated quarterly based on project accomplishments. Inventory and conditions for Lighting Rehabilitation, as of 2018, are presented in Table 5-21.

Table 5-21. Lighting Rehabilitation Inventory and Conditions

Inventory and Conditions				
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**
Lighting Rehabilitation (each)	94,724	40.1%	14.5%	45.4%

Performance Targets

Table 5-22 presents the asset performance targets for Lighting Rehabilitation.

Table 5-22. Lighting Rehabilitation Performance Targets

Desired State of Repair			
Objective (unit of measure)	**Good**	**Fair**	**Poor**
Lighting Rehabilitation (each)	100.0%		0.0%

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

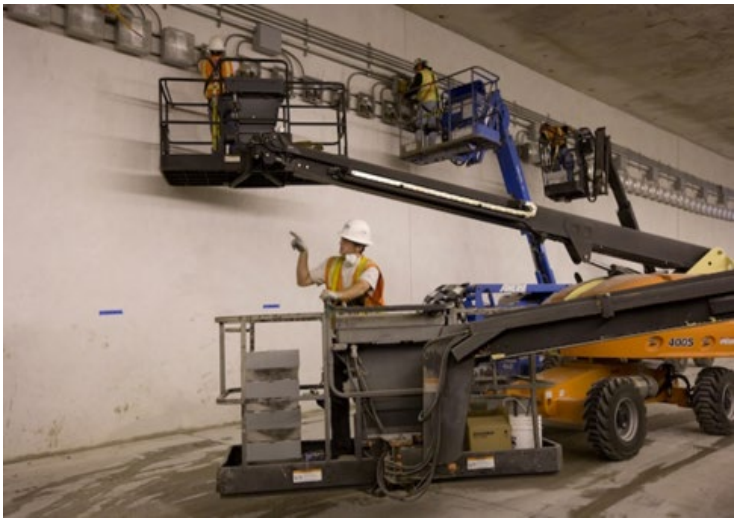
Deterioration rates for lighting are based on the service life of the asset. Specifically, on an annual basis a percentage of assets in good condition deteriorates to fair condition, while a percentage of assets in fair condition deteriorates to poor.

Unit costs are based on an analysis of historical cost data composed of capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The capital construction cost includes work associated with the construction, traffic handling, mobilization, supplemental work and contingencies.

In addition, lighting rehabilitation unit cost is based on two factors, highway lighting, and tunnel/soffit lighting. The highway lighting unit cost is calculated using an estimator tool employed by the electrical designers. The tunnel and soffit cost were based on a PID estimate for a tunnel lighting system in District 4. These were weighted together based on the performance gap quantities.

Typical Treatments

Maintenance work, either with Field Maintenance Crews or Major Maintenance projects, is limited to treatment strategies such as relamping or replacing luminaires when they fail or when scheduled for mass replacement (end of life of the luminaire or lamp, but infrastructure is still in acceptable condition). Field Maintenance Crews may also replace individual poles that get damaged by others, but these repairs would not include upgrading the pole to current standard.



SHOPP projects include treatment strategies that completely rehabilitate and replace the existing lighting asset to current standards. For pole mounted roadway lighting, work would include replacing the foundation, pole, luminaire, and associated electrical wire. It may include underground components such as electrical conduit if it is not usable. For tunnel and soffit lighting, work would include replacement of the existing luminaire and electrical wire. Tunnel lighting control systems would also be upgraded by SHOPP. New control systems are needed to properly control new lighting technology such as LED and to make the system as efficient as possible.

Stewardship: Major Damage

Overview

The Major Damage objective was established in the 2017 SHSMP as a Reservation Model performance objective. Major Damage Restoration consists of Emergency Opening and Permanent Restoration. These components are identified as separate SHOPP funding programs with distinct objectives.

A Director's Order is a formal document that grants legal authority by state contract law 10122 to set aside normal procedures for the advertising, bidding, and awarding of construction contracts because of an emergency or urgent situation. This type of work may be eligible for federal assistance by either FHWA or Federal Emergency Management Agency (FEMA). Every effort should be made to maximize federal participation. Exceptions may be allowed on a case-by-case basis if using 100 percent funding is not in the public's best interest.

From an asset management perspective, the condition of the state highway assets damaged in a catastrophic event may deteriorate drastically. However, following Caltrans emergency response, the conditions may go from poor to fair, or even good. In the case of a Permanent Restoration response, it is expected that the conditions of the restored assets become Good.

Emergency Opening

The Emergency Opening objective includes emergency repair of assets damaged or imminently threatened by natural or human-caused events. Qualifying repairs include those needed to restore essential travel. To be considered, the work is typically tied to an identifiable natural event such as a storm, flood, fire, earthquake, tsunami, or volcanic action. Human-caused events such as vehicle collisions, explosions, civil unrest and acts of war or terrorism are included. Repair to current design standards is allowed. The level of repairs needed varies annually depending on the number and severity of damaging events. Funding needs

are estimated in real-time when the event(s) occur, based on the damage experienced and cost of repair. The goal is to repair 100 percent of damaged assets as soon as possible.

Permanent Restoration

The Permanent Restoration objective includes permanent repair and restoration of assets to pre-emergency condition and either follows or runs concurrently with the emergency opening phase. Restoration to current design standards is allowed and may include betterments. It is expected that projects begin construction as soon as possible. Funding needs are estimated based on the damage experienced and cost of repair.

Typical Treatments

Field Maintenance Crews may respond as necessary to assist in clearing the roadway and providing for essential traffic after a natural or man-made emergency event. In some cases, Major Maintenance projects are also used. Emergency Opening projects typically include any work or treatment that allows the roadway to open to essential traffic. This work may include earthwork, demolition, drainage, flood protection, or other major structural work or treatment. Any disaster-generated debris removal work is also allowed. In Permanent Restoration, projects are handled similarly to any other competitively bid and awarded contract. Typical work is the reconstruction or replacement of the transportation facility damaged during the emergency event to restore the facility to its intended purpose.

Stewardship: Office Buildings

Overview

The Office Buildings objective includes major rehabilitation and/or replacement projects for Caltrans office buildings. The Administration Program, Division of Business Operations, is responsible for Caltrans Statewide Office Buildings (District and Headquarters). Some projects require external approvals, including from the State Transportation Agency, Department of General Services, Department of Finance, and the Legislature. The Division of Business Operations must be consulted for all SHOPP related projects for office buildings. As office building infrastructure deteriorates or becomes obsolete, the SHOPP objective will include major repair or replacement projects to address the facility operational and useful life issues. Projects may include those that improve building conditions or address critical infrastructure deficiencies, such as fire, life safety, seismic, code, or building system deficiencies.

Performance Metrics

The inventory of Office Buildings in good condition remains unchanged since the last SHSMP. In the event that an office building is damaged, the damaged location is considered to be in poor condition and will require restoration. The goal is to award construction contracts within three years of damaging events for all known needs. Table 5-23 describes the performance metrics that define the criteria for determining good, fair, and poor Office Building condition.

Table 5-23. Office Building Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Fixed buildings less than 25 years old
Fair	Fixed buildings between 25 and 50 years old
Poor	Greater than 50 years old for fixed buildings; 20 years for modular buildings or with critical infrastructure deficiencies

Inventory and Conditions

There are 10 office buildings in Caltrans' portfolio, including district and headquarters office buildings that are Caltrans owned and operated. Leased locations and Department of General Services owned locations are not included. Caltrans owns approximately 2.7 million square feet of office buildings. The inventory and conditions for Office Buildings, as of 2018, are presented in Table 5-24.

Table 5-24. Office Buildings Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**	
Office Buildings (square feet)	**2,679,281**	**43.4%**	**29.3%**	**27.3%**	

Performance Targets

Table 5-25 presents the statewide asset performance targets for Office Buildings.

Table 5-25. Office Buildings Performance Targets

Desired State of Repair			
Objective (unit of measure)	**Good**	**Fair**	**Poor**	
Office Buildings (square feet)	**60.0%**	**40.0%**	**0.0%**	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and, potentially, maintenance and other contributions.

Deterioration rates for Office Buildings are based on the asset's age. Specifically, on an annual basis a percentage of assets in good condition deteriorates to fair condition, while a percentage of assets in fair condition deteriorates to poor. SHOPP projects primarily address assets in poor condition and restore the condition of the asset through rehabilitation or replacement. Maintenance activities focus on maintaining assets to be safe and functional for Caltrans employees, regardless of asset condition.

Unit costs for Office Buildings are based on analysis of historical cost data composed of the capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction cost includes work associated with the construction of office buildings, traffic handling, mobilization, supplemental work and contingencies.

Typical Treatments

The SHOPP funds treatment strategies for office buildings that need major rehabilitation and/or replacement and that have deteriorated conditions or critical infrastructure deficiencies, such as fire, life safety, seismic, code, or other building deficiencies. Additionally, Government Code and State policy requires Department of Finance and Department of General Services approval and oversight for some office building projects. Reconstruction of office buildings is not completed by Field Maintenance Crews or by Major Maintenance projects.

Stewardship: Overhead Sign Structures Rehabilitation

Overview

The Overhead Sign Structure Rehabilitation objective includes replacement and upgrade of overhead sign structures (which support overhead sign panels) that have damage or have deteriorated because of aging, weather, or other factors. Overhead sign structures in the inventory generally fall into one of five categories: Truss, Tubular, Box Beam, Closed Truss, Bridge Mounted, and Lightweight.

Sign structures are susceptible to corrosion and metal fatigue and are exacerbated by the age of the structure. Many older structures were designed to previous standards and are at risk of failure because of metal fatigue from constant vibration.

Performance Metrics

The conditions of Overhead Sign Structure assets are based on a visual inspection of the structural elements (foundations, anchor bolts, base plates, column supports, arm/chord members and connection, etc.). Each element is scored on a four-point scale from 1 to 4 where 1 is good condition, 2 is fair condition, 3 is poor condition, and 4 is critical condition. The overall sign structure category (1, 2, 3 or 4) is assigned based on its elements' conditions, and the overall structure condition is assigned in accordance with Table 5-26. Table 5-26 describes the performance metrics for determining condition for good, fair, and poor Overhead Sign Structure Rehabilitation.

Table 5-26. Overhead Sign Structures Rehabilitation Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Category 1: elements in new or like-new condition with no significant deficiencies
Fair	Category 2: structures requiring minor repair of the structural members
Poor	Category 3: structures requiring on-site works if sand blasting, cleaning and painting or Category 4: structures requiring removal/replacement or major on-site repair of the structural members.

Inventory and Condition

The inventory and condition survey of overhead sign structures, conducted by the Caltrans Division of Maintenance, SM&I, is updated every four years. The current cycle of inspection is in progress, so the complete inventory was not available at the time this document was prepared. Instead, the latest inventory was based on inspections performed between 2011 and 2015. The inventory includes all overhead sign structures within the SHS right-of-way.

The inventory and conditions of Overhead Sign Structure Rehabilitation, as of 2018, are presented in Table 5-27.

Table 5-27. Overhead Sign Structures Rehabilitation Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**	
Overhead Sign Structures Rehabilitation (each)	**15,837**	**73.9%**	**22.1%**	**4.0%**	

Performance Targets

Table 5-28 presents the statewide asset performance targets for Overhead Sign Structure Rehabilitation.

Table 5-28. Overhead Sign Structures Rehabilitation Performance Targets

Desired State of Repair			
Objective (unit of measure)	**Good**	**Fair**	**Poor**
Overhead Sign Structures Rehabilitation (each)	**100.0%**		**0.0%**

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

Historical condition assessment data (first round between 2007 and 2011 and second round between 2011 and 2015) indicate the annual deterioration rates for good to fair condition and fair to poor are about 0.2 percent and 1.7 percent, respectively. These shorter term (based on a four-year period) rates are lower than the longer-term (10-year Plan period) rates (1.8 percent and 5.3 percent) used in the 2017 SHSMP. This is consistent with general observations that the deteriorating rates are expected to accelerate as sign structures become older.

Unit costs are based on an analysis of historical cost data composed of capital construction and support costs. There is a wide variability in the cost of an overhead sign structure. It depends on many factors including the number of sign panels it is intended to support, and if it is attached to a bridge. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction cost includes work associated with the construction, traffic handling, mobilization, supplemental work and contingencies.

Typical Treatments

Typical SHOPP treatment will include upgrading or reconstructing existing overhead sign structures to meet current design standards. Reconstruction of these structures is not completed by either Field Maintenance Crews or by Major Maintenance projects.

Stewardship: Pavement (Class I, II, III)

Overview

Pavement is designed to support anticipated traffic loads and provide a safe and smooth driving surface. Keeping pavements in good condition lengthens its life, enhances safety, helps reduce user's operating costs, and reduces vehicle emission. Rough roads cause more wear and tear on vehicles, increasing user costs and in some cases hindering mobility.

The SHS consists of two pavement surfaces types: asphalt and concrete. Asphalt pavements include pavement surfaced with conventional Hot Mix Asphalt (either open-graded or dense-graded), Rubberized Hot Mix Asphalt (either open-graded or gap-graded), chip seal, slurry seal, bonded wearing course, or other asphaltic materials. Composite pavements consist of concrete pavement with an asphaltic pavement surface and are typically categorized as asphalt pavements. Concrete pavement includes pavement surfaced with concrete materials such as Jointed Plain Concrete Pavement (JPCP), Continuously Reinforced Concrete Pavement (CRCP), and Precast Panel Concrete Pavement (PPCP).

Performance Metrics

Caltrans collects pavement condition data through APCS[28]. The APCS uses high definition cameras and lasers to capture roadway and pavement images and measure pavement profiles and distresses for both NHS and SHS. Caltrans began this data collection effort in 2011 and currently has data for 2011, 2015, 2016, and 2018. Caltrans reports pavement condition data to the Highway Performance Monitoring System (HPMS)[29], a national database maintained by FHWA.

Figure 5-6. Examples of Pavement Conditions

Pavement condition is assessed based on the final rule of the Federal MAP-21 performance measures as of January 2017. Cracking, Rutting, and International Roughness Index (IRI) metrics are used to assess the condition of asphalt pavement; while cracking, faulting and IRI metrics are used to assess the condition of JPCP. For each of these metrics, FHWA has established thresholds as shown in Figure 5-6. For each tenth-mile long section, condition is rated good if all three metrics for this section are rated good; poor if two or more metrics are rated poor; and fair, otherwise. Lane miles in good, fair, and poor condition are tabulated for all sections to determine the overall percentage of pavement in good, fair, and poor condition. Caltrans uses additional metrics, beyond federal requirements, to assess pavement condition. For asphalt pavement, MAP-21 assessment does not include alligator-A cracking, block cracking, longitudinal cracking, transverse cracking, potholes, bleeding, and raveling. For concrete pavement, MAP-21 assessment does not include corner cracking, 3rd stage cracking, longitudinal cracking, and D-cracking. Table 5-29 describes performance metrics for determining condition for good, fair, and poor pavement.

[28] Automated Pavement Condition Survey (APCS), http://dot.ca.gov/hq/maint/Pavement/Offices/Pavement_Management/index.html
[29] Highway Performance Monitoring System (HPMS), https://www.fhwa.dot.gov/policyinformation/hpms.cfm

Table 5-29. Pavement Performance Metrics

Performance Metrics			
Metrics	**Good**	**Fair**	**Poor**
IRI (inches/mile)	**<95**	**95-170**	**>170**
Cracking (%)			
Asphalt	<5	5-20	>20
Jointed Concrete	<5	5-15	>15
Continuously Reinforced Concrete	<5	5-10	>10
Rutting (inches)	**<0.20**	**0.20-0.40**	**>0.40**
Faulting (inches)	**<0.10**	**0.10-0.15**	**>0.15**

Inventory and Condition

The SHS includes 50,259 lane miles of pavements, based on APCS data collected from January to November 2018, following Caltrans' 2014 Linear Referencing System. Bridge decks and approach slabs are not included in the pavement inventory. SHS Pavements is associated with one of three primary classes, based on the functional classification of the roadway to which they belong. Throughout the SHSMP a shortened naming convention (e.g., "Pavement Class I") is used in lieu of the full descriptive phrase (e.g., "Pavement on Roadway Class I"). Figure 5-7 describes these primary classes and shows the percentage of lanes miles in each classification.

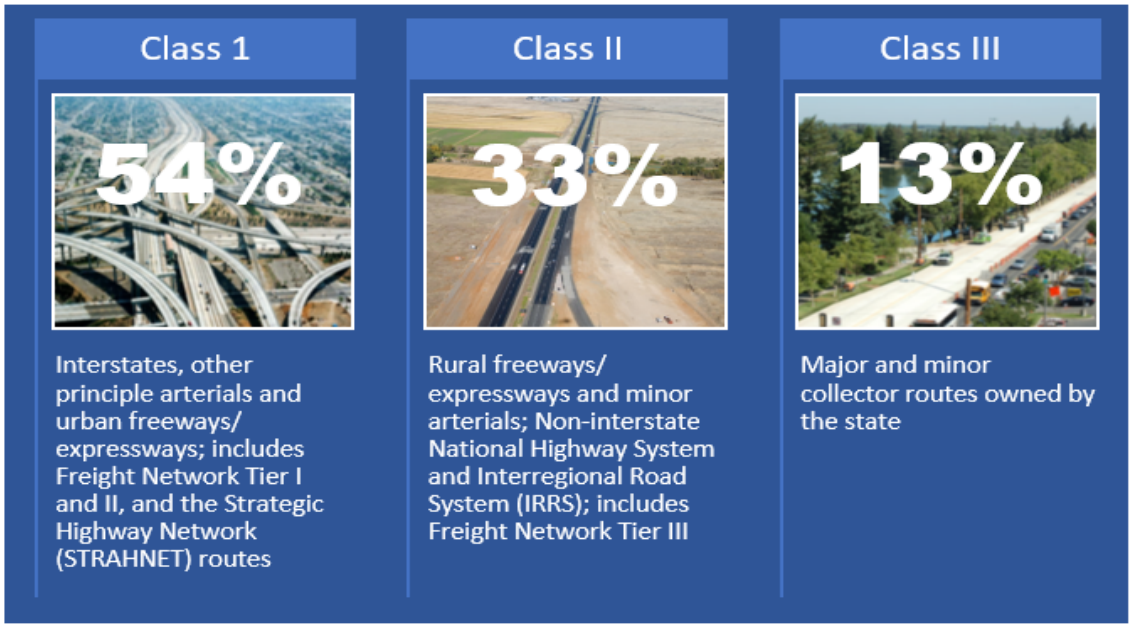


Figure 5-7. Pavement Classifications and Percentages of Pavement in Each Class

The reported SHS pavement inventory shows an increase in lane miles across all pavement classes by approximately one percent compared with the previous SHSMP. This change is likely attributed to new construction or pavement re-classification.

Caltrans strives to effectively manage the SHS pavement with the most cost-effective strategies over the long term. To maintain the system health, Caltrans has invested in Ground Penetrating Radar (GPR) and APCS and implemented the Pavement Management System (PaveM). APCS data, along with GPR data, can be used to assess pavement condition and predict future performance. PaveM is a "state of the art" pavement management system that stores APCS data and can analyze pavement performance for every mile of roadway pavement. PaveM uses pavement condition, climate, traffic loading, and pavement history to develop the right treatment for the location at the right time. PaveM recommends the most cost-effective repairs for future projects.

Pavement condition changes over time because of construction activities, traffic loading, and environmental factors, such as aging and changes in temperature and moisture. These changes are captured over time as new data become available. The pavement inventory and conditions, as of 2018, are presented in Table 5-30.

Table 5-30. Pavement Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	Inventory	Good	Fair	Poor	
Pavement Class					
Total	**50,259**	**55.7%**	**43.2%**	**1.1%**	
Class I (lane miles)	**27,151**	**65.0%**	**33.8%**	**1.3%**	
Class II (lane miles)	**16,396**	**45.9%**	**53.3%**	**0.9%**	
Class III (lane miles)	**6,712**	**42.5%**	**56.5%**	**1.0%**	

Performance Targets

Table 5-31 presents the statewide asset performance targets for each Pavement class.

Table 5-31. Pavement Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Pavement Class				
Class I (lane miles)	60.0%	39.0%	1.0%	
Class II (lane miles)	55.0%	43.0%	2.0%	
Class III (lane miles)	45.0%	53.0%	2.0%	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

On an annual basis, a percentage of pavement assets in good condition naturally deteriorate to fair condition, while a smaller percentage of assets in fair condition deteriorates to poor. The term "deterioration" is generally used to refer to the loss of either the structural or functional qualities of the pavement that are often manifested as surface distresses or degradation of ride comfort and skid resistance. The design life of a pavement treatment is the time duration between construction and the time each performance indicator (e.g., cracking, IRI, etc.) reaches a pre-selected performance threshold. Therefore, for a given pavement treatment there are a number of performance life spans; each depending on the performance being tracked in the analysis. PaveM utilizes performance modeling to project future pavement condition. Performance models are a function of pavement material, prior work, age, climate, truck traffic levels, treatment strategies, and investment levels.

Unit costs for pavement repairs are composed of the capital construction cost and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The capital construction cost is based on PaveM recommended treatments. This cost includes work associated with the construction of pavement, traffic handling, mobilization, supplemental work and contingencies.

Typical Treatments

Caltrans' Maintenance Program strives to use maintenance resources effectively to slow down pavement deterioration and maintain the SHS at the lowest possible long-term cost. The SHSMP uses preservation strategies on pavement conditions which benefit from this philosophy. PaveM is used to identify the right locations and times to perform pavement preservation to minimize future costs in the SHOPP (SHOPP avoidance). Pavement identified in fair condition may be targeted for various preservation, corrective or rehabilitation strategies.

Field Maintenance Crews perform treatment strategies such as crack sealing, pothole fixes, and spall repairs. These repairs or treatments are used in determining an LOS score for pavement. LOS is another way Caltrans measures pavement health or condition.

Major Maintenance projects are used to meet longer-term SHS maintenance needs. Preventive maintenance treatments include seal coats, thin overlays for asphalt pavements, or joint seal installation, grinding, and individual slab replacement for concrete pavements. Corrective maintenance treatments include dig-outs, cold in-place recycling, grinding, and individual slab replacements. By efficiently using these treatments, Caltrans can avoid more costly repairs in the future.

Capital Preventive Maintenance (CAPM) projects involve lower cost minor rehabilitation strategies for pavements that exhibit surface wear because of weather, aging, and traffic. CAPM-level projects typically have limited or minor structural damage that is more than what can be addressed with Major Maintenance but less than needed for major pavement rehabilitation. CAPM strategies are intended to extend project service life for 5-15 years. CAPM strategies typically include pavement grinding to improve smoothness, individual slab replacements, and medium overlays. CAPM projects target primarily pavement work (thus are less expensive than a rehabilitation project), but can include low cost safety/maintenance upgrades such as guardrails, worker safety, sign panels, striping, ADA curb ramps, and other items which do not require widening or realigning the roadway. CAPM projects are generally more costly than Major Maintenance projects and often require a longer lead-time to prepare the projects, due to the inclusion of other work.

The SHOPP funds treatment strategies such as rehabilitation projects that include major rehabilitation and replacement of pavement with significant structural distress (damage impacting the underlying layers of pavement) because of repeated loading and wear from trucks along with impacts from weather and aging of the pavement. A rehabilitated roadway should provide at least 20-40 years of service life with relatively low maintenance expenditures (not requiring an additional SHOPP project during its life cycle). Rehabilitation strategies include lane replacement and thick overlays.

When pavement requires major rehabilitation or replacement, it may be appropriate to include other work items to make operational and performance improvements, such as guardrail modifications, pedestrian and bicycle improvements, storm water or other environmental enhancements, shoulder improvements, and other valued transportation enhancements. These projects may require expensive environmental and cultural resource mitigation.

Stewardship: Relinquishments

Overview

The Relinquishment objective was established in the 2017 SHSMP as a Reservation Model performance objective. California SHC, Sections 73 and 73.5 defines the Commission's role and authority to relinquish a state highway.

There are three types of relinquishments:

1. Deletion of a state highway by legislative enactment.
2. Superseding the existing state highway by relocation.
3. Agreement with a local agency to accept a collateral facility that is not part of the main traveled way constructed by a state highway project.

The primary purpose is to relinquish state highway routes or portions of a route that no longer serve regional and statewide transportation needs. Relinquishments funded through the SHOPP are "in the best interest of the State."

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Additional benefits include:

- Eliminates the need for state encroachment permits, resulting in cost savings to the tax payer.
- Reduction of ongoing state maintenance costs.
- Reduction in state tort liability.
- Decrease in incident response efforts.
- Decrease competition for capital funds for regional and statewide improvements.

Legislative relinquishments may require negotiation between Caltrans and a local agency. The associated cost to relinquish shall be based on a benefit-cost analysis using a 10-year analysis period, assumed interest rate based on the escalation rate used in the STIP, and appropriate costs and benefits specific to the portion of the state highway considered for relinquishment.

Stewardship: Roadway Protective Betterments

Overview

The Roadway Protective Betterments objective is to protect highway assets from anticipated future catastrophic damage from natural events such as storms and floods. This program provides a proactive approach to averting emergencies through identification of vulnerabilities along highways and potentially reducing the overall risk to the transportation system.

Performance Metrics

Roadway Protective Betterment is based on a deficiency model. Locations where a deficiency exists are designated as poor, while locations with deficiencies that have been addressed are designated as good. The fair designation does not apply in the deficiency model. Table 5-32 describes the performance metrics for determining condition for good, fair, and poor Roadway Protective Betterments.

Table 5-32. Roadway Protective Betterments Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Deficiency has been addressed
Fair	N/A
Poor	Deficient location

Inventory of Deficiencies

In 2018 the districts' assessment of vulnerable roadways identified locations that could be reinforced for protection against failure during natural extreme events.

Although deficiencies are being addressed through various projects, new vulnerable locations, discovered during the most recent highway system assessment, were added to the overall deficient locations that need to be addressed. The deficiency of Roadway Protective Betterments, as of 2018, is presented in Table 5-33.

Table 5-33. Roadway Protective Betterments Inventory of Deficiencies

Inventory of Deficiencies					
Objective (unit of measure)	Inventory	Good	Fair	Poor	
Roadway Protective Betterments (locations)	113	0.0%	N/A	100.0%	

Performance Targets

Ideally, the goal of the Roadway Protective Betterment objective would be to address all identified vulnerable locations in the roadway system. However, due to the dynamic nature of natural events that often expose more vulnerable locations or the discovery of new, vulnerable locations, it is not realistic to assume that at the end of the 10-year cycle all vulnerabilities would be addressed. Table 5-34 presents the statewide asset performance targets for Roadway Protective Betterments.

Table 5-34. Roadway Protective Betterments Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Roadway Protective Betterments (locations)	100.0%	N/A	0.0%	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

Unit costs are based on an analysis of historical data composed of capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The estimate capital construction cost includes work associated with the construction, traffic handling, mobilization, supplemental work and contingencies.

Typical Treatments

Protective Betterment protects infrastructure at vulnerable locations to reduce risk of roadway closures during anticipated natural events (storms, floods, landslides, etc.) or human-caused events. Typical SHOPP-funded treatments or projects may include: protecting rock slopes, preventing rock fall, stabilizing slopes and trenches, improving retaining walls, improving pumping stations at depressed sections, and security improvements.

Stewardship: Safety Roadside Rest Area Rehabilitation

Overview

The Safety Roadside Rest Area (SRRA) Rehabilitation objective is to correct deficiencies, restore existing facilities to a safe and maintainable condition, and improve capacity and operations at the 86 active SRRA locations in the SHS. The objective includes addressing the following needs:

- Operational improvements
- SRRA building improvements (comfort station or other structural element)
- On-site capacity expansion (parking and comfort stations)
- Utility upgrades

Compliance with regulatory mandates, include:

- ADA
- Water Quality mandates and Regional Water Quality Control Board (RWQCB) regulations
- California Division of Occupational Safety and Health (Cal/OSHA) regulations
- Caltrans Memorandum of Understanding (MOU) with California Highway Patrol (CHP)
- California Green Building Standards (CALGreen) Code
- Leadership in Energy and Environmental Design (LEED)
- Relocation of existing SRRAs
- Auxiliary facility construction where expansion and upgrading an existing site is not feasible
- Alternative stopping opportunities for freight trucking only

The purpose of the SRRA program is to provide safe, conveniently-spaced stopping opportunities as an integral part of the SHS where the traveler may stop, rest, relax, obtain travel information, and return to the highway more alert and driving safely. California law states that SRRAs, "should be provided so that, in

combination with other stopping facilities, there shall be facilities available at intervals of approximately one-half hour's normal driving time." The SRRA Rehabilitation objective includes the Roadside Stopping Opportunities activity. This activity includes Vista Point Rehabilitation, parking expansion, Public/Private partnership opportunities, and demonstration programs. The current SRRA Rehabilitation inventory does not include needs associated with the Roadside Stopping Opportunities activity.

Performance Metrics

The SRRA assets' condition is primarily age-based. Age is estimated from the original construction or reconstruction date. Intensity of use impacts the deterioration of the facilities and is also considered when determining the asset condition based on the inspection and maintenance report. In addition, a major rehabilitation of an SRRA facility in poor condition may improve the condition of that SRRA facility to fair. Table 5-35 describes the performance metrics for determining condition for good, fair, and poor Safety Roadside Rest Areas.

Table 5-35. Safety Roadside Rest Area Rehabilitation Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Age of SRRA < 20 years
Fair	20 years ≤ Age of SRRA < 30 years
Poor	Age of SRRA ≥ 30 years

Inventory and Conditions

The Landscape Architecture Program maintains the inventory of SRRAs on the SHS and updates it annually between January and June. The SRRA assets' condition is primarily age-based as defined in the table above. Age is estimated from the original construction or reconstruction date. Intensity of use impacts the deterioration of the facilities and is also considered to determine the asset condition based on the inspection and maintenance report. In addition, a major rehabilitation of a SRRA facility in poor condition may improve the condition of that SRRA facility to fair. The inventory and conditions of Safety Roadside Rest Area Rehabilitation, as of 2018, are presented in Table 5-36.

Table 5-36. Safety Roadside Rest Area Rehabilitation Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**	
Safety Roadside Rest Area Rehabilitation (locations)	86	34.9%	36.0%	29.1%	

Performance Targets

Table 5-37 presents the statewide asset performance targets for Safety Roadside Rest Area Rehabilitation.

Table 5-37. Safety Roadside Rest Area Rehabilitation Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Safety Roadside Rest Area Rehabilitation (locations)	**80.0%**	**20.0%**	**0.0%**	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These include deterioration rates, capital and support unit costs, and SHOPP and maintenance contributions.

The condition of SRRA assets in the future is projected using the effective annual deterioration rate as of 2017 SHSMP, which was primarily based on the service life of the asset.

Unit costs for SRRAs are based on an analysis of historical cost data composed of the capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction cost includes work associated with the construction of SRRA, traffic handling, mobilization, supplemental work, and contingencies.

Typical Treatments

Field Maintenance Crews provide maintenance operations limited to those activities or treatments necessary to maintain safe and functioning SRRA facilities. Major Maintenance projects are used for projects related to the preservation, maintenance, and protection of the overall integrity of the SRRA facilities. These are minor maintenance projects that address specific items of concern for maintenance that need immediate attention and that, if not performed, could result in increased preservation needs requiring SHOPP funding in the future.

The SHOPP funds projects to address SRRA site, building, utilities, and ramp operational issues. The SHOPP may also fund Roadside Stopping Opportunities, which are projects that provide Vista Point Rehabilitation and address parking expansion needs. However, at this time these projects have not been included in the SHSMP. When the SRRA facilities cannot be kept open, operational and maintainable to meet the needs of the traveling public, the SRRA may be relocated.

Stewardship: Transportation Related Facilities

Overview

The Transportation Related Facilities (TRF) objective includes correcting building and site deficiencies associated with worker safety, Cal/OSHA and ADA, as well as improve operational efficiency at equipment shops, maintenance facilities, transportation management centers and transportation material and testing laboratories. The goal is to have no TRFs in poor condition.

Performance Metrics

The condition of TRF is based on the age of the building. Table 5-38 describes the performance metrics for determining condition for good, fair, and poor TRFs.

Table 5-38. Transportation Related Facilities Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Buildings less than or equal to 20 years old
Fair	Buildings between 20 and 40 years old
Poor	Buildings greater than 40 years old

Inventory and Conditions

Caltrans owns approximately 4 million square feet of Transportation Related Facilities. Although TRF condition is based on age for this SHSMP, a consultant service contract is currently underway to develop a sustainable, comprehensive, long-range transportation planning and budgeting program that will provide a more comprehensive approach to assessing facility conditions. They are researching and analyzing best management practices appropriate to TRF and providing a long-term budgeting and planning tool that will assist in calculating the Facility Condition Index (FCI) for each facility location. The inventory and conditions of Transportation Related Facilities, as of July 2018, are presented in Table 5-39.

Table 5-39. Transportation Related Facilities Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	Inventory	Good	Fair	Poor	
Transportation Related Facilities (square feet)	4,027,759	22.9%	14.5%	62.6%	

Performance Targets

Table 5-40 presents the statewide asset performance targets for Transportation Related Facilities.

Table 5-40. Transportation Related Facilities Performance Targets

Desired State of Repair			
Objective (unit of measure)	Good	Fair	Poor
Transportation Related Facilities (square feet)	60.0%	40.0%	0.0%

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, potentially maintenance and other contributions.

Deterioration rates for TRF are based on the age of the asset. Specifically, on an annual basis a percentage of assets in good condition deteriorates to fair condition, while a percentage of assets in fair condition deteriorates to poor. SHOPP projects primarily address assets in poor condition and restore the condition of the asset, while maintenance focuses on maintaining assets in good condition as well as addressing assets in fair condition.

Unit costs for TRFs for the 2019 SHSMP are based on national average costs to design and construct TRFs, which include the engineering and oversight work and the construction capital costs to build the facilities.

Typical Treatments

Major Maintenance projects are used for the repair and replacement of defective, obsolete, or worn-out building components, or site features, at Transportation Related Facilities. Proposed projects target building infrastructure that enables or enhances program delivery. Such projects include treatment strategies that fix lighting, heating ventilation and air conditioning and cooling, utilities (sewer, water, electrical), reroofing, and remodeling of interior space to increase efficiency.

Typical SHOPP projects include treatment strategies to rehabilitate, restore, and replace existing, or the construction of new facilities to current design standards that provide a safe and functional working environment to meet operational needs.

Stewardship: Water and Wastewater Treatment at Safety Roadside Rest Areas

Overview

The Water/Wastewater Treatment at Safety Roadside Rest Areas (SRRA) objective is to maintain the traveler safety benefits provided by the SRRA System by preventing closures due to noncompliance with drinking water quality and wastewater treatment standards or the failure of these systems. All ADA and structural deficiencies at SRRAs are identified through the SRRA Rehabilitation element. Water provided at the SRRAs is from surface, ground, or municipal supply. The sanitary or wastewater generated is treated on-site using septic tank, leach field, sewer ponds, seepage pit, wetlands or other advanced methods, or self-contained in portables, or diverted off-site through municipal sewer connection.

All SRRA facilities must comply with RWQCB regulations. Water and wastewater treatment projects should be programmed to address water and wastewater deficiencies at SRRA facilities where no SRRA Rehabilitation project is planned.

Performance Metrics

The water and wastewater treatment assets' condition are primarily age-based. Age is calculated from the original construction date, or a complete reconstruction date, to determine the current asset condition. The intensity of use may impact the deterioration of the facilities and is also considered to determine the asset condition through maintenance inspection. In addition, mandates such as violations of RWQCB guidelines may require additional capital investment in wastewater treatment facilities. Table 5-41 describes the performance metrics for determining condition for good, fair, and poor water and wastewater treatment at SRRAs.

Table 5-41. Water and Wastewater Treatment at Safety Roadside Rest Areas Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Age of treatment system < 20 years
Fair	20 years ≤ Age of treatment system < 30 years
Poor	Age of treatment system ≥ 30 years

Inventory and Conditions

There are 76 on-site water and/or wastewater treatment facilities identified in the 86 SRRAs. The inventory and conditions of Water and Wastewater Treatment at SRRAs, as of 2018, are presented in Table 5-42.

Table 5-42. Water and Wastewater Treatment at Safety Roadside Rest Areas Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**	
Water and Wastewater Treatment at Safety Roadside Rest Areas (locations)	**76**	**9.2%**	**7.9%**	**82.9%**	

Performance Targets

Table 5-43 presents the statewide asset performance targets for Water and Wastewater Treatment at Safety Roadside Rest Areas.

Table 5-43. Water and Wastewater Treatment at Safety Roadside Rest Areas Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Water and Wastewater Treatment at Safety Roadside Rest Areas (locations)	80.0%	20.0%	0.0%	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

The condition of the water and wastewater treatment assets in the future is projected using the effective annual deterioration rate as of 2017 SHSMP, which was primarily based on the service life of the asset.

Unit costs are based on an analysis of historical cost data composed of the capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction cost includes work associated with the construction, traffic handling, mobilization, supplemental work and contingencies.

Typical Treatments

Field Maintenance Crews provide maintenance operations limited to those activities or treatments necessary to maintain safe and functioning SRRA facilities. Major Maintenance projects are used for projects related to the preservation, maintenance, and protection of the overall integrity of the SRRA facilities. These projects address specific items of concern for maintenance that need immediate attention and which, if not performed, could result in increased preservation needs requiring SHOPP funding in the future.

The SHOPP funds projects that include treatment strategies such as installing, replacing or upgrading drinking water systems, and those treatments associated with the installation, replacement, or upgrade of wastewater treatment systems.

5.4 Sustainability

Goals and Objectives

Sustainability activities cover a broad spectrum of work that is intended to minimize transportation system impacts on the climate, environment, and communities, improve transportation system resiliency, improve the livability of California communities, improve economic prosperity, and reduce health and environmental impacts associated with freight movement. Collectively, sustainability activities strive to improve the quality of life in California by making responsible transportation decisions that will be sustainable for future generations. Several activities included within the sustainability area have specific legal or permit requirements that mandate minimum investment levels. Failure to adhere to mandated requirements could have future legal implications and condition and performance ramifications that could negatively impact transportation in California. Failure to reduce transportation-related pollution and biological impacts is not sustainable for future generations of Californians.

Examples of Sustainability Activities

- Make multimodal transportation accessible for all Californians.
- Provide safe, efficient, and attractive pedestrian, bicycle, and transit infrastructure and services within an integrated multimodal transportation system.
- Minimize transportation impacts on climate, air quality, water quality, and wildlife.
- Improve the resiliency of the transportation system to extreme events and climate change.
- Make freight enhancements to improve prosperity and to reduce health, climate, and community impacts of freight movement.
- Reduce GHG emissions associated with the use, construction, maintenance, and operations of the SHS.

Sustainability: Americans with Disabilities Act Pedestrian Infrastructure

Overview

The goal of the Americans with Disabilities Act (ADA) Pedestrian Infrastructure objective is to provide improvements to existing pedestrian infrastructure to make the path of travel safe and accessible in compliance with ADA regulations on the SHS. Pedestrian facilities include sidewalks, crosswalks, curb ramps, pedestrian overcrossings and under crossings, park and ride lots, driveways, accessible parking lots and accessible pedestrian signals. While the ADA pedestrian objective is mandated by state and federal law, Caltrans has additional requirements to implement ADA improvements as part of a settlement agreement, the Californians for Disability Rights, Inc. v. California Department of Transportation (2010), Case No.: C 06 5125[30]. This settlement agreement requires that a total of $1.1 billion be spent over a 30-year period beginning in FY 2010/11, with annual spending increasing from $25 million the first five FYs to $45 million the last five FYs. For each year the required amount is not met, the remaining balance rolls over to the next FY year towards the following types of activities:

- Project development and construction costs (including staffing costs) associated with the covered program access improvements.
- Establish and maintain accessibility grievance procedures, including a system to process other access requests.

[30] Californians for Disability Rights, Inc. v. California Department of Transportation (2010), Case No.: C 06 5125, http://www.dot.ca.gov/hq/bep/documents/Settlement_Agreement.pdf

Performance Metrics

The condition designations for ADA Pedestrian Infrastructure elements are based on a deficiency model. Elements where a deficiency still exists are designated as poor, while elements with deficiencies that have been addressed are designated as good. The fair designation does not apply in the deficiency model. Table 5-44 describes the performance metrics for determining the condition for ADA assets.

Table 5-44. Americans with Disabilities Act Pedestrian Infrastructure Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Deficiency has been addressed
Fair	N/A
Poor	Deficient element

Inventory of Deficiencies

Caltrans implemented the ADA Pedestrian Infrastructure program in July 2010 and determined there were 206,922 non-compliant elements/barriers within pedestrian facilities statewide. Since 2010, through the end of FY 2015-16, Caltrans has upgraded 2,955 curb ramps, 258,996 linear feet of sidewalk, 1,911 pedestrian signals, and 31 park-and-ride lots through various ADA and non-ADA projects along with CAPM. The total accomplishments statewide are compiled from ADA program annual reports[31]. Table 5-45 presents the unaddressed proportion of ADA deficiencies relative to the proportion of deficiencies that have been addressed.

Table 5-45. Americans with Disabilities Act Pedestrian Infrastructure Inventory of Deficiencies

Inventory of Deficiencies				
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**
Americans with Disabilities Act Pedestrian Infrastructure (elements)	**180,779**	**0.0%**	**N/A**	**100.0%**

Performance Targets

The ADA pedestrian infrastructure objective must meet the annual expenditure amount (ranging between $25 million -$40 million) required by the court settlement ruling from FY 2010-11. Except for limited costs ($8.75 million total) associated with CAPM projects, costs associated with new construction or alterations of pedestrian facilities or park-and-ride lots that are part of a project undertaken for purposes other than ADA access improvements do not count towards the annual expenditure amount. Because of this, it is still necessary to program “ADA stand-alone” projects where most of the performance achieved are ADA

[31] Caltrans, ADA Annual Reports, http://dot.ca.gov/ada/ada_infrastructure/reports.html

improvements. Table 5-46 presents the statewide asset performance targets for ADA Pedestrian Infrastructure.

Table 5-46. Americans with Disabilities Act Pedestrian Infrastructure Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Americans with Disabilities Act Pedestrian Infrastructure (elements)	25.0%	N/A	75.0%	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

Four primary elements, curb ramps, driveways, pedestrian paths, and ramps, were used as the basis for the unit price determination. These are the elements predominantly addressed through SHOPP projects. SHOPP project cost data are analyzed to establish average statewide unit costs. A weighted average was then calculated based on proportion of these deficient elements. The unit cost associated with pedestrian paths was based on an average length of 30 feet per element and considers that approximately 10 percent of the sidewalks can have a higher unit cost. The unit cost is composed of capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction cost includes work associated with the construction, traffic handling, mobilization, supplemental work, and contingencies.

Typical Treatments

SHOPP projects include treatment strategies that correct ADA pedestrian infrastructure deficiencies such as curb ramps, sidewalks, driveways, and other pedestrian infrastructure. These fixes include correcting grade breaks, lowering pedestrian push buttons, upgrading marker lines for crosswalks, straightening curbs or defining edges, correcting cross slope, running slope or gutter slope, install detectable warning surfaces, fixing transitions, gaps or clear width, removing obstructions, or removing abrupt level changes. ADA projects specifically address these deficient elements, but other work by SHOPP projects and Field Maintenance Crews would include upgrading ADA issues.

The ADA work achieved by Field Maintenance Crews includes paint marking and installing sign identification and wheel stop for accessible parking spaces along with lowering pedestrian push buttons and installing handrails. This work sometimes includes removing abrupt transitions or filling in gaps in sidewalk.

Sustainability: Advance Mitigation

Overview

The Advance Mitigation objective was established in the 2017 SHSMP as a Reservation Model performance objective. Moving forward with the 2019 SHSMP, programming stand-alone advance mitigation projects may be allowed to provide for early implementation of anticipated mitigation requirements associated with SHOPP transportation projects. Neither a separate reserve nor performance objective has been set.

Advance Mitigation, now largely being funded by a new SB 1 program, will be eligible for use by SHOPP projects if they fully reimburse the Advance Mitigation Program. The new SB 1 program manages mitigation efforts that include developing stand-alone compensatory mitigation projects that help to ensure the right type and quantity of environmental mitigation are available for future transportation projects, in advance of funding those projects.

Currently, the statutory requirement for compensatory mitigation due to unavoidable impacts to jurisdictional resources can significantly increase the uncertainty related to a project's scope, schedule, and cost. However, having available mitigation reserves in place reduces the risk to a transportation project's cost and schedule.

The means to implement advance mitigation includes, but is not limited to:

- Conservation or mitigation banks (either by creating new banks or through bulk credit purchases from existing banks)
- In-lieu fee programs (either by creating new in-lieu fee programs or through bulk credit purchases from existing in-lieu fee programs)
- Contributions/fees to Habitat Conservation Plans or Natural Communities Conservation Plans
- Identified activities in Regional Conservation Investment Strategies that yield Mitigation Credit Agreements or permittee responsible mitigation (i.e., mitigation on public or private lands including restoration property acquisitions and transfers with conservation easements or deed restrictions)

Planning for the advance mitigation goal is based on the acreage of estimated potential compensatory mitigation need for the future transportation projects in the SHSMP. The estimated need is informed by long range plans and mitigation needs assessments. The magnitude of the need is dependent on project delivery mitigation requirements that can use credits developed through this program.

Sustainability: Bridge Scour Mitigation

Overview

The Bridge Scour Mitigation objective is to prevent catastrophic failure from natural disasters, such as floods and storm events. Bridge Scour Mitigation addresses bridges over water whose bridge foundations have been determined to be unstable for potential assessed or calculated scour conditions (scour critical) per federal guidelines.

Only bridges with foundations within a waterway are reviewed for scour vulnerability. Those bridges that are calculated or assessed to be scour critical under the FHWA Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges manual are addressed under this objective.

Performance Metrics

Bridges are assessed for scour with the following criteria: an NBI rating of 7, 8, or 9 is classified as good where foundations have no scour potential or scour countermeasures have been installed; a rating of 4, 5, 6, T, or U is classified as fair where foundations are determined to be stable for scour conditions; and a rating of 0, 1, 2, or 3 is classified as poor where foundations are determined to be unstable for scour conditions. As only poor bridges are considered vulnerable (unstable) for scour, the scour vulnerability conditions are shown in a deficiency model. Table 5-47 describes the performance metrics for determining condition for good, fair, and poor bridge scour mitigation.

Table 5-47. Bridge Scour Mitigation Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	No scour potential or countermeasures installed
Fair	Stable for assessed scour
Poor	Unstable for assessed scour (scour critical)

Inventory of Deficiencies

The Bridge Scour Mitigation inventory data include the total deck area (square footage) of bridges that have been assessed to be unstable for scour (scour critical or poor). Caltrans performs scour analyses for all bridges that cross over waterways. These analyses are completed to evaluate whether a bridge is unstable for potential assessed or calculated scour conditions (scour critical) per federal guidelines. When bridges are assessed for scour, the findings are documented with a Specialty Investigation Bridge Inspection Report. Any recommended work to protect for scour is documented within the report. If the bridge is assessed to be unstable for scour, a Scour Plan of Corrective Action is also documented. All bridges on the SHS are included in this inventory except for Bay Area Toll Authority and Golden Gate Transportation District bridges and bridges built and maintained under Public Private Partnerships. Only bridges that have been assessed as scour critical (poor) are included in this inventory. Table 5-48 presents an inventory of the proportion of current deficiencies, as of March 2018.

Table 5-48. Bridge Scour Mitigation Inventory of Deficiencies

Inventory of Deficiencies					
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**	
Bridge Scour Mitigation (square feet)	1,694,576	0.0%	N/A	100.0%	

Performance Targets

Ideally, the goal of the Bridge Scour Mitigation objective would be to address all identified scour critical (poor) bridges. Due to the dynamic nature of identification of scour critical bridges (major flooding or storm events) and the time required for the project delivery process, it is not realistic to assume that at the end of the 10-year cycle all scour critical bridges would be addressed. The Bridge Scour Mitigation target is to reduce scour critical bridges to 10 percent of the projected 10-year scour critical need. Table 5-49 presents the statewide asset performance targets for Bridge Scour Mitigation.

Table 5-49. Bridge Scour Mitigation Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Bridge Scour Mitigation (square feet)	90.0%	N/A	10.0%	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

Projected Needs for bridge scour mitigation are estimated based on historical trends but may increase with major storm events that occur within the next 10 years. Scour typically has no deterioration model, because it is not possible to control either the weather or the migration of streams and channels.

Unit costs for the Bridge Scour Mitigation objective are based on an analysis of historical data composed of the capital construction and support costs. Support costs are those associated with engineering and/or oversight work to design and construct the project. The estimated capital construction cost includes the structure costs and an applied factor to account for associated roadway items, traffic handling, mobilization, supplemental work, and contingencies. It is assumed that half the identified deficiencies would require rehabilitation and the other half would require replacement of the existing structure.

Typical Treatments

The SHOPP funds projects that may include various treatments such as bridge scour improvements from rehabilitation measures (such as rock slope protection of the channel walls and/or floors) to extensive foundation rehabilitations (which may include modifying or adding foundation elements such as piles, pier walls or footings) or could include projects that require full bridge replacement. Many factors play a role in addressing scour vulnerabilities such as the health condition of the structure or possible seismic vulnerabilities of the substructure as they may be subject to liquefaction in a seismic event.

Sustainability: Bridge Seismic Restoration

Overview

The focus of the Bridge Seismic Restoration objective is to mitigate catastrophic bridge failures from seismic events (earthquakes). Bridge Seismic Restoration addresses bridges assessed to be vulnerable to potential seismic activity through screening processes implemented by Caltrans. Periodic rescreening of state bridges is conducted to assess the structures for seismic vulnerabilities using the most current seismic criteria. The most recent rescreening was completed in 2015.

Performance Metrics

Bridges are assessed for seismic vulnerability based on the screenings performed by the Offices of Earthquake Engineering and Geotechnical Services. If a bridge is assessed to have potential seismic vulnerabilities, the bridge is classified as poor. If there is no potential vulnerability, the bridge is classified as good. The fair designation is not used. As only poor bridges are considered vulnerable for seismic events, seismic vulnerability conditions are shown in a deficiency model. Table 5-50 describes the performance metrics for determining condition for good, fair, and poor bridge seismic restoration.

Table 5-50. Bridge Seismic Restoration Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	No seismic vulnerability
Fair	N/A
Poor	Potential seismic vulnerability

Inventory of Deficiencies

The bridge seismic restoration inventory data include the total deck area (square footage) of bridges assessed to be vulnerable to seismic events. These assessments are conducted for ground motion and seismic movement. For bridges with foundations in or near a waterway, the potential for soil liquefaction is also analyzed. Those that are found to have a potential vulnerability for seismic activity are identified and classified as a potential need. All SHS bridges are included in this inventory, except Bay Area Toll Authority, Golden Gate Transportation District bridges, and bridges built and maintained under Public Private Partnerships. Only bridges that have been assessed with a potential seismic vulnerability (poor) are included in this inventory. The deficiency of Bridge Seismic Restoration, as of March 2018, is presented in Table 5-51.

Table 5-51. Bridge Seismic Restoration Inventory of Deficiencies

Inventory of Deficiencies				
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**
Bridge Seismic Restoration (square feet)	**14,801,682**	**0.0%**	**N/A**	**100.0%**

Performance Targets

Ideally, the goal of the Bridge Seismic Restoration objective is to address all seismically vulnerable (poor) bridges identified in the preliminary screening process. The screening process is a preliminary review of bridges that may be seismically vulnerable based on the element configuration of the structure and the surrounding soil prior to detailed seismic analyses being completed. Because bridges identified in the screening process may be found to not require seismic restoration during detailed seismic analysis, and due to the length of the time required for the project delivery process, it is not realistic to assume that at the end of the 10-year cycle all currently identified seismically vulnerable bridges would be addressed. Therefore, the Bridge Seismic Restoration target is to reduce seismically vulnerable bridges to 30 percent of the projected 10-year seismic need. Table 5-52 presents the statewide asset performance targets for bridge seismic restoration.

Table 5-52. Bridge Seismic Restoration Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Bridge Seismic Restoration (square feet)	70.0%	N/A	30.0%	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

Unit costs for Bridge Seismic Restoration are based on an analysis of historical cost data composed of the capital construction and support costs. Support costs are those associated with engineering and/or oversight work to design and construct the project. The estimated capital construction cost includes the structure costs and an applied factor to account for associated roadway items, traffic handling, mobilization, supplemental work and contingencies. Historical trends of previously delivered projects, including the previously completed Tier I and Tier II retrofit programs, are used to estimate these costs. It is assumed that three-quarters of the identified deficiencies would require rehabilitation and the other quarter would require replacement of the existing structure.

Typical Treatments

The SHOPP funds projects that address bridges found to be vulnerable to seismic events. The retrofit treatments can vary from rehabilitation measures, such as catcher blocks or retrofit of the foundation or superstructure of the structure, to full bridge replacement. Many factors play a role in addressing seismic vulnerabilities, such as the health condition of the structure, assessed scour vulnerability, and proximity to substantial fault lines.

Sustainability: Roadside Rehabilitation

Overview

The Roadside Rehabilitation objective is to reduce long-term maintenance costs of highway planting and related roadside infrastructure, and provide for replacement, restoration, and rehabilitation of almost 30,000 acres of existing highway planting to an economically maintainable state in coordination with the adjacent community and surrounding environs following damage by extreme weather, acts of nature, or deterioration. This objective is not to be used for Replacement Planting resulting from a roadway improvement project.

This objective includes:

- Improvements for water conservation
- Restore erosion control planting to comply with National Pollution Discharge Elimination System (NPDES)[32] permit requirements.
- Implement strategies to improve worker and traveler safety by reducing the frequency and duration of maintenance workers' exposure to traffic.
- Improve roadside appearance to help integrate the facility with the adjacent community and surrounding environs.
- Perform roadside rehabilitation to maintain classified landscaped freeway designation and comply with mandates.

[32] Caltrans Storm Water and Water Pollution Control website, http://www.dot.ca.gov/trafficops/ep/water.html

Performance Metrics

For Roadside Rehabilitation, the condition of the asset is determined from visual inspections and expert judgment that considers three primary factors:

1. Tree Canopy - percentage of canopy covering the roadside area
2. Ground Plane - percentage of ground cover and shrub covering the ground
3. Irrigation Equipment - the operational status of the irrigation delivery system

Each of these criteria is evaluated and the roadside is assigned a condition based on the aggregate of these evaluations. Table 5-53 describes the performance metrics for determining condition for good, fair, and poor Roadside Rehabilitation.

Table 5-53. Roadside Rehabilitation Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	• Tree Canopy: >50% canopy cover • Ground Plane: >75% coverage • Irrigation Equipment: Installed within the previous 5 years, includes functioning Smart Irrigation Controllers. Currently, operational with an expected remaining life cycle of 10 years.
Fair	• Tree Canopy: 25%-49% canopy cover • Ground Plane: 30%-74% coverage • Irrigation Equipment: Installed >5 years and <10 years, includes Smart Irrigation Controllers. Currently, operational requiring minor repairs with an expected remaining life cycle of 5 years
Poor	• Tree Canopy: 0%-24% canopy cover • Ground Plane: 0%-29% coverage • Irrigation Equipment: Installed >10 years prior, includes Smart Irrigation Controllers. Currently, non-operational and requires repair to return to a functional status.

Note: The activity for Water Conservation includes the installation of Smart Irrigation Controllers and/or conversion to non-potable water. However, these activity details are not included in the Condition Criteria.

Inventory and Conditions

The inventory of Roadside Rehabilitation areas is surveyed by Caltrans districts, compiled by the Caltrans Landscape Architecture Program, and updated every two years. The inventory includes existing highway planting in all classified landscaped freeways. The inventory and conditions of Roadside Rehabilitation, as of July 2018, are presented in Table 5-54.

Table 5-54. Roadside Rehabilitation Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	Inventory	Good	Fair	Poor	
Roadside Rehabilitation (acres)	29,937	21.1%	32.0%	46.9%	

Performance Targets

Table 5-55 presents the statewide asset performance targets for Roadside Rehabilitation.

Table 5-55. Roadside Rehabilitation Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Roadside Rehabilitation (acres)	60.0%	30.0%	10.0%	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

The future condition of roadside rehabilitation assets is projected using the effective annual deterioration rate as of 2017 SHSMP, which was based on the service life of the asset.

Unit costs for roadside rehabilitation are based on an analysis of historical cost data composed of the capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The capital construction cost includes work associated with the construction, traffic handling, mobilization, supplemental work, and contingencies.

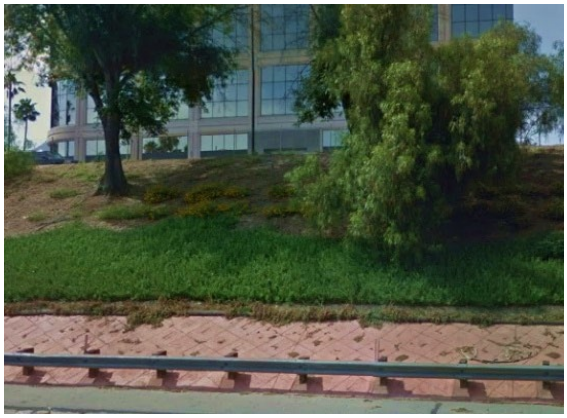
Typical Treatments

Field Maintenance Crews provide maintenance operations limited to those activities or treatments necessary to maintain a healthy roadside planting. These activities include minor repairs necessary to keep the irrigation system functioning.

Major Maintenance funds treatments related to the preservation of roadside elements to maintain and protect the overall integrity of the adjacent properties and the environment. These maintenance projects address specific items of concern for maintenance that need immediate attention and that, if not performed, could result in increased preservation needs requiring SHOPP funding in the future.

The SHOPP funds projects that include treatment strategies for the replacement, restoration, and rehabilitation of existing highway planting to preserve or improve the function aspects of the planting. Typical projects also include water conservation improvements by upgrading or replacing irrigation facilities, conversion to a non-potable water source, replacing planting to native plant materials, and projects that are necessary to meet NPDES permit requirements.

Sustainability: Storm Water Mitigation



Overview

The Storm Water Mitigation objective ensures that Caltrans storm water discharges to waters of the State or waters of the United States meets the applicable water quality standards, through construction of control measures to meet the current NPDES permit requirements and other state and federal laws, such as the Porter-Cologne Water Quality Control Act, the Clean Water Act and evolving storm water requirements.

Performance Metrics

The condition designations for storm water mitigation are based on a deficiency model. Locations where a deficiency still exists as identified by the NPDES are designated as poor, while locations with deficiencies that have been addressed are designated as good. The fair designation does not apply in the deficiency model. Table 5-56 describes the performance metrics for determining condition for good and poor storm water mitigation locations.

Table 5-56. Storm Water Mitigation Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Deficiency has been addressed
Fair	N/A
Poor	Deficient element

Inventory of Deficiencies

The NPDES permit mandates Caltrans to achieve a minimum of 33,000 compliance units (CUs) over a 20-year window starting from 2014-15 or 1,650 CUs annually within the 84 Total Maximum Daily Loads (TMDLs) as well as Areas of Special Biological Significance (ASBS). A compliance unit is defined as one acre of Caltrans right-of-way from which runoff is retained, treated, and/or otherwise controlled prior to discharge to a water body with an established TMDL. CUs may be credited to Caltrans for the following actions:

- Multiple objective projects that incorporate Best Management Practices (BMP) retrofits
- SHOPP Financial Contribution Only (FCO) projects
- Stand-alone BMP retrofits
- Post-construction treatment beyond permit requirements
- Fish passage projects in TMDL watersheds that also improve water quality
- Projects in TMDL watersheds that place open-graded friction course (OGFC) pavement
- Trash control BMPs, and
- Other pollution reduction practices necessary to comply with TMDL

Failure to achieve annual CU requirements could result in NPDES permit non-compliance and increased project delivery costs, including penalties. In addition, CUs will accumulate and be added to the 1,650 CU requirement in the following year. Currently, there are 1,770 CU which were not addressed in prior years. This carryover balance has been added to the 10-year compliance requirement of 16,500 CU resulting in a total statewide deficiency balance of 18,270 CU.

From 2015 through 2018, Caltrans completed work resulting in 4,830 CU. Table 5-57 presents an assessment of the proportion of current deficiencies relative to the proportion of deficiencies that have been addressed.

Table 5-57. Storm Water Mitigation Inventory of Deficiencies

Inventory of Deficiencies					
Objective (unit of measure)	Inventory	Good	Fair	Poor	
Storm Water Mitigation (compliance units)	**18,270**	**0%**	**N/A**	**100%**	

Performance Targets

The goal of the Storm Water Mitigation objective is to achieve 18,270 CU over this Plan within the 84 TMDLs as well as ASBS. The performance targets over the 10-year Plan period is presented in Table 5-58.

Table 5-58. Storm Water Mitigation Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Storm Water Mitigation (compliance units)	100.0%	N/A	0.0%	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

The requirements of the storm water regulations are dynamic in nature. For example, the State Water Resources Control Board (SWRCB) recently issued Trash Provisions Order 13383, which requires Caltrans to implement trash control measures statewide. In addition, the cost of delivering storm water improvements can vary significantly, so performance is planned to be achieved through a more cost-effective mix of multi-objective asset management projects, FCO projects, stand-alone BMP retrofit projects, and non-SHOPP projects.

Storm water quality improvements can also be constructed economically by addressing this deficiency as a satellite need to an anchor project belonging to a major asset category.

Typical Treatments

In consultation with the SWRCB, Caltrans uses the following four methods to achieve CUs:

- Caltrans SHOPP storm water projects (storm water mitigation stand-alone projects).
- Caltrans SHOPP storm water FCO projects (in partnership with local agencies).
- Caltrans SHOPP projects, such as fish passage projects, also improving water quality; projects that include post-construction storm water BMPs; and pavement projects placing OGFC in TMDL watersheds.
- Other Non-SHOPP projects that provide funding for local agency projects.

Caltrans prioritizes its storm water related activities and addresses TMDLs through implementation of source control measures, BMPs, and other pollutant reduction activities. Caltrans will use asset management principles and multi-objective decision analysis during project planning and programming to optimize the achievement of CUs through the SHOPP program. Caltrans will continue to collaborate with the SWRCB and Regional Water Quality Control Boards to achieve maximum water quality benefit economically and efficiently.

5.5 System Performance
Goals and Objectives

System performance activities focus on increasing mode choice, providing reliable travel times, improving goods movement and minimizing delay associated with congestion. The noted activities are all designed to maximize the capacity of the existing transportation system footprint because available funding programs for the maintenance, rehabilitation and replacement of transportation assets prohibit the expansion of the highway system lanes, and the state's priorities have shifted away from adding new highway lanes to making the most efficient use of the existing system and diversifying mode choice. Many of the system performance activities also help to improve freight movement that benefits California's businesses and consumers and provide increased employment opportunities. Failure to adequately invest in system performance activities would result in greater congestion, less reliable travel, and a less favorable business climate.

Examples of System Performance Activities

- Maintaining adequate signage
- Improving highway system traffic flow using transportation management systems
- Installation of cameras and monitoring systems to help minimize non-recurrent delay
- Construction of truck climbing lanes, acceleration and deceleration lanes and interchange weave lanes
- Installation of ramp meters and connected corridors

System Performance: Bridge Goods Movement Upgrades

Overview

The Bridge Goods Movement Upgrades objective is to identify and address geometric restrictions to permit vehicle traffic on the SHS. Bridge Goods Movement Upgrades address restrictions from reduced vertical clearance as established in the Caltrans HDM, and load capacity restrictions as identified by federal guidelines. The emphasis of this objective is to address poor condition bridges impacting Interstate mainline traffic.

Performance Metrics

The condition designations for Bridge Goods Movement Upgrades are determined through assessments of a bridge's two possible restrictions to goods movement: vertical clearance (VC) and permit vehicle rating based on load capacity. Each bridge is analyzed for these individual criteria.

The rating of good, fair, and poor for vertical clearance is determined based on conformance with HDM standards for the functional classifications of the roadway beneath the structure. The rating of good, fair, and poor for permit vehicle rating is a function of load capacity restrictions on the structure as identified in federal guidelines. Once classified for the two individual aspects (VC and permit vehicle rating), the overall rating for the bridge is assigned by the lower of the two individual ratings. Table 5-59 describes the performance metrics for determining condition for good, fair, and poor Bridge Goods Movement Upgrades.

Table 5-59. Bridge Goods Movement Upgrades Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Both VC and permit condition ratings are Good
Fair	The lowest of the VC or Permit rating is Fair
Poor	The lowest of the VC or Permit rating is Poor

Inventory and Conditions

The Bridge Goods Movement Upgrade inventory data are based on both VC and permit vehicle capacity restrictions. Vertical clearance restrictions are documented and/or updated during biennial routine bridge inspections. The minimum VC and the classification of the roadway beneath the structure are entered in SM&I's bridge management system using the SMART database. In addition, all bridges are periodically analyzed for permit vehicle load capacity per federal guidelines through a load rating summary of the structure, performed by SM&I's Load Rating Unit. All bridges on the SHS are included in the inventory except for Bay Area Toll Authority and Golden Gate Transportation District bridges and bridges built and maintained under Public Private Partnerships. The inventory and conditions for Bridge Goods Movement Upgrades, as of March 2018, are presented in Table 5-60.

Table 5-60. Bridge Goods Movement Upgrades Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**	
Bridge Goods Movement Upgrades (square feet)	**246,100,957**	**79.2%**	**8.3%**	**12.5%**	

Performance Targets

Table 5-61 presents the statewide asset performance targets for Bridge Goods Movement Upgrades.

Table 5-61. Bridge Goods Movement Upgrades Performance Targets

Desired State of Repair				
Objective (unit of measure)	**Good**	**Fair**	**Poor**	
Bridge Goods Movement Upgrades (square feet)	**75.0%**	**15.0%**	**10.0%**	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

Bridge Goods Movement Upgrades conditions do not follow a deterioration model. New needs are identified based on changes in legislation regarding allowable permit vehicles or changes in design standards for VC. For example, if California bridges are required to accommodate heavier truck loads to comply with rules imposed by the federal government, the needs under this objective would increase. Currently, heavier trucks are allowed only through the issuance of a permit. Should these trucks become legal loads and be allowed to travel without restriction on the SHS, the load carrying capacity of California bridges will be decreased and bridge needs to strengthen or replace bridges will be greatly increased.

Unit costs for the Bridge Goods Movement Upgrades are based on an analysis of historical data composed of the capital construction and support costs. Support costs are associated with engineering and/or oversight work to design and construct the project. The Capital construction cost includes the structure costs and an applied factor to account for associated roadway items, traffic handling, mobilization, supplemental work and contingencies. It is assumed that all fair deficiencies would require rehabilitation, and half of the poor deficiencies would require rehabilitation, while the other half would require replacement of the existing structure.

Typical Treatments

The SHOPP funds projects and treatments that either improve VC or improve the load capacity of the bridge. Fair condition bridge restrictions for VC indicate that the elevation of the existing structure is typically within six inches of the vertical clearance standards in the HDM and may restrict larger vehicles traveling under the structure. Fair condition bridge restrictions for load capacity indicates that five and seven axle vehicles have no restrictions when traveling over the structure while larger vehicles are impacted.

Poor condition bridge restrictions for VC indicate that the elevation of the existing structure is typically posted with identified reduced VC signage. Poor condition bridge restrictions for load capacity indicates that all permit vehicles have some level of restriction when traveling over the structure. Typical treatments and the work to address these restrictions require either rehabilitation or replacement of the structures. Rehabilitation for VC restrictions typically requires a lowering of the roadway beneath the structure or a raising of the deck and superstructure of the bridge above the roadway. Rehabilitation for load capacity restrictions typically requires a strengthening of deck and superstructure to handle the increased loading.

System Performance: Commercial Vehicle Enforcement Facilities

Overview

The Commercial Vehicle Enforcement Facilities (CVEF), commonly called Weigh Stations, are owned by Caltrans and operated by CHP. CHP monitors and inspects trucks using the SHS to ensure that they are operating safely, licensed properly, and conformed to legal size and weight, which ensures that bridge and pavement assets are not damaged prematurely by overweight trucks. The presence of CVEF helps in preserving state infrastructures, improving truck operations, and enhancing the safety of the traveling public. Caltrans and CHP work cooperatively to ensure that all facilities are in good operational condition for truck enforcement efforts.

Performance Metrics

Table 5-62 describes the performance metrics for determining condition for good, fair, and poor for CVEF.

Table 5-62. Commercial Vehicle Enforcement Facilities Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	• Facility is either new or recently completed with major rehabilitation • Has no known building or pavement issues • Facility is in good operational condition • Meets most functional needs of the CHP
Fair	• Requires minor building modification • Requires minor upgrade in pavement, inspection bay, or technology • Some known building or pavement issues that can be fixed via building maintenance • Still meets most of the functional needs of the CHP
Poor	• Requires major building rehab • Location needs upgrade in classification • Functionally obsolete • Facility needs technology expansion to meet CHP operations

Inventory and Conditions

There are 54 CVEF stations in California. The 2017 SHSMP inventory was measured in stations; however, the inventory is revised to square feet for the 2019 SHSMP. The measurement unit is changed to be consistent with all other Caltrans' building type assets like Transportation Related Facilities.

The condition of CVEFs is based on survey information from CHP commanders at each facility. Additional information is also gathered from recently completed CVEF projects, field inspections, Google map photo observation, and age of the facility. The inventory and conditions of Commercial Vehicle Enforcement Facilities, as of July 2018, are presented in Table 5-63.

Table 5-63. Commercial Vehicle Enforcement Facilities Inventory and Condition

Inventory and Conditions					
Objective (unit of measure)	Inventory	Good	Fair	Poor	
Commercial Vehicle Enforcement Facilities (square feet)	309,395	35.1 %	45.7 %	19.3 %	

Performance Targets

Table 5-64 presents the statewide asset performance targets for CVEFs.

Table 5-64. Commercial Vehicle Enforcement Facilities Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Commercial Vehicle Enforcement Facilities (square feet)	60.0%	40.0%	0.0%	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

The deterioration rate for CVEF is based on the age/life cycle of the building, pavement, landscape, and other inspection equipment at the CVEF station. Specifically, on an annual basis, a percentage of the CVEFs that is in good condition deteriorates to fair condition, and a percentage of the CVEFs in fair condition deteriorates to poor condition. SHOPP projects primarily address CVEF in poor or fair condition and restore the condition of the asset, while maintenance focuses on maintaining CVEF in good condition as well as addressing CVEF in fair condition.

Unit cost for CVEF is based on an analysis of historical cost data composed of the capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction cost includes work associated with the construction of commercial vehicle enforcement stations including traffic handling, mobilization, supplemental work, and contingencies.

Typical Treatments

The Inventory of Needs Report specifies the Inter Agency Agreement (IAA) and is the mechanism for joint operations pertaining to maintenance of the CVEFs. The IAA establishes the responsibility for specified repairs and maintenance at these facilities. Items specific to building interiors such as plumbing repair, water quality testing, and minor roof and flooring repair are procured by CHP. IAA maintenance funds can be used to reimburse the CHP for such expenses. Additionally, Caltrans Field Maintenance Crews may be dispatched on an as-needed basis to address general items such as building exteriors or minor site work on the property.

Projects designed to construct new CVEFs, to relocate existing CVEFs for more efficient operations, and to upgrade/rehab existing CVEFs are all treatments funded in the SHOPP. Major rehab includes the upgrade of the CVEF classification, expanding the building structure for administration offices or inspection bays, or upgrading technology to improve truck operations. The 2018 CVEF Inventory of Needs report is being updated to include a priority list of new CVEFs and existing CVEFs in need of major improvement.

Additionally, some CVEF improvements and treatments strategies, such as pavement rehab, ADA, landscape and drainage correction, signing and striping, weight scale replacement, and other electrical or electronic elements, are funded and completed through Minor SHOPP projects.

System Performance: Operational Improvements

Overview

The Operational Improvement objective includes projects which reduce highway user delay by delivering improvements that alleviate localized congestion on the SHS. Projects tend to be low-cost, high benefit investments for a corridor. Delay is typically calculated by summing the amount of time vehicles spend below 60 mph on monitored freeway sections of the SHS.

Performance Metrics

Operational Improvements use a deficiency model and a performance metric of Daily Vehicle Hours of Delay (DVHD). A deficiency of DVHD that still exists and has not improved is designated as poor, while DVHD that have been improved are designated as good. The fair designation does not apply in the deficiency model.

Table 5-65 describes the performance metrics for determining good, fair, and poor operational improvements.

Table 5-65. Operational Improvements Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Daily Vehicle Hours of Delay Deficiency has been improved
Fair	N/A
Poor	Daily Vehicle Hours of Delay Deficiency has not been improved

Inventory of Deficiencies

The current asset deficiency or need for the nine districts that have automated detection on freeway portions of the SHS reporting to Caltrans' Performance Measurement System (PeMS) is based on data reported in the first quarter Mobility Performance Report (MPR) of 2018. For the three Caltrans' districts that do not have automated detection reporting to PeMS (Districts 1, 2, and 9) the current asset deficiency or need is based on traffic volumes that are obtained from a variety of sources; primarily from Traffic Census detection. The method for measuring asset deficiency or need using PeMS represents delay only on freeway portions of the SHS where automated detection has been installed. This method excludes delay occurring on conventional highway facilities and on freeway segments where automated freeway detection has not been installed.

The deficiency is presented in terms of DVHD: the average weekday amount of time vehicles spend below 60 mph on the SHS. DVHD is further broken down by vehicle speed under two operating conditions. The first condition is delay that occurs over 35 mph and under 60 mph. Under this condition, while vehicles are delayed and operating at slower than 60 mph speeds; traffic flow is generally constant, with few rapid fluctuations in speed. The second condition is severe delay, or delay that occurs at or under 35 mph. Severe delay occurs when there is greater demand than available capacity, and is characterized by frequent fluctuations in vehicle speeds, including 0 mph or stop conditions. This roadway condition is colloquially referred to as "stop-and-go" traffic. The sum of both conditions is the total DVHD under 60 mph.

The deficiency of Operational Improvements, as of March 2018, is presented in Table 5-66.

Table 5-66. Operational Improvements Inventory of Deficiencies

Inventory of Deficiencies					
Objective (unit of measure)	Inventory	Good	Fair	Poor	
Operational Improvements (DVHD)					
Total	**1,056,914**	**0.0%**	**N/A**	**100.0%**	
Operational Improvements (Delay under 60 mph and over 35 mph)	**577,340**	**0.0%**	**N/A**	**54.6%**	
Operational Improvements (Severe delay under 35 mph)	**479,574**	**0.0%**	**N/A**	**45.4%**	

Performance Targets

Caltrans has established a goal to improve the deficient condition (DVHD hours) by 10 percent, or approximately one percent annually over 10-years. Table 5-67 presents the statewide asset performance targets for Operational Improvements.

Table 5-67. Operational Improvements Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Operational Improvements (DVHD)	**10.0%**	**N/A**	**90.0%**	

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions. Operational improvements are based on existing data and estimated project improvements resulting from traffic analyses and engineering judgment. During times of economic growth, demand on the State's transportation system typically increases, while during times of economic decline, demand on the State's transportation system decreases. California's economy has experienced growth over the past several years and an analysis of existing traffic data indicates that for each of the past two-years, DVHD on the State Freeway System has increased 5 and 6 percent respectively. It is anticipated that fluctuations in the State's economy will continue to impact DVHD over the 10-year Plan period of the SHSMP, therefore a more modest two to three percent annual growth rate in DVHD is forecast over the 10 years. The unit cost estimate is based on the capital costs of the SHOPP Operational Improvement projects programmed in the adopted 2018 SHOPP divided by the total DVHD reduction associated with the programmed projects. This cost includes work for the construction of operational improvements, traffic handling, mobilization, supplemental work, and contingencies.

Typical Treatments

Operational Improvement projects improve transportation system performance on the SHS by reducing congestion, delay, and operational deficiencies at spot locations and improve the reliability and efficiency of people and goods movement. Reduced congestion and delay improve the environment and livability and facilitate economic development. The SHOPP funds projects to accomplish these goals through typical treatments such as ramp metering projects, traffic signal installation including coordination, and improvements to existing signals, auxiliary lane construction, roundabout construction, widening of on/off-ramps or shoulders, improvements of lane/shoulder/turning radius dimensions for trucks, installation or extension of acceleration or turn lanes, and alteration of High Occupancy Vehicle (HOV) lane access configuration.

System Performance: Sign Panel Replacement

Overview

The Sign Panel Replacement objective is to replace all large overhead and roadside signs to meet federal requirements for retro-reflectivity which reduces the need for overhead sign lighting. Federal requirements for retro-reflectivity are in place to ensure that signs are visible even during night and in inclement weather. The goal is to replace all signs with the current standard for high performance retro-reflective sheeting. The use of this type of sheeting will increase sign service life 15 to 20 years. This will reduce annual replacement needs. Removal of the catwalks should reduce the potential for graffiti and the need for graffiti mitigation. In addition, the elimination of overhead sign lighting will reduce Caltrans' maintenance and utility costs and contribute to Caltrans' goal for reduced GHG footprint.

Performance Metrics

The condition of sign panel assets is based on if the sign panel has been replaced by Type XI sheeting. Table 5-68 describes the performance metrics for determining good, fair, and poor Sign Panel Replacement.

Table 5-68. Sign Panel Replacement Performance Metrics

Performance Metrics	
Condition	**Metrics**
Good/Fair	Sign has Type XI sign panel sheeting less than 20 years old
Poor	Sign does not have Type XI sign panel sheeting or has Type XI sign panel sheeting 20 years of age or older

Inventory and Conditions

The inventory of large sign panels in the SHS is maintained in Caltrans IMMS and the number of the signs is updated periodically and manually by local supervisors. The sign panels considered include overhead and roadside two-post, ground mounted sign panels, and exclude one-post sign panels which are typically small and relatively inexpensive. The inventory and conditions for Sign Panel Replacement, as of 2018, are presented in Table 5-69.

Table 5-69. Sign Panel Replacement Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	**Inventory**	**Good**	**Fair**	**Poor**	
Sign Panel Replacement (each)	87,187	6.0%	0.0%	94.0%	

Performance Targets

Caltrans has established a goal to replace all signs with the current standard for high performance retro-reflective sheeting or Type XI sheeting with no change from the 2017 SHSMP. Table 5-70 presents the statewide asset performance targets for Sign Panel Replacement.

Table 5-70. Sign Panel Replacement Performance Targets

Desired State of Repair			
Objective (unit of measure)	**Good**	**Fair**	**Poor**
Sign Panel Replacement (each	100.0%		0.0%

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

The deterioration rates for sign panel are based on the service life of the asset once it is replaced by Type XI sheeting. Specifically, on an annual basis a percentage of assets in good condition deteriorates to fair condition, while a percentage of assets in fair condition deteriorates to poor. It is anticipated that the service life of a sign with a new Type XI sheeting replacement will have an extended life of 15 to 20 years.

Unit costs are composed of the capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The capital construction cost includes work associated with the construction of sign panel replacement, traffic handling, mobilization, supplemental work and contingencies. Separate average unit costs were calculated for overhead panels and two-post roadside panels.

Typical Treatments

In addition to large signs (overhead and roadside two-post, ground mounted sign panels), Caltrans owns nearly 500,000 small signs (one post signs; stop signs, speed limit signs, route shield signs, etc.), which are difficult to track. Any of these signs can be maintained by Caltrans Field Maintenance Crews or funded by the SHOPP. Replacement of large signs is primarily completed through the SHOPP. Field Maintenance Crews replace and update small signs on a continuous basis.

System Performance: Transportation Management Systems

Overview

A Transportation Management System (TMS) is comprised of electrical/electronic TMS units that work together to reduce highway user delay, provide traveler information, and collect information on traffic behavior. These units are an integral part of the SHS, performing critical functions that keep people, vehicles and goods moving. TMS units also support Integrated Corridor Management (ICM) strategies and systems.

TMS unit types include several different TMS elements defined further in the Inventory and Condition Section, but also include the associated communications infrastructure and central system software that support their operation and connection to the district Transportation Management Centers (TMCs). TMS units such as traffic signals and ramp meters control the flow of traffic on the SHS to optimize efficiency. Central and communications systems that connect to TMS units enable system operators to detect highway incidents and dispatch assistance or provide information about detours to minimize congestion related to incidents, estimated by FHWA to account for approximately one-third of delay on any highway system. In addition to providing real-time data for system operators and travelers, TMS units also provide historic data to help system planners and engineers forecast and plan projects.

The existing inventory of TMS units represents a significant historical investment by Caltrans and its partners. Many of these units are over ten years old and approaching the end of their expected life cycles. They will require rehabilitation in the next five to ten years. Technological improvements are likely to make future TMS units more reliable and potentially increase equipment life cycle expectancies.

TMS units are also collectively referred to nationally as Intelligent Transportation Systems (ITS). For the purposes of asset management, performance targets focus on the nine core types of TMS units. In addition to the nine types of TMS units presented below, there are several types of central system software and communications systems (including leased, dedicated fiber, and microwave links) that are required to manage the TMS units remotely and enable advanced functions that enable effective integrated corridor management. While not currently explicitly enumerated as core TMS units, these types of systems are integral to remotely managing and monitoring TMS units and are often included as part of TMS projects or separate projects altogether. Furthermore, as newer technologies become available and are deployed to support connected and autonomous vehicles in the TMS infrastructure, the number and types of TMS units are expected to continue to grow.

Caltrans works diligently to keep TMS units functioning as intended. In addition to performing preventive maintenance checks, per Chapter K of the Maintenance Manual, Volume 1[33], Caltrans will be developing active monitoring and regular functional check programs to meet the Caltrans Strategic Management Plan and SB 1 goals for TMS Up-time Health.

Performance Metrics

For asset management purposes, TMS units are categorized as being in either good or poor condition. The condition of a TMS unit is based on the unit being within its expected life cycle and its functional availability. In the 2017 SHSMP, operational readiness was used to define whether a TMS unit was operational but beyond its service life and obsolete. The term functional availability will be used in 2019 and in future plans to clarify if a TMS unit is functioning as intended. This change in terminology has not affected the condition criteria for TMS. In addition, the two criteria for determining condition align with Caltrans Strategic Management Plan. Table 5-71 describes the performance metrics for determining good, fair, and poor Transportation Management Systems.

Table 5-71. Transportation Management Systems Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Within expected lifecycle and consistent functional availability
Fair	N/A
Poor	Beyond expected life cycle or is not meeting functional availability because of chronic down time

[33] Caltrans Maintenance Manual, Chapter K, Volume 1, http://www.dot.ca.gov/hq/maint/manual/2014/(27)_Chpt_K_July_2014_corr_1.01.pdf

Table 5-72 further illustrates the criteria for determining good and poor condition.

Table 5-72. Transportation Management Systems Unit Condition

Unit Condition				
Criteria	Good		Poor	
Is the Unit within Life Cycle?	Yes	No	Yes	No
Is the Unit consistently functionally available?	Yes	Yes	No	No

Inventory and Conditions

There are over 19,500 TMS units on the SHS. The nine core types of TMS units include:

- Closed circuit televisions
- Changeable message signs
- Traffic monitoring detection stations
- Highway advisory radios
- Freeway ramp meters
- Roadway weather information systems
- Traffic signals
- Traffic census stations
- Extinguishable message signs

In the future, TMS units such as central system software, communication systems, and newer TMS unit technologies may be included, expanding the list of core TMS units. The inventory and conditions for TMS, as of 2018, are presented in Table 5-73.

Table 5-73. Transportation Management Systems Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	Inventory	Good	Fair	Poor	
Transportation Management Systems (each)	19,853	67.4%	N/A	32.6%	

Performance Targets

Table 5-74 presents the statewide asset performance targets for TMS.

Table 5-74. Transportation Management Systems Performance Targets

Desired State of Repair				
Objective (unit of measure)	Good	Fair	Poor	
Transportation Management Systems (each)	**90.0%**	**N/A**	**10.0%**	

Caltrans has established two targets to bring 90 percent TMS units to good condition:

1. TMS Life Cycle Health – 90 percent within expected life cycle and functionally available
2. TMS Up-time Health – 90 percent TMS units functional

For Caltrans to meet these targets, a collaborative effort between Caltrans Division of Traffic Operations and Division of Maintenance will be required. Traffic Operations will focus on the Life Cycle Health target and Maintenance will focus on the Up-time Health target.

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

An average of 4.75 percent units in good Life Cycle Health condition deteriorates annually to poor condition. Because of the electronic nature of the units, condition can go from good to poor quickly and there is no intermediate condition. Furthermore, the Life Cycle Health condition is based on the life cycle of the technological components of a TMS (i.e., camera, controller, other electronics) and the life cycle of the structural components constructed for it (i.e., steel pole, mast arm, foundation). Technological life cycles may be affected by industry obsolesce, changes in standards, geographical location, and environmental factors. Structural life cycles may be affected by changes in standards, geographical location, and environmental factors. A TMS may only need to replace the technological components to prolong its service life until the end of the structural life cycle is reached. On an average, the structural components of a TMS are expected to last about four times as long as the technological components.

The deterioration rate of a TMS unit is based on the service life of the unit as compared to either the original installation date or the most recent life cycle replacement date. SHOPP life cycle replacement projects primarily address TMS units in Poor Life Cycle Health condition and restore the Life Cycle Health condition of the unit. Field Maintenance Crews primarily focus on keeping the TMS units functional and prolonging their service life. The functional availability of a TMS unit is an indicator of its condition. A TMS unit that does not meet the functional availability criteria is flagged to be experiencing chronic down time, an indicator of poor health, and may need an early replacement through a SHOPP project.

Unit costs are based on an analysis of historical cost data composed of the capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction cost includes work associated with TMS, communication infrastructure, traffic handling, mobilization, supplemental work, and contingencies.

Typical Treatments

Field Maintenance Crews perform preventive maintenance on a regular basis to maintain the functional availability, and to achieve maximum service life of the TMS Units. TMS Units require, on an average, over 81,000 preventive maintenance checks and repairs annually to maintain a goal LOS of 100 for Traffic Signals and 90 for all other TMS units. Maintenance checks for traffic signals take priority over other TMS units, ensuring safety to the traveling public. Maintenance uses a combination of treatments by Field Maintenance Crews and on call service contracts to maintain TMS units. Field Maintenance Crews address preventive maintenance checks and repairs. On-call maintenance service contracts are used for overflow repairs beyond the scope of our Field Maintenance Crews and for the field units associated with the Traffic Operations Systems Network (TOSNET), which include the maintenance of wireless units, fiber optic cables, copper cable, and communications hubs. Without active monitoring, preventive maintenance, and regular functional checks, TMS units may not function properly, may decline to poor condition sooner, and may not provide reliable data to the TMCs or be able to provide accurate and reliable information to the motoring public.

The SHOPP typically addresses units which are at the end of life, obsolete, or otherwise non-functional because of chronic operational issues. These projects could include treatments that address system failures, systemic repairs, replacements, or upgrades. The goal is to bring 90 percent of TMS units in good condition by end of year 2027. The upgrade or replacement of a TMS unit from poor to good condition requires that the full TMS System is upgraded or replaced.

System Performance: Weigh-In-Motion Scales

Overview

Weigh-In-Motion (WIM) Scales are devices installed in the SHS pavement to weigh vehicles traveling at traffic speed and do not require the vehicle to come to a stop. These systems can calculate the gross vehicle weight of any car or truck, as well as measure the individual axle weights and spacing to determine vehicle classifications. This information is used to fulfill federal mandates and to determine enforcement needs. It is also used to collect data needed to calculate bridge and pavement conditions, to better perform safety analysis, and to meet the special operational needs of trucks. Besides, WIM data are processed, validated, and disseminated to other Caltrans units such as HPMS, Highway Cost Allocation Studies (HCAS), and Pavement Analysis and Vehicle Enforcement Strategic Information (PAVES-IT).

Performance Metrics

The WIM Scales' condition is based on the age of WIM, equipment functionality, and semi-annual onsite field maintenance inspections. Based on historical data, WIM lifecycle is 20 years. Any WIM stations older than 20 years are considered in poor condition and need to be replaced.

Table 5-75 describes the performance metrics for determining condition for good, fair, and poor WIM Scales.

Table 5-75. Weigh-In-Motion Scales Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	• WIM is less than five years old • All sensors and frames are secured, and electronics are functional • No known issues and meets standard Portland Cement Concrete (PCC) length (ASTM E1318) and smoothness • No surface cracking or noticeable movement of PCC panels • Weigh sensor panel(s) does not have any cracks
Fair	• WIM is older than five years but less than 20 • All sensors and frames are secured, and electronics are functional • No known issues and meets standard PCC length (ASTM E1318) and smoothness • Minor surface cracking without noticeable movement at PCC panels not near the WIM sensors • Weigh sensor panel(s) does not have any cracks
Poor	• WIM is older than 20 years • Any sensors and frames are not secured and/or electronics are not functional • Substandard PCC length and/or smoothness as outlined in standard (ASTM E1318) • Cracking or potholes of PCC in any of the approach and departure concrete slabs • Cracking exists beneath the scale frames in the PCC • Weigh sensor panel rocking as traffic drives across WIM

Inventory and Conditions

Currently, there are 141 WIM Scales located over 635 lanes on the mainline SHS. These Scales are fitted with various instrumentation, such as associated concrete pavement, piezoelectric sensors, electronics, poles, mast arms, conduits, and controller cabinets. The mainline Scales consist of 103 “Data” and 38 “Pre-Pass” WIMs, which include seven WIMs that are both “Data” and “Pre-Pass.”

In the 2017 SHSMP, the inventory count was listed as 176 WIM Scales instead of the current count of 141. This was because the piezoelectric sensor locations were counted as their own stations. However, this method of counting is not accurate because the piezoelectric sensor is a component of the “Pre-Pass” WIM and cannot function independently. Thus “Pre-Pass” WIM with piezoelectric sensors are recounted as one complete WIM station in the current inventory. It should be noted that there would be future changes to the number of WIM locations inventory due to new installations and/or abandonment of existing stations.

The TMS database is the information source for inventory and condition of WIM Scales. The condition of WIM Scales is based on the age of the WIM, equipment functionality, and semi-annual onsite field maintenance inspections. Based on historical data, a WIM lifecycle is 20 years. Any WIM Scale older than

20 years is considered poor condition and needs to be replaced. The inventory and conditions of WIM Scales, as of 2018, are presented in Table 5-76.

Table 5-76. Weigh-In-Motion Scales Inventory and Conditions

Inventory and Conditions					
Objective (unit of measure)	Inventory	Good	Fair	Poor	
Weigh-In Motion Scales (stations)	141	19.9 %	48.2 %	31.9 %	

Performance Targets

Table 5-77 provides the statewide asset performance targets for WIM Scales.

Table 5-77. Weigh-In-Motion Scales Performance Targets

Desired State of Repair			
Objective (unit of measure)	Good	Fair	Poor
Weigh-In-Motion Scales (stations)	90.0%	10.0%	0.0%

Other Performance Management Parameters

Several other parameters are required in the performance management analysis. These may include deterioration rates, capital and support unit costs, SHOPP, and potentially maintenance and other contributions.

The deterioration rate for WIM Scales is based on the asset's service life. Specifically, on an annual basis, a percentage of assets in good condition deteriorates to fair condition while a percentage of assets in fair condition deteriorates to poor. SHOPP projects primarily replace assets in poor condition, while maintenance focuses on maintaining assets in good condition as well addressing assets in fair condition.

The unit cost for WIM Scales is based on an analysis of historical data composed of the capital construction and support costs. Support costs are those associated with engineering and oversight work to design and construct the project. The estimated capital construction includes work associated with the average construction cost of a four lane WIM Scale project including traffic handling, mobilization, supplemental work, and contingencies.

Typical Treatments

Typical WIM Scale maintenance treatments are routinely performed by a WIM vendor through a maintenance service contract. However, Field Maintenance Crews may be needed to assist with issues such as pull-box repairs, cabinet replacements, communication line work, and other minor repairs.

The SHOPP funds projects designed to build new WIM Scales or to reconstruct existing poor condition sites. Typical treatments include rehabilitating existing WIM systems with minor concrete to improve smoothness and surface crack corrections, or to improve the non-standard pavement roadway length of the WIM. In addition, some WIM installations are handled as Minor A projects funded by SHOPP reservations.

5.6 Organizational Excellence
Goals and Objectives

The Organizational Excellence goals influence on the SHSMP is in how Caltrans carries out its work regardless of the type of work. These overarching principles will result in better project planning and development regardless of the type of work being performed. Collectively, the Organizational Excellence objectives help to make Caltrans a better organization for the public and our employees.

Concepts that may be Applied Individually or in Combination as Applicable to a Project

Communication Caltrans shall communicate our planned and programmed projects publicly. This communication allows interested parties to understand our plans and initiate communication related to specific projects as appropriate. Communication often means listening to input from differing perspectives related to proposed transportation solutions. This communication also provides a means of explaining the various transportation investments being made on behalf of the people of California.

Partnering The SHS is a portion of a larger network of transportation that must work together to efficiently meet the transportation needs of all Californians. Caltrans shall partner with local transportation providers to maximize the benefit to the system users. This activity focuses on understanding shared objectives and working together to realize the coordinated delivery of transportation services to the public.

Innovation Caltrans strives to be innovative in our work. Innovation may take the form of new procurement methods, improved safety ideas, incorporation of state-of-the-art practices, use of innovative construction methods or materials, creative design approaches or creative coordination. Caltrans should adapt to transportation technology advances and their impacts on travel demand and operation. Regardless of the form, innovation helps to make Caltrans a world leader in transportation and a premier transportation employer.

Risk Management Transportation projects have many risks that must be appropriately considered during the project development process. Risks take many forms including design and construction risks, environmental permitting risks, schedule risks, cost risks and many more. Caltrans shall consider project risks and mitigate or manage the risk during the planning and development of our projects.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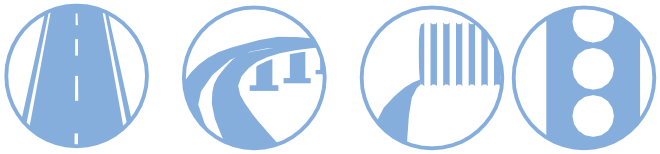
STOP



6 Life Cycle Planning Strategies

The basis of Life Cycle Planning (LCP) is doing the right treatment at the right time, while minimizing cost.

LCP is the process to estimate the cost of an asset over its whole life while preserving or improving condition at optimum time and cost. Cost effective investment strategies consider the whole life cycle of an asset and are critical in managing transportation assets across the entire transportation system.

In the development of performance and risk-based asset management plans, LCP guides the development of investment strategies by using asset condition data, deterioration rates, and treatment options to determine the most cost-effective approach to achieve the Desired State of Repair (DSOR) and sustain Caltrans investment in transportation assets. LCP is critical for achieving the lowest practical cost for improving and preserving the transportation system.

6.1 Life Cycle Planning

One of the core principles of asset management is making investment decisions that consider the full life cycle and associated costs of an asset or system of assets. Transportation asset management involves developing life cycle plans of individual assets as an implementation strategy for life cycle planning (LCP) which includes evaluating multiple assets and its impact to system-wide performance. An LCP is a strategy for managing an asset over its life to achieve a target level of performance while minimizing life cycle costs.

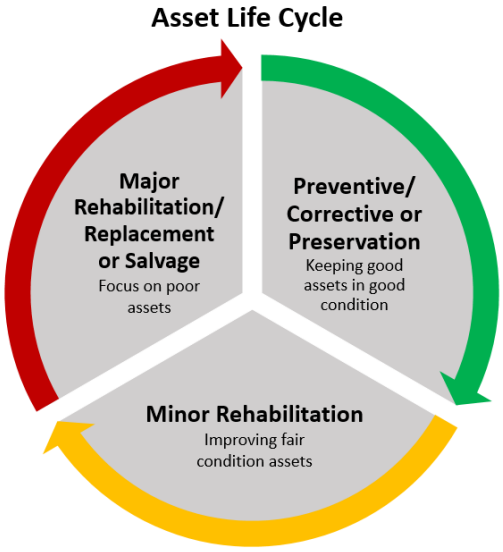


Figure 6-1. Asset Life Cycle

Life Cycle Planning vs. Life Cycle Cost Analysis

LCP focuses on general network-level asset management strategies, that is, the best sequence of maintenance and rehabilitation treatments for a given asset type. Figure 6-1 describes Caltrans' Asset Life Cycle, which begins with the asset's initial construction through maintenance, preservation, repair, rehabilitation, reconstruction, replacement, or removal. Figure 6-2 provides a more detailed look at LCP for pavements. Life cycle cost analysis (LCCA) complements LCP. LCCA is a technique for comparing cost alternatives over the life cycle of a project, allowing agencies to minimize life cycle cost while maintaining or even extending the life of the asset. FHWA defines life cycle cost as "the cost of managing an asset class or asset sub-group for its whole life, from initial construction to its replacements."[34] LCCA can be used for project level decisions to select the design option that minimizes the initial and discounted future agency, user, and other relevant costs over an analysis time period. The basic principle underlying both LCP and LCCA is fundamental to asset management: timely investments in an asset can result in improved condition and lower cost over the life cycle.

Typical Asphalt Pavement Life Cycle Planning Treatments to Extend the Life of Assets

Primary Asset	Preservation	Minor Rehabilitation	Major Rehabilitation or Replacement
• Pavements	• Seal Coat • Crack Seal • Dig-out	• Capital Maintenance • Medium Overlay	• Thick Overlay • Full Depth Reclamation • New Construction

Figure 6-2. Typical Asphalt Pavement Life Cycle Planning Treatments

[34] Asset Management Plan Definitions. 23 CFR § 515.5. October 24, 2016, https://www.federalregister.gov/documents/2016/10/24/2016-25117/asset-management-plans-and-periodic-evaluations-of-facilities-repeatedly-requiring-repair-and

Life Cycle Planning Modeling

LCP should be based on a good understanding of the costs and life spans of different types of treatments. It involves use of predictive models for how assets will deteriorate depending on the different types of treatments selected. Ideally, these models are developed based on several years of data on effectiveness and longevity of the applied treatments and the resulting measured condition.

In practice, LCP models are typically based on a combination of data and expert judgment. The Director's Office of Asset Management worked with Caltrans Headquarters Program Managers and Caltrans district staff to update and verify the following elements needed for a network level LCP process in this SHSMP:

- Identification of deterioration models
- Potential work types, including treatment options and unit costs
- Strategies for minimizing life cycle costs and achieving performance targets
- Asset performance targets

Factors to Consider in Life Cycle Planning

LCP is intended to help achieve asset performance targets. District Performance Plans, as described in Section 4.2, guide districts to achieve target expectations within the budget constraints. They articulate how districts will incorporate life cycle planning to minimize long term costs of asset ownership and document the decision-making process relative to less expensive short-term repairs versus more expensive long-term fixes. For example, one district identified that in the case of High Friction Surface Treatments (HFST) that typically last about 10 years, they would identify locations that are six years or older and prioritize these locations for replacement, if still needed, so that restoration occurs at the end of the treatment life cycle or at the optimum time. In addition, Life Cycle Plans would be developed by Program Managers in HQ that would lay out sound policies to assist districts in minimizing the life cycle cost of their assets. Furthering this effort, LCCA would be ideally implemented across all performance objectives to improve upon the procedures already in place.

Early identification of changes in traffic demand, environmental conditions including extreme weather events, climate change, and seismic activity are also important aspects of any LCP. Vulnerability assessments provide an evaluation of the asset's risk to these types of exposures. District by district vulnerability assessments are currently in process, as described in Section 5.1. Figure 6-3, from the vulnerability assessment, presents how these assessments can be used for managing pavements. The figure identifies various roadway assets and how planning and designing for uncertainties are impacted by asset life spans. In the case of pavements, it shows that climate change could affect pavement climate zones influencing pavement design and treatment decisions.

Timeframe for Decision Making - Planning/Designing to Uncertainties

EARLY

CULVERTS
BRIDGES
RETAINING WALLS
TUNNELS
DRAINAGE
EMBANKMENTS

THE VERY LONG LIFETIMES OF MANY STATE DOT ASSETS COULD LEAD TO SIGNIFICANT IMPACTS FROM CLIMATE CHANGE DURING THEIR LIFETIME, AND THEREFORE CAREFUL PLANNING IS REQUIRED.

STEEL SAFETY BARRIER
CONCRETE SAFETY BARRIER
CONCRETE PAVEMENT
BASE & SUB-BASE LAYERS OF PAVEMENT

THE MEDIUM RANGE LIFETIMES OF THESE ASSETS REQUIRES CONSIDERATION OF A RANGE OF CLIMATE CHANGE STRESSES TO ENSURE ASSETS ARE PROTECTED.

ASPHALT PAVEMENT
SIGNS & SIGNALS
ROADWAY LIGHTING

THE RELATIVE SHORT LIFETIMES OF ASSETS MEAN THAT IMPACTS OF CLIMATE CHANGE MAY BE MORE LIMITED.

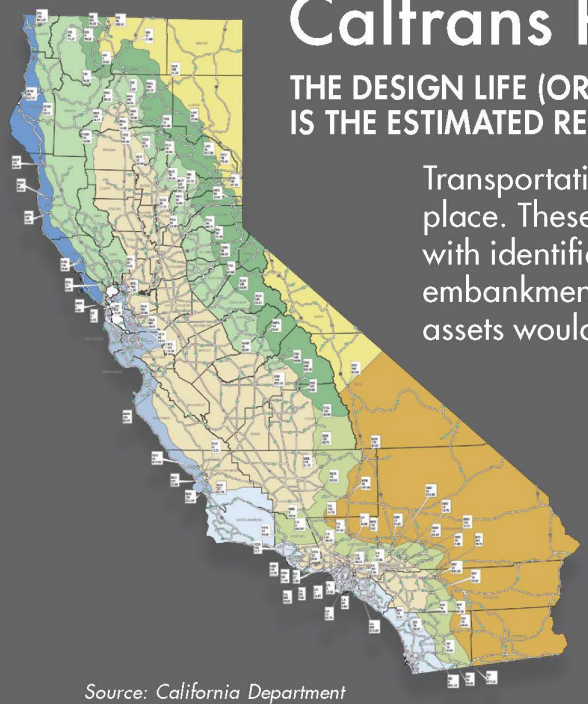
LATER 10 20 30 40 50 60 70 80 90 100

ASSET LIFETIME IN YEARS

Caltrans Pavement Regions

THE DESIGN LIFE (OR "USEFUL LIFE") OF TRANSPORTATION INFRASTRUCTURE IS THE ESTIMATED REMAINING TIME THAT AN ASSET WILL BE IN SERVICE.

Transportation assets have differing periods of useful life once put in place. These timeframes should be a factor when planning in areas with identified climate change concerns. Roadway alignments and embankments could be in place for a century or beyond, while other assets would have a less or much less useful life.



- North Coast
- Central Coast
- Inland Valley
- Low Mountain
- High Mountain
- Desert
- High Desert
- South Coast
- South Mountain

Source: California Department of Transportation

Note: Markers indicate County/Route/Post Mile of State Hwys. at region boundaries. When there is no marker, the region follows a county boundary.

Figure 6-3. Pavement Climate Zone Uncertainties

Life Cycle Plan Development Considerations

IN DEVELOPING A LIFE CYCLE PLAN, ONE SHOULD CONSIDER THE FOLLOWING QUESTIONS:

- How is the unit cost impacted by using more frequent maintenance activities over the life of an asset versus doing a full rehabilitation at optimum time?
- What is the remaining life of a bridge and when might be the right time to replace a bridge due to sea level rise?
- Is there redundancy built into the transportation system or are there regions and routes that need to have systematic treatments to maintain assets in good condition over the typical and standard treatments due to climate change or other risks?
- Are we making the right investment decision to rehabilitate all lanes of a highway irrespective of their condition instead of lane by lane treatments based on its condition? What about other strategies that could be implemented to reduce cost?
- What impacts, and risks can be identified at the corridor and network level that would provide for better asset management and life-cycle decisions?

Life Cycle Planning Maturity

The results of a Caltrans completed self-assessment of LCP maturity for the California TAMP are shown in Figure 6-4. Caltrans has been able to improve the maturity of LCP by requiring District Performance Plans and by identifying additional strategies, such as development of Program LCPs and the use of LCCA for all performance objectives.

The primary elements of the LCP Maturity Model are described below:

LEVEL 1

Single Asset Based Needs include the inventory and condition assessment of a single asset over the useful life of the asset, considering the cost of the treatment and deterioration that occurs over time.

LEVEL 2

Project Level LCCA includes performing a project-level LCCA compliant with environmental, economic, and legislative requirements that considers treatments evaluated over an analysis period, taking into account traffic and user costs. A strong LCCA policy would be strategically implemented across all assets and programs.

LEVEL 3

Corridor LCP includes elements of Level 2, but includes a strong LCP Policy that will focus on improving and preserving major corridors and Strategic Highway Network (STRAHNET) routes. Investment strategies are considered for long-term asset investment needs and maximize performance with constrained funding. At this level, multi-asset investment decisions are incorporated, and performance gaps are eliminated. Internal and external stakeholders are emphasized. Reducing the annual cost of preservation through more research and innovated practices is prevalent and risk sharing is stressed between public and private sector.

LEVEL 4

Network Level LCP includes Level 2 and 3 elements, but considers long-term focus on improving and preserving the system and network conditions achieved through different levels of funding where conditions are optimized with multi-asset investment. Improvements to policy through research and partnerships are emphasized.

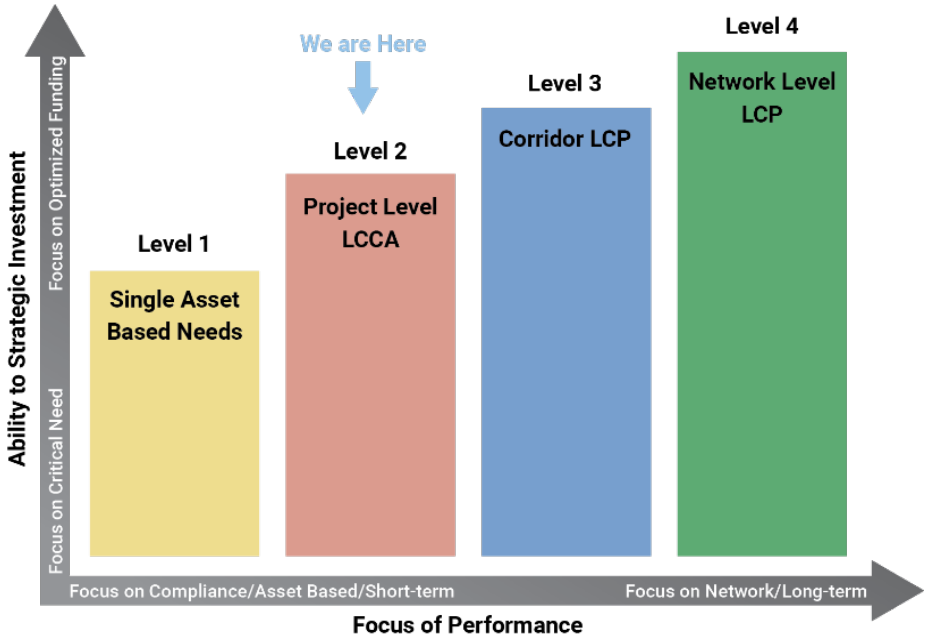


Figure 6-4. Life Cycle Planning Maturity Model

6.2 Cost Effectiveness

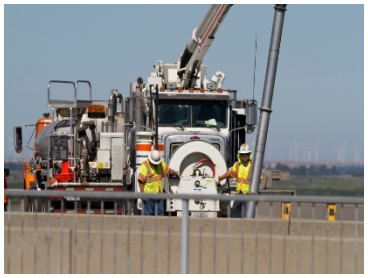
California Government Code requires Caltrans to identify strategies to control costs associated with the SHS maintenance. Figure 6-5 identifies a number of strategies being used in the SHOPP or the Maintenance Program for each asset class:

Pavements

- Improve effectiveness of pavement projects through detailed selection of project limits and treatment combinations.
- Perform life cycle cost analysis in design.
- Use appropriate 3 to 20 year cycle of preservation treatments.
- Recycled materials to reduce the impact on new materials and the environment while maintaining the same or better performance.

Bridges

- Select new materials that last longer and are easier to apply.
- Establish policies to ensure that new projects are built with cost-effective and easily maintained elements.
- Implement accelerated bridge construction (ABC) techniques where appropriate to minimize the impact of the construction on the traveling public.



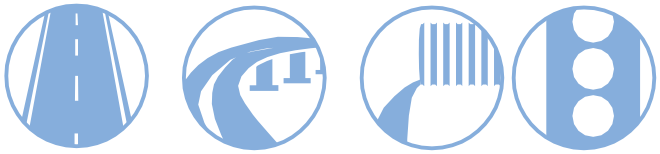
Culverts

- Use remote controlled cameras and equipment for culvert inspections to reduce worker exposure.
- Clean ditches and culverts on an annual basis to prolong the service life of the culverts.
- Use trenchless culvert replacement and lining techniques to help minimize disruptions to the ground surface and the infrastructure above it.

Transportation Management Systems

- Execute on-call service contracts to supplement state forces which help to minimize administrative costs.
- Implement Trouble Ticket system to ensure problems are reported as expeditiously as possible, and minimizes inaccurate trouble reporting, and duplication of efforts.

Figure 6-5. Cost Effective Strategies Used in the SHOPP and Maintenance Programs for Maintaining the SHS



7 Risk Management

Risk management strengthens life cycle planning and asset management by explicitly recognizing that any objective faces uncertainty and by identifying strategies to reduce either uncertainty or its effects. As a result, it leads to better decision making.

Being proactive rather than reactive in managing risk, and avoiding "management by crisis," helps Caltrans to best use available resources to address, minimize, and respond to risk thereby increasing public trust.

CLIMATE CHANGE AND EXTREME WEATHER EVENTS HAVE RECEIVED INCREASING ATTENTION WORLD-WIDE AS POTENTIALLY ONE OF THE GREATEST CHALLENGES FACING MODERN SOCIETY.

Climate Change has various implications worldwide. In California and the west, the following general climate trends are expected:

- More severe droughts, less snowpack, and changes in water availability
- Rising sea levels, more severe storm impacts and coastal erosion
- Increased temperatures and more frequent, longer heat waves
- Longer and more severe wildfire seasons

7.1 Risk Management at Caltrans

Caltrans is actively engaged in improving approaches to risk management, in part, through the Office of Innovation, Risk, and Strategic Management that performs biennial enterprise risk assessments. The most recent Enterprise Risk Management Report was published in 2017 and is based on the International Standards Organization (ISO) 31000 Risk Management Standard. The current policy for Risk Management requires communication of risks across project milestones and its management rather than passing the risk on to the next phase. It is important that the risks are scalable to the project's size and complexity and are integrated into the project delivery process. The following Division Offices have implemented specific risk management approaches to mitigate project delivery risks, information technology risks, emergency risk, and safety risks. Their risk management approaches are codified in handbooks, guidance, and tools.

Risk Management at Caltrans

- **Enterprise Risk Management**–Director's Office of Innovation, Risk, and Strategic Management
- **Project Risk Management**–Project Delivery
- **Information Technology Security**–Information Technology
- **Emergency Risk Management**–Maintenance and Operations
- **Safety Risk Management**–Office of Health and Safety

7.2 Major Transportation System Risks

Caltrans has to manage a variety of risks; however, a number of these risks need to be considered during the development of asset management plans. The 2018 TAMP identified the following risks as those which should be associated with asset and system performance management.

Asset and System Performance Risks

- Consistency and reliability of state and federal revenues over the plan period
- Construction inflation which can increase costs and reduce buying power
- Reliable project delivery
- Natural events such as floods, fires, and earthquakes, and the negative impacts of climate change
- Lack of asset management maturity
- Changing priorities that drive investment and project decision making
- Incomplete inventory and condition assessment of assets, such as pedestrian and bicycle infrastructure
- Availability and quality of data, models, and information

These risks were identified as part of an initial risk register. A risk register is a simple spreadsheet or matrix that summarizes an organization's risks, shows how they are analyzed, and records how they will be managed. This assessment will prioritize which of these risks can be mitigated through risk mitigation strategies.

Prioritizing Caltrans' risks also includes reviewing the likelihood and significance of the risks and groups the risks into low, medium, high, and very high categories, similar to Figure 7-1, which is based on the National Cooperative Highway Research Project 08-93, "Managing Risk Across the Enterprise: A Guidebook for State Departments of Transportation"[35].

	Likelihood Rating				
Aggregate Impact (actions across all impact types)	**Rare**	**Unlikely**	**Possible**	**Likely**	**Very Likely**
Very Significant	M	M	H	VH	VH
Major	L	M	M	H	VH
Moderate	L	M	M	M	H
Minor	L	L	L	M	M
Insignificant	L	L	L	L	M
L: Low; M: Medium; H: High; VH: Very High					

Figure 7-1. Risk Assessment Model

[35] National Cooperative Highway Research Project 08-93, "*Managing Risk Across the Enterprise: A Guidebook for State Departments of Transportation*", 2016, http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3635

One example of an immediate risk that could be categorized as a high financial and operational risk to Caltrans is the influx of funding from SB 1. SB 1 increases risks associated with project delivery and construction demands, as increased construction demand could drive up construction costs and impede project delivery if supply does not expand. Mitigation actions have not only included increased communication with general contractors to inform them of the additional expected type and cost of work, but Caltrans also implemented an SB 1 website that provides mapping of upcoming construction work locations.

Natural events such as floods, fire, slides, and earthquakes are unpredictable risks and have the potential to cause extensive damage to transportation infrastructure. The uncertainty of changing climate and rising seas also poses numerous risks to the transportation network. These negative impacts along with others could have a cascading effect, including increased erosion rates, exacerbated bridge scour, intensified and enlarged geo-hazards, and expanded areas vulnerable to flooding. These are all examples of risk that could cause huge relocation, resilience, and reconstruction costs.

As described in Section 5.1, (System Resiliency and Climate Change), Caltrans has completed the first vulnerability assessment report to identify vulnerabilities and assess the impacts and risk to the SHS[36]. This report is the first of 12 studies that will eventually cover each Caltrans district. With the completion of this study, Caltrans now has an approach to vulnerability. The vulnerability assessment process proposed in the report is presented in Figure 7-2. It was developed to help guide future planning and programming processes. It outlines actions to be taken to achieve long-term highway system resiliency.

Although this report provides valuable information, it does not identify projects to be implemented, nor presents costs associated with those changes. Caltrans plans to implement these strategies in subsequent planning and design processes.

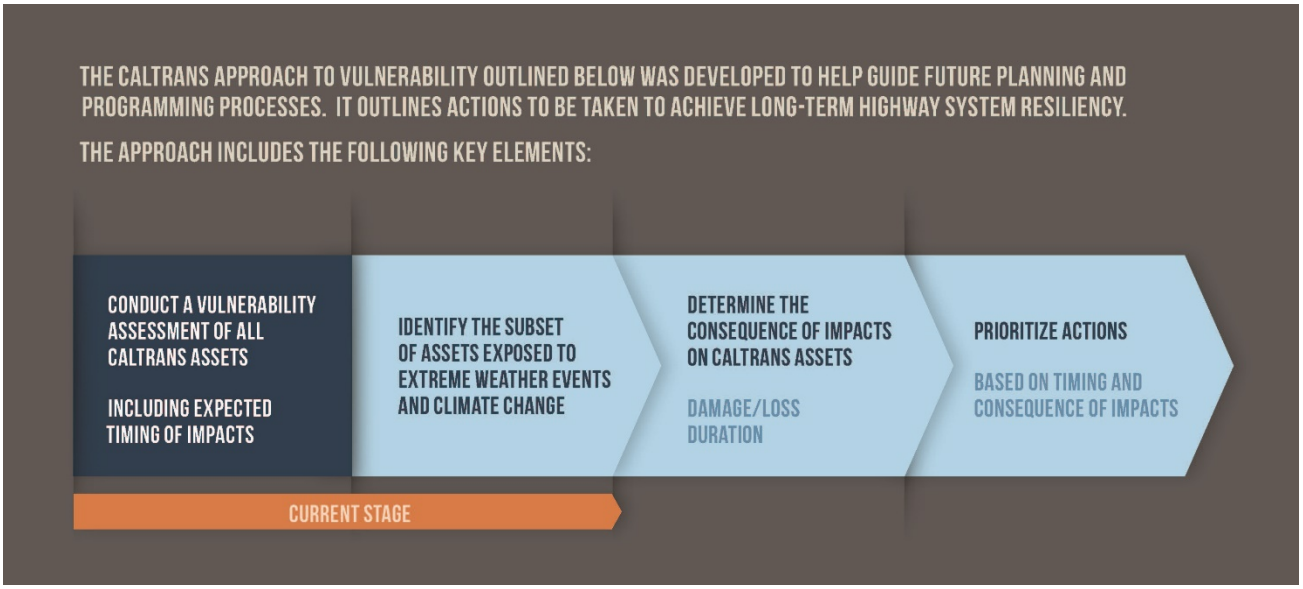


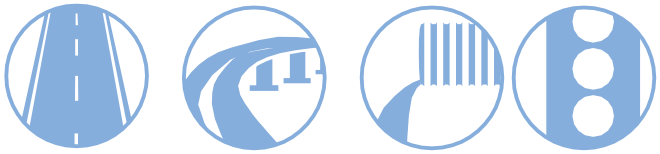
Figure 7-2. Vulnerability Assessment Process

[36] Caltrans Climate Change Vulnerability Assessment Summary Report District 4, 2018, http://www.dot.ca.gov/transplanning/ocp/docs/D4_Caltrans_Vulnerability_Assessment_v49.pdf

7.3 Incorporating Risk into Asset Management Practices

While current Caltrans enterprise risk management practices are fairly mature and well aligned with industry best practice, the application to asset management continues to evolve. Moving forward, asset management practices will be adapted to incorporate risk factors as statewide vulnerability assessments are completed, life cycle planning methods and models mature, agency and/or political priorities are clarified, and availability and quality of data and models improve. These risks all have the potential of negatively impacting decision making, either through underdeveloped processes, misaligned priorities, or lack of supporting data. To proactively address these risks, Caltrans, along with other California state and local agencies, has participated in several risk management efforts to identify, assess, prioritize, mitigate, and monitor risks. For additional information on the work completed, refer to the 2018 California TAMP[37], Caltrans Structure Policy Directives[38], Caltrans Improvement Projects (CIP)[39], and the Caltrans Project Risk Management Handbook and Tools[40]. The asset management function in Caltrans is planning to build upon the current state of knowledge and initiate research studies where the goal is to incorporate risk into asset management practices.

[37] 2018 California TAMP http://www.dot.ca.gov/assetmgmt/tam_plan.html
[38] Caltrans Structure Policy Directives http://www.dot.ca.gov/des/techpubs/structure_policy_directives/
[39] Caltrans Improvement Projects, http://www.dot.ca.gov/ctcip/index.html
[40] Caltrans Project Management, http://www.dot.ca.gov/hq/projmgmt/guidance_prmhb.htm



8 Conclusion

The SHSMP presents a performance driven and integrated management plan for the SHS that considers needs, investments, and resulting performance projections for the 10-year period spanning July 2019 – June 2029. The SHSMP builds from the Caltrans Strategic Management Plan to align California's investments in transportation infrastructure with strategic goals, while addressing state and federal requirements. The Plan expands upon a framework introduced in 2017 and strengthens integration with the 2018 California TAMP.

The SHSMP implements a performance-based asset management approach comprised of several key analysis steps. These steps include defining the inventory and condition of assets, establishing condition targets, determining the magnitude of condition gaps, developing cost estimates to close the gaps to determine needs, and producing a constrained investment plan.

The Needs Assessment provides a comprehensive picture of the total needs on the SHS, unconstrained by currently available funding. The majority of the SHS needs is determined through a gap analysis, considering projected asset condition, project work underway, and performance targets. The 10-year SHOPP need for the 2019 SHSMP is estimated at $83.3 billion, a decrease of about 3% from the prior 2017 SHSMP. Maintenance needs constitute $7.1 billion over the 10-year Plan period. Combined, the total SHOPP and Maintenance needs are estimated to be $90.4 billion.

The SHSMP presents an Investment Plan that defines the distribution of available funding from the SHA and the RMRA established in 2017 through SB 1. These accounts are used to fund maintenance, operations, and capital projects including asset management-related activities. The SHOPP and the HM jointly fund maintenance, preservation, rehabilitation, and replacement projects; all are intended to maintain or improve asset condition. The SHOPP is the single largest funding source available to address rehabilitation needs on the SHS. The SHOPP Investment Plan is approximately $47.1 billion over the 10-year Plan period.

Maintenance and SHOPP funds are committed to treatments and strategies that extend the service life of existing assets. In the SHSMP, approximately 69 percent of available SHOPP funding is focused on fixing the existing transportation system, 13 percent for safety improvement, 8 percent for sustainability initiatives, and 10 percent for system performance improvements. The SHSMP fully implements the performance management requirements of MAP-21 and the FAST Act. This strategic way of looking at performance-based infrastructure management has resulted in a plan that is consistent in approach across assets and deficiencies in addition to being fully transparent in its analysis. The performance management approach implemented in this Plan supports the ongoing implementation of Transportation Asset Management in California. Together, these pieces along with others are building the structure for sound asset management of the state highway system in California.

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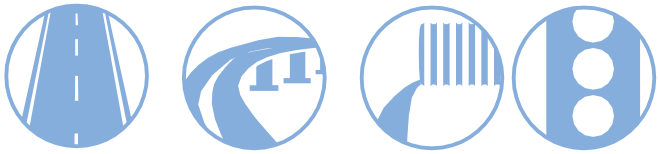

Appendices

Appendix A: Statutory Requirements

The State Highway System Management Plan incorporates guidance from many sources. The Appendix includes summaries or links to the most influential guiding documents for preparing the SHSMP. It lists federal and state legislation, including Senate Bills 1 and 486, and the Commission TAMP Guidelines and Actions which directed the state specific aspects of the Plan.

Americans with Disabilities Act (ADA)

Governs accessibility services and facility requirements for individuals with disabilities.

42 U.S.C. Section 12101 et seq.
http://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title42-section12101&num=0&edition=prelim

California Endangered Species Act (CESA)

Protects and preserves all native species threatened by extinction or experiencing a significant decline which, if not halted, would lead to a threatened or endangered designation.

Fish and Game Code sections 2050-2069
http://www.leginfo.ca.gov/cgi-bin/displaycode?section=fgc&group=02001-03000&file=2050-2069

California Environmental Quality Act (CEQA)

CEQA requires state and local agencies to identify the significant environmental impacts associated with their activities and to mitigate those impacts.

Public Resources Code Section 21000-21177
http://leginfo.legislature.ca.gov/faces/codes_displayexpandedbranch.xhtml?tocCode=PRC&division=13.&title=&part=&chapter=&article=

California Ocean Plan

The California Ocean Plan contains standards that protect the beneficial uses of California's marine waters through establishing water quality objectives and implementation provisions in statewide water quality control plans and polices.

https://www.waterboards.ca.gov/water_issues/programs/ocean/

Capital Improvement Projects

Amends California Government Code section 14526.5 to include capital improvement projects relative to the operation of state highways and bridges.

Assembly Bill 2289, Chapter 76, Statutes of 2016
http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB2289

California Transportation Commission: Interim SHOPP Guidelines, Resolutions, and Delegations

The guidelines, resolutions, and delegations describe the policy, standards, criteria and procedures for the development, adoption, and management of the SHOPP by the Commission. This includes requirements for the SHSMP and TAMP.

Interim State Highway Operation and Protection Program Guidelines (October 2017)
http://www.catc.ca.gov/programs/shopp/docs/Interim_SHOPP_Guidelines_101817.pdf
Commission Resolutions G-00-13, G-06-13, G-05-05, G-05-16, G-16-11, and G-16-12
http://www.dot.ca.gov/hq/transprog/ctcliaison/resolutions/greshtml/index.htm
Transportation Asset Management Plan and Performance Measures (March 26, 2015)
http://catc.ca.gov/meetings/2015/2015-03/pinks/Tab_26_4.19_BI.pdf

Federal Comprehensive Environmental Response Compensation and Liability Act (CERCLA)

Governs hazardous waste site cleanup resulting from accidents, spills, and other emergency releases of pollutants and contaminants into the environment.

42 U.S.C. Section 9601 et seq.
http://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title42-section9601&num=0&edition=prelim

Federal Endangered Species Act

Governs conservation of threatened and endangered ecosystems that species of fish, wildlife, and plants depend.

16 U.S.C. Section 1531 et seq.
http://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title16-section1531&num=0&edition=prelim

Federal Water Pollution Control Act (Clean Water Act)

Governs surface water pollution as enforced by the Environmental Protection Agency (EPA).

33 U.S.C. Section 1251
http://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title33-section1251&num=0&edition=prelim

Fish and Wildlife Protection and Conservation

Requires written notification when an activity/project may substantially divert or obstruct the natural flow of any river, stream, or lake.

Fish and Game Code Section 1602
http://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?sectionNum=1602.&lawCode=FGC

Fish Passage

Senate Bill 857 requires Caltrans to prepare an annual report to the Legislature regarding fish passage. Caltrans is tasked with locating, assessing, and remediating fish passage barriers. SB 857 adds Article 3.5 (commencing with Section 156) to Chapter 1 of Division 1 of, the Streets and Highways Code, relating to fish passages. Transportation projects will be assessed for fish passage barriers and designed to remediate barriers or not create new barriers to fish on the SHS.

Senate Bill 857, Chapter 589, Statutes of 2005
http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200520060SB857

Fixing America's Surface Transportation Act, PL 114-94

On December 4, 2015, the Fixing America's Surface Transportation Act, or "FAST Act," was signed into law. It is the first law enacted in over 10 years that provides long-term funding certainty for surface transportation, meaning States and local governments can move forward with critical transportation projects, like new highways and transit lines, with the confidence that they will have a federal partner over the long term. The FAST Act continues asset management requirements and added critical infrastructure to the considerations a State may include in its asset management plan [23 U.S.C. 119(j)(2)].

Public Law 114-94
https://www.gpo.gov/fdsys/pkg/PLAW-114publ94/html/PLAW-114publ94.htm

Highway Users Tax Account (HUTA)

Explains fuel tax revenue uses and establishes county apportionment amounts in accordance with various tax laws.

Streets and Highways Code sections 2104-2108
http://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=SHC&division=3.&title=&part=&chapter=3.&article=

Moving Ahead for Progress in the 21st Century Act (MAP-21)

MAP-21 authorizes the federal surface transportation programs for highways, highway safety, and transit and provides funding of over $105 billion for the federal fiscal years 2013 and 2014. It covers a variety of transportation related issues including financing, state and metropolitan transportation planning, congestion relief, improved safety, expedited project delivery, consolidation of federal programs, goods movement, and transportation related research and studies.

Public Law 112-141
https://www.gpo.gov/fdsys/pkg/PLAW-112publ141/html/PLAW-112publ141.htm

National Pollutant Discharge Elimination System (NPDES)

Governs construction and maintenance activities that impact storm water quality.

33 U.S.C. Section 1342
http://uscode.house.gov/view.xhtml?req=(title:33%20section:1342%20edition:prelim)%20OR%20(granuleid:USC-prelim-title33-section1342)&f=treesort&edition=prelim&num=0&jumpTo=true

Pavement and Bridge Performance Management

The Pavement and Bridge Performance Management Final Rule was established to implement MAP-21 and FAST Act performance management requirements.

23 Code of Federal Regulations Part 490
https://www.federalregister.gov/documents/2017/01/18/2017-00681/national-performance-management-measures-assessing-performance-of-the-national-highway-system

Railroad Crossings

Outlines construction practices surrounding railroad crossings, including policy development by CTC in consultation with Caltrans.

Public Utilities Code sections 1201-1220
http://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=PUC&division=1.&title=&part=1.&chapter=6.&article=

Railway-Highway Crossings

Requires states to make safety improvements at public railroad-highway crossings and submit an annual progress report to FHWA.

23 U.S.C. Section 130
http://uscode.house.gov/view.xhtml?req=(title:23 U.S.C. section:130 edition:prelim) OR (granuleid:USC-prelim-title23 U.S.C. -section130)&f=treesort&edition=prelim&num=0&jumpTo=true

Resource Conservation and Recovery Act (RCRA)

Governs hazardous and non-hazardous solid waste management.

42 U.S.C. Section 6901 et seq.
http://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title42-section6901&num=0&edition=prelim

Road Repair and Accountability Act of 2017

SB 1 provides the first significant, stable, and on-going increase in state transportation funding in more than two decades.

Senate Bill 1, Chapter 5, Statutes of 2017
https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1

Safety Roadside Rest Areas

Streets and Highways Code Section 218 requires the Commission and Caltrans to plan, design, and construct safety roadside rest areas outside the state park system units. In addition, Caltrans must maintain safety roadside rest areas on the State Highway System.

Streets and Highways Code Section 218 et seq.
http://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=SHC&division=1.&title=&part=&chapter=1.&article=7

State Highway Operation and Protection Program (SHOPP)

The State Highway Operation and Protection Program (SHOPP) is a four-year document of projects that is adopted by the California Transportation Commission (Commission). California Government Code requires Caltrans to prepare a state highway operation and protection program and submit to the Commission for adoption no later than January 31 of each even-numbered year.

California Government Code Section 14526.5
http://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?sectionNum=14526.5.&lawCode=GOV

State Highway System Management Plan (SHSMP)

The State Highway System Management Plan (SHSMP) presents a performance driven and integrated management plan for the State Highway System (SHS) in California.

Streets and Highways Code Section 164.6 requires Caltrans to prepare a 10-year state rehabilitation plan and a five-year maintenance plan that addresses rehabilitation and maintenance needs of the state highway system.

Assembly Bill 515
http://uscode.house.gov/view.xhtml?req=(title:23%20section:130%20edition:prelim)%20OR%20(granuleid:USC-prelim-title23-section130)&f=treesort&edition=prelim&num=0&jumpTo=true
Streets and Highways Code Section 164.6
http://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?sectionNum=164.6.&lawCode=SHC

Statewide Potable Urban Water Usage Reduction

Requires State Water Resources Control Board (SWRCB) to reduce statewide water usage by 25 percent.

Executive Order B-29-15
https://www.gov.ca.gov/docs/4.1.15_Executive_Order.pdf

Surface Mining and Reclamation Act of 1975 (SMARA)

SMARA establishes surface mining and reclamation policy to regulate surface mining operations to minimize adverse environmental impacts and ensure reclaimed mined lands are in a usable condition.

Public Resources Code Section 2710 et. seq.
http://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=PRC&division=2.&title=&part=&chapter=9.&article=1

Transportation Asset Management Plan (TAMP)

The Transportation Asset Management Plan (TAMP) Final Rule establishes the processes State departments of transportation must use to develop a TAMP. Each state is required to develop a risk-based TAMP for the National Highway System (NHS) to improve or preserve the assets' condition and the performance of the system in accordance with Moving Ahead for Progress in the 21st Century (MAP-21) § 1106(a), codified as 23 U.S.C. 119 (e) and (t).

Senate Bill 486 requires that Caltrans in consultation with the California Transportation Commission prepare a robust asset management plan to guide the selection of projects in the State Highway Operation and Protection Program (SHOPP).

23 Code of Federal Regulations Part 515
https://www.federalregister.gov/documents/2016/10/24/2016-25117/asset-management-plans-and-periodic-evaluations-of-facilities-repeatedly-requiring-repair-and
Senate Bill 486, Section 6, Statutes of 2014
https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1

Appendix B: Performance Management Summary Sheets

The Performance Management Summary Sheets included in Appendix B summarize the inventory and conditions, deterioration rates, pipelined work, desired state of repair targets, unit costs to address needs, statewide cost, and district-level breakdowns for each of the 32 Performance Objectives identified in the 2019 SHSMP. Table B-1 identifies the page number in which each Summary Sheet is in the appendix. The Summary Sheets are separated into sections (A-K). Table B-2 provides a description for each section.

Table B-1.
Performance Management Summary Sheets – Page Numbers

Table B-2.
Performance Management Summary Sheets - Legend

Description
A. **Baseline Inventory** The total quantity of physical assets or asset/performance deficiencies at the start of the 10-year Plan period.
B. **Projected Inventory** The total quantity of physical assets or asset/performance deficiencies expected at the end of the 10-year Plan period, resulting from the addition of new assets from the pipeline.
C. Baseline Performance The breakdown of the Baseline Inventory (A) by quantity and percentage in terms of good, fair, and poor performance measures. Asset/performance deficiencies are reported as poor.
D. **Desired State of Repair (DSOR) Target Performance** The fiscally-unconstrained performance target, with a breakdown of the Projected Inventory (B) inventory by quantity and percentage in terms of good, fair, and poor performance measures.
E. **Effective Deterioration** The effective deterioration of a physical asset in a 10-year do-nothing scenario is presented as an average annual rate. The "Into Fair" average annual rate represents the percentage of the Baseline Performance (C) good-condition assets which deteriorate into a fair condition per year. The "Into Poor" average annual rate represents the percentage of the Baseline Performance (C) fair-condition assets which deteriorate into a poor condition per year. The "10-Year Deterioration" column represents the sum of the annual deteriorations using a simple, non-compound rate calculation.
F. Projected Performance The projected future condition of a physical asset in a 10-year do-nothing scenario is determined using the Baseline Performance (C) and adding/subtracting the Effective Deterioration (E).
G. Pipelined Projects Performance Committed projects which improve the condition of physical assets or remove asset/performance deficiencies, and their accomplishments are not reflected in the baseline performance, regardless of fund source. The performance of pipelined projects is quantified by performance measures (fair, poor, new) and fund source or maintenance strategy.
H. **Performance Gap** The difference between the Projected Performance (F) and the DSOR Target Performance (D), subtracting the Pipelined Projects Performance (G) and excluding negative district-level gaps in the District Breakdown (K). A fair, poor, or new gap in each district is the estimated work which should be accomplished in addition to the pipelined projects to ensure that the district will reach the statewide DSOR target performance at the end of the 10-year Plan period.

Table B-2.
Performance Management Summary Sheets - Legend

	Description
I.	**Average Capital Unit Cost and Support Ratio** These costs are presented by performance measures (fair, poor, new) and maintenance strategy (SHOPP, HM). These are the escalated costs to the midpoint of the last five years of the Plan. Capital unit costs include material, labor, mobilization, traffic control, contingency, supplemental work, right of way, state-furnished material and labor, and any other construction costs. Support costs include Project Approval and Environmental Documentation (PA&ED), Plan, Specification and Estimate (PS&E), right of way support, and construction support costs.
J.	**Estimated SHOPP and Maintenance Costs for 10 Years** The 10-year total of SHOPP and Maintenance needs in the SHSMP is summarized in this section. This total includes both the cost of the unfunded pipelined projects (in the first five-years) and the performance gap for the SHOPP (last five-years) and Maintenance (all 10-years). The cost of unfunded pipelined SHOPP projects consists of: the total (escalated capital and support) cost of programmed SHOPP projects with an Ready to List (RTL) FY 2019/20, 2020/21, and 2021/22; the total (escalated capital and support) cost of SHOPP projects in the SHOPP Ten-Year Project Book with an RTL FY 2022/23 and 2023/24, and the PA&ED cost of long lead projects with an RTL FY within the SHSMP. The cost of unfunded pipelined Maintenance work is typically zero, because Maintenance allocations are determined annually.
K.	**District Breakdown** This section presents a district-level breakdown of inventory, gaps, total (capital and support) unit costs, and performance gap costs. The performance gap costs include the costs to address the gap through the SHOPP, Maintenance, and other programs.

Note: A negative gap in a district indicates that the projected future performance of this objective in the district, after accounting for the accomplishments of pipelined projects, will surpass the statewide DSOR target performance at the end of the Plan.

Bridge Rail Replacement and Upgrade

(A) Baseline Inventory

8,605,742	Linear Feet

(B) Projected Inventory (in 2029)

8,605,742	Linear Feet

(C) Baseline Performance

Good	5,360,733	62.3%
Fair	2,788,515	32.4%
Poor	456,494	5.3%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	8,605,742	100.0%
Fair	0	0.0%
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	0.00%	0
Into Poor	0.00%	0

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	5,360,733	62.3%
Fair	2,788,515	32.4%
Poor	456,494	5.3%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	274,988
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	71,897
	Total	**346,885**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	119,764
	Maintenance through 2018/19	1,606
	Other (STIP, Local, etc.)	21,211
	Total	**142,581**
Add New	Any SHOPP or 2020 PID Work Plan	0

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	2,441,630	488,326/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**2,441,630**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	313,913	62,783/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**313,913**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	$1,872	40.0%
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$1,872	40.0%
	Maintenance	N/A	N/A
Add New	SHOPP	$1,872	40.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$753,699,105
	5-Year Performance Gap	$7,221,806,014
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$7,975,505,119**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	287,040	$2,621	$752,282,653	0	$2,621	94,863	$2,621	29,477	$2,621	$325,873,833
D2	286,488	$2,621	$750,835,956	0	$2,621	86,132	$2,621	8,573	$2,621	$248,205,576
D3	851,982	$2,621	$2,232,898,827	0	$2,621	321,747	$2,621	39,276	$2,621	$946,179,418
D4	1,829,285	$2,621	$4,794,242,519	0	$2,621	411,166	$2,621	71,649	$2,621	$1,265,375,380
D5	361,471	$2,621	$947,353,549	0	$2,621	103,470	$2,621	39,718	$2,621	$375,271,211
D6	429,912	$2,621	$1,126,725,682	0	$2,621	99,356	$2,621	15,434	$2,621	$300,844,920
D7	1,805,429	$2,621	$4,731,720,031	0	$2,621	539,629	$2,621	88,153	$2,621	$1,645,309,046
D8	785,091	$2,621	$2,057,588,978	0	$2,621	228,405	$2,621	2,628	$2,621	$605,497,903
D9	44,976	$2,621	$117,874,389	0	$2,621	10,779	$2,621	157	$2,621	$28,661,382
D10	397,891	$2,621	$1,042,804,129	0	$2,621	165,692	$2,621	8,212	$2,621	$455,772,584
D11	959,817	$2,621	$2,515,515,883	0	$2,621	299,144	$2,621	8,651	$2,621	$806,677,951
D12	566,360	$2,621	$1,484,332,509	0	$2,621	81,247	$2,621	1,985	$2,621	$218,136,809
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**8,605,742**	**N/A**	**$22,554,175,105**	**0**	**N/A**	**2,441,630**	**N/A**	**313,913**	**N/A**	**$7,221,806,014**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Collision Severity Reduction

(A) Baseline Inventory

5,356	Fatal / Serious Injury Collisions

(B) Projected Inventory (in 2029)

5,356	Fatal / Serious Injury Collisions

(C) Baseline Performance

Good	N/A	N/A
Fair	N/A	N/A
Poor	5,356	100.0%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	343	6.4%
Fair	N/A	N/A
Poor	5,013	93.6%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	N/A	N/A

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	N/A	N/A
Fair	N/A	N/A
Poor	5,356	100.0%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	98
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**98**
Add New	Any SHOPP or 2020 PID Work Plan	N/A

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	248	50/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**248**	**N/A**
Add New	SHOPP for the Last 5 Years	N/A	N/A

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$1,034,717	48.0%
	Maintenance	N/A	N/A
Add New	SHOPP	N/A	N/A

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$893,687,327
	5-Year Performance Gap	$379,782,440
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$1,273,469,767**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	198	N/A	N/A	N/A	N/A	N/A	N/A	11	$1,531,381	$16,845,189
D2	145	N/A	N/A	N/A	N/A	N/A	N/A	7	$1,531,381	$10,719,666
D3	438	N/A	N/A	N/A	N/A	N/A	N/A	18	$1,531,381	$27,564,855
D4	802	N/A	N/A	N/A	N/A	N/A	N/A	27	$1,531,381	$41,347,282
D5	276	N/A	N/A	N/A	N/A	N/A	N/A	14	$1,531,381	$21,439,331
D6	401	N/A	N/A	N/A	N/A	N/A	N/A	25	$1,531,381	$38,284,520
D7	1,006	N/A	N/A	N/A	N/A	N/A	N/A	49	$1,531,381	$75,037,660
D8	803	N/A	N/A	N/A	N/A	N/A	N/A	38	$1,531,381	$58,192,471
D9	56	N/A	N/A	N/A	N/A	N/A	N/A	-3	$1,531,381	$0
D10	401	N/A	N/A	N/A	N/A	N/A	N/A	14	$1,531,381	$21,439,331
D11	486	N/A	N/A	N/A	N/A	N/A	N/A	25	$1,531,381	$38,284,520
D12	344	N/A	N/A	N/A	N/A	N/A	N/A	20	$1,531,381	$30,627,616
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**5,356**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**248**	**N/A**	**$379,782,440**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Roadside Safety Improvements

(A) Baseline Inventory

18,862	Locations

(B) Projected Inventory (in 2029)

18,862	Locations

(C) Baseline Performance

Good	N/A	N/A
Fair	N/A	N/A
Poor	18,862	100.0%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	18,862	100.0%
Fair	N/A	N/A
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	N/A	N/A

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	N/A	N/A
Fair	N/A	N/A
Poor	18,862	100.0%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	8,669
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**8,669**
Add New	Any SHOPP or 2020 PID Work Plan	N/A

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	10,223	2,045/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**10,223**	**N/A**
Add New	SHOPP for the Last 5 Years	N/A	N/A

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$62,737	49.4%
	Maintenance	N/A	N/A
Add New	SHOPP	N/A	N/A

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$744,239,884
	5-Year Performance Gap	$958,372,515
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$1,702,612,399**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	214	N/A	N/A	N/A	N/A	N/A	N/A	-30	$93,747	$0
D2	233	N/A	N/A	N/A	N/A	N/A	N/A	24	$93,747	$2,249,921
D3	1,108	N/A	N/A	N/A	N/A	N/A	N/A	655	$93,747	$61,404,089
D4	2,750	N/A	N/A	N/A	N/A	N/A	N/A	1,916	$93,747	$179,618,677
D5	646	N/A	N/A	N/A	N/A	N/A	N/A	238	$93,747	$22,311,715
D6	1,568	N/A	N/A	N/A	N/A	N/A	N/A	1,185	$93,747	$111,089,840
D7	5,763	N/A	N/A	N/A	N/A	N/A	N/A	2,702	$93,747	$253,303,584
D8	1,872	N/A	N/A	N/A	N/A	N/A	N/A	1,174	$93,747	$110,058,626
D9	110	N/A	N/A	N/A	N/A	N/A	N/A	78	$93,747	$7,312,243
D10	622	N/A	N/A	N/A	N/A	N/A	N/A	158	$93,747	$14,811,979
D11	2,092	N/A	N/A	N/A	N/A	N/A	N/A	1,011	$93,747	$94,777,914
D12	1,884	N/A	N/A	N/A	N/A	N/A	N/A	1,082	$93,747	$101,433,930
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**18,862**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**10,223**	**N/A**	**$958,372,515**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Safety Improvements

(A) Baseline Inventory

N/A	N/A

(B) Projected Inventory (in 2029)

N/A	N/A

(C) Baseline Performance

Good	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(D) Desired State of Repair (DSOR) Target Performance

Good or New	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	N/A	N/A

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Add New	Any SHOPP or 2020 PID Work Plan	N/A

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Add New	SHOPP for the Last 5 Years	N/A	N/A

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Add New	SHOPP	N/A	N/A

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$1,789,118,800
	5-Year Performance Gap	$1,250,000,000
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$3,039,118,800**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Bridge and Tunnel Health

(A) Baseline Inventory

251,190,698	Square Feet

(B) Projected Inventory (in 2029)

251,190,698	Square Feet

(C) Baseline Performance

Good	165,605,196	65.9%
Fair	77,268,169	30.8%
Poor	8,317,333	3.3%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	209,744,232	83.5%
Fair	37,678,605	15.0%
Poor	3,767,861	1.5%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	0.45%	7,452,234
Into Poor	0.75%	5,795,113

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	158,152,962	63.0%
Fair	78,925,290	31.4%
Poor	14,112,446	5.6%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	8,865,396
	Maintenance through 2018/19	11,621,110
	Other (STIP, Local, etc.)	779,611
	Total	**21,266,117**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	1,779,662
	Maintenance through 2018/19	2,344,790
	Other (STIP, Local, etc.)	153,278
	Total	**4,277,730**
Add New	Any SHOPP or 2020 PID Work Plan	0

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	5,746,083	1,149,217/year
	Maintenance for 10 Years	17,238,246	1,723,825/year
	Other	0	N/A
	Total	**22,984,326**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	1,516,714	303,343/year
	Maintenance for 10 Years	4,550,143	455,014/year
	Other	0	N/A
	Total	**6,066,855**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	$408	38.0%
	Maintenance	$34	43.0%
Fix Poor to Good	SHOPP	$517	27.0%
	Maintenance	$34	43.0%
Add New	SHOPP	$681	27.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$1,885,642,473
	5-Year Performance Gap	$4,235,319,721
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$1,059,351,473
	Total	**$7,180,313,667**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	5,937,273	$865	$5,132,968,937	0	$865	742,442	$177	81,847	$201	$148,121,501
D2	5,929,196	$865	$5,125,986,103	0	$865	1,125,984	$177	155,744	$201	$230,985,675
D3	22,383,956	$865	$19,351,670,512	0	$865	1,447,973	$177	481,305	$201	$353,447,515
D4	54,941,630	$865	$47,498,856,822	0	$865	5,650,034	$177	2,286,197	$201	$1,461,086,550
D5	7,655,303	$865	$6,618,262,711	0	$865	411,984	$177	235,380	$201	$120,323,474
D6	10,989,652	$865	$9,500,917,735	0	$865	580,239	$177	278,880	$201	$158,899,778
D7	64,137,472	$865	$55,448,966,466	0	$865	-2,380,731	$177	284,270	$201	$57,060,814
D8	22,273,302	$865	$19,256,006,468	0	$865	2,815,754	$177	652,993	$201	$630,523,251
D9	966,385	$865	$835,471,804	0	$865	32,715	$177	12,296	$201	$8,271,151
D10	9,947,594	$865	$8,600,024,119	0	$865	2,485,677	$177	496,197	$201	$540,501,641
D11	25,750,337	$865	$22,262,018,260	0	$865	331,752	$177	67,246	$201	$72,343,595
D12	20,278,598	$865	$17,531,518,868	0	$865	7,359,772	$177	1,034,500	$201	$1,513,106,249
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**251,190,698**	**N/A**	**$217,162,668,807**	**0**	**N/A**	**22,984,326**	**N/A**	**6,066,855**	**N/A**	**$5,294,671,194**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Drainage Pump Plants

(A) Baseline Inventory

291	Locations

(B) Projected Inventory (in 2029)

291	Locations

(C) Baseline Performance

Good	33	11.3%
Fair	86	29.6%
Poor	172	59.1%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	233	80.1%
Fair	58	19.9%
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	3.03%	10
Into Poor	2.67%	23

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	23	7.9%
Fair	73	25.1%
Poor	195	67.0%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	1
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**1**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	73
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**73**
Add New	Any SHOPP or 2020 PID Work Plan	0

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	20	4/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**20**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	122	24/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**122**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	$707,964	50.0%
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$816,882	50.0%
	Maintenance	N/A	N/A
Add New	SHOPP	$816,882	50.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$124,665,979
	5-Year Performance Gap	$170,728,266
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$295,394,245**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	0	$1,225,322	$0	0	$1,225,322	0	$1,061,946	0	$1,225,322	$0
D2	0	$1,225,322	$0	0	$1,225,322	0	$1,061,946	0	$1,225,322	$0
D3	43	$1,225,322	$52,688,867	0	$1,225,322	-3	$1,061,946	33	$1,225,322	$40,435,642
D4	71	$1,225,322	$86,997,896	0	$1,225,322	6	$1,061,946	30	$1,225,322	$43,131,351
D5	10	$1,225,322	$12,253,225	0	$1,225,322	2	$1,061,946	4	$1,225,322	$7,025,182
D6	74	$1,225,322	$90,673,864	0	$1,225,322	5	$1,061,946	35	$1,225,322	$48,196,018
D7	52	$1,225,322	$63,716,769	0	$1,225,322	1	$1,061,946	11	$1,225,322	$14,540,493
D8	2	$1,225,322	$2,450,645	0	$1,225,322	1	$1,061,946	0	$1,225,322	$1,061,946
D9	0	$1,225,322	$0	0	$1,225,322	0	$1,061,946	0	$1,225,322	$0
D10	21	$1,225,322	$25,731,772	0	$1,225,322	-2	$1,061,946	4	$1,225,322	$4,901,290
D11	5	$1,225,322	$6,126,612	0	$1,225,322	1	$1,061,946	0	$1,225,322	$1,061,946
D12	13	$1,225,322	$15,929,192	0	$1,225,322	4	$1,061,946	5	$1,225,322	$10,374,397
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**291**	**N/A**	**$356,568,842**	**0**	**N/A**	**20**	**N/A**	**122**	**N/A**	**$170,728,266**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Drainage Restoration

(A) Baseline Inventory

20,984,702	Linear Feet

(B) Projected Inventory (in 2029)

20,990,692	Linear Feet

(C) Baseline Performance

Good	14,530,820	69.2%
Fair	4,399,719	21.0%
Poor	2,054,163	9.8%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	16,792,554	80.0%
Fair	2,099,069	10.0%
Poor	2,099,069	10.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	2.00%	2,906,164
Into Poor	2.00%	879,944

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	11,630,646	55.4%
Fair	6,425,939	30.6%
Poor	2,934,107	14.0%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	43,331
	Maintenance through 2018/19	11,907
	Other (STIP, Local, etc.)	0
	Total	**55,238**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	330,794
	Maintenance through 2018/19	28,823
	Other (STIP, Local, etc.)	0
	Total	**359,617**
Add New	Any SHOPP or 2020 PID Work Plan	5,990

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	2,263,964	452,793/year
	Maintenance for 10 Years**	2,007,668	200,767/year
	Other	0	N/A
	Total	**4,271,632**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	484,733	96,947/year
	Maintenance for 10 Years	234,393	23,439/year
	Other	0	N/A
	Total	**719,126**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	$485	53.9%
	Maintenance**	$113	61.0%
Fix Poor to Good	SHOPP	$2,042	53.9%
	Maintenance	$35	0.0%
Add New	SHOPP	$2,042	53.9%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$1,394,557,391
	5-Year Performance Gap	$3,211,201,602
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$373,458,794
	Total	**$4,979,217,787**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	1,070,634	$3,142	$3,363,858,221	0	$3,142	294,499	$481	64,484	$2,129	$278,874,140
D2	1,582,998	$3,142	$4,973,670,588	0	$3,142	352,809	$481	172,217	$2,129	$536,295,100
D3	1,974,570	$3,142	$6,203,962,818	0	$3,142	457,816	$481	301,177	$2,129	$861,363,476
D4	1,889,942	$3,142	$5,938,067,476	0	$3,142	396,714	$481	-23,674	$2,129	$190,708,171
D5	1,511,771	$3,142	$4,749,880,264	0	$3,142	284,680	$481	32,079	$2,129	$205,155,118
D6	1,764,475	$3,142	$5,543,858,811	0	$3,142	526,737	$481	102,197	$2,129	$470,817,357
D7	3,951,648	$3,142	$12,415,805,598	0	$3,142	698,073	$481	-58,246	$2,129	$335,577,922
D8	1,864,463	$3,142	$5,858,014,214	0	$3,142	291,425	$481	-98,593	$2,129	$140,093,724
D9	451,509	$3,142	$1,418,610,152	0	$3,142	73,200	$481	-23,806	$2,129	$35,188,714
D10	1,012,934	$3,142	$3,182,568,799	0	$3,142	221,756	$481	46,972	$2,129	$206,618,426
D11	2,012,022	$3,142	$6,321,634,420	0	$3,142	372,223	$481	-30,417	$2,129	$178,934,984
D12	1,903,726	$3,142	$5,981,375,853	0	$3,142	301,700	$481	-8,969	$2,129	$145,033,265
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**20,990,692**	**N/A**	**$65,951,307,213**	**0**	**N/A**	**4,271,632**	**N/A**	**719,126**	**N/A**	**$3,584,660,396**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

(**) The maintenance Fix-Fair-to-Good unit cost, support ratio, and performance gap represent the contributions of both Major Maintenance and Field Maintenance Crews.

Lighting Rehabilitation

(A) Baseline Inventory

94,724	Each

(B) Projected Inventory (in 2029)

94,736	Each

(C) Baseline Performance

Good	37,998	40.1%
Fair	13,709	14.5%
Poor	43,017	45.4%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	0	0.0%
Fair	94,736	100.0%
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	4.28%	16,271
Into Poor	10.00%	13,709

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	21,727	22.9%
Fair	16,271	17.2%
Poor	56,726	59.9%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	0
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**0**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	6,018
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**6,018**
Add New	Any SHOPP or 2020 PID Work Plan	12

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	0	0/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**0**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	50,708	10,142/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**50,708**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	$19,741	50.0%
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$19,741	50.0%
	Maintenance	N/A	N/A
Add New	SHOPP	$19,741	50.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$123,319,778
	5-Year Performance Gap	$1,501,563,266
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$1,624,883,044**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	1,345	$29,612	$39,828,086	0	$29,612	-1,115	$29,612	687	$29,612	$20,343,416
D2	2,212	$29,612	$65,501,655	0	$29,612	-1,798	$29,612	919	$29,612	$27,213,391
D3	7,429	$29,612	$219,987,251	0	$29,612	-6,070	$29,612	2,987	$29,612	$88,450,924
D4	22,106	$29,612	$654,601,987	0	$29,612	-20,339	$29,612	14,385	$29,612	$425,968,044
D5	3,055	$29,612	$90,464,538	0	$29,612	-2,506	$29,612	1,422	$29,612	$42,108,207
D6	5,579	$29,612	$165,205,125	0	$29,612	-4,421	$29,612	2,288	$29,612	$67,752,164
D7	24,658	$29,612	$730,171,709	0	$29,612	-21,499	$29,612	16,450	$29,612	$487,116,741
D8	8,464	$29,612	$250,635,629	0	$29,612	-6,786	$29,612	2,671	$29,612	$79,093,545
D9	441	$29,612	$13,058,874	0	$29,612	-352	$29,612	217	$29,612	$6,425,795
D10	3,783	$29,612	$112,022,045	0	$29,612	-3,495	$29,612	1,534	$29,612	$45,424,747
D11	6,779	$29,612	$200,739,477	0	$29,612	-4,516	$29,612	2,580	$29,612	$76,398,857
D12	8,885	$29,612	$263,102,264	0	$29,612	-5,568	$29,612	4,568	$29,612	$135,267,433
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**94,736**	**N/A**	**$2,805,318,639**	**0**	**N/A**	**0**	**N/A**	**50,708**	**N/A**	**$1,501,563,266**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Major Damage (Emergency Opening)

(A) Baseline Inventory

N/A	N/A

(B) Projected Inventory (in 2029)

N/A	N/A

(C) Baseline Performance

Good	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(D) Desired State of Repair (DSOR) Target Performance

Good or New	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	N/A	N/A

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Add New	Any SHOPP or 2020 PID Work Plan	N/A

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Add New	SHOPP for the Last 5 Years	N/A	N/A

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Add New	SHOPP	N/A	N/A

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$0
	5-Year Performance Gap	$2,387,645,000
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$2,387,645,000**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Major Damage (Permanent Restoration)

(A) Baseline Inventory

N/A	N/A

(B) Projected Inventory (in 2029)

N/A	N/A

(C) Baseline Performance

Good	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(D) Desired State of Repair (DSOR) Target Performance

Good or New	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	N/A	N/A

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Add New	Any SHOPP or 2020 PID Work Plan	N/A

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Add New	SHOPP for the Last 5 Years	N/A	N/A

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Add New	SHOPP	N/A	N/A

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$1,049,372,000
	5-Year Performance Gap	$1,059,963,750
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$2,109,335,750**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Office Buildings

(A) Baseline Inventory	
2,679,281	Square Feet

(B) Projected Inventory (in 2029)	
2,679,281	Square Feet

(C) Baseline Performance		
Good	1,163,096	43.4%
Fair	785,192	29.3%
Poor	730,993	27.3%

(D) Desired State of Repair (DSOR) Target Performance		
Good or New	2,058,706	60.0%
Fair	1,372,470	40.0%
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario	Average Annual Rate	10-Year Deterioration
Into Fair	3.09%	359,616
Into Poor	0.32%	25,435

(F) Projected Performance (in 2029) - Do Nothing Scenario		
Good	803,480	30.0%
Fair	1,119,373	41.8%
Poor	756,428	28.2%

(G) Pipelined Projects Performance		
Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	0
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**0**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	41,700
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**41,700**
Add New	Any SHOPP or 2020 PID Work Plan	61,566

(H) Performance Gap			
Fix Fair to Good	SHOPP for the Last 5 Years	651,600	130,320/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**651,600**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	714,728	142,946/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**714,728**	**N/A**
Add New	SHOPP for the Last 5 Years	690,329	138,066/year

(I) Average Capital Unit Cost and Support Ratio*			
Fix Fair to Good	SHOPP	$22	0.0%
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$749	0.0%
	Maintenance	N/A	N/A
Add New	SHOPP	$749	0.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years		
SHOPP	Unfunded Pipelined Projects	$27,460,399
	5-Year Performance Gap	$1,066,312,315
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$1,093,772,714**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	91,456	$749	$68,483,001	0	$749	-32,406	$22	0	$749	$0
D2	55,581	$749	$41,619,508	67,549	$749	-49,252	$22	55,581	$749	$92,200,752
D3	0	$749	$0	0	$749	0	$22	0	$749	$0
D4	750,000	$749	$561,606,137	0	$749	450,000	$22	0	$749	$9,802,580
D5	41,700	$749	$31,225,301	0	$749	-41,306	$22	0	$749	$0
D6	64,374	$749	$48,203,778	192,092	$749	-102,586	$22	64,374	$749	$192,043,839
D7	716,200	$749	$536,296,421	0	$749	-286,480	$22	0	$749	$0
D8	336,000	$749	$251,599,549	0	$749	201,600	$22	0	$749	$4,391,556
D9	37,545	$749	$28,114,003	7,509	$749	-18,022	$22	37,545	$749	$33,736,804
D10	90,804	$749	$67,994,778	18,161	$749	-43,586	$22	90,804	$749	$81,593,884
D11	0	$749	$0	0	$749	0	$22	0	$749	$0
D12	0	$749	$0	0	$749	0	$22	0	$749	$0
HQ	495,621	$749	$371,125,060	405,018	$749	-331,059	$22	466,424	$749	$652,542,901
Statewide Totals	**2,679,281**	**N/A**	**$2,006,267,537**	**690,329**	**N/A**	**651,600**	**N/A**	**714,728**	**N/A**	**$1,066,312,315**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Overhead Sign Structures Rehabilitation

(A) Baseline Inventory	
15,837	Each

(B) Projected Inventory (in 2029)	
15,843	Each

(C) Baseline Performance		
Good	11,704	73.9%
Fair	3,497	22.1%
Poor	636	4.0%

(D) Desired State of Repair (DSOR) Target Performance		
Good or New	0	0.0%
Fair	15,843	100.0%
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario		
	Average Annual Rate	10-Year Deterioration
Into Fair	1.79%	2,096
Into Poor	5.26%	1,839

(F) Projected Performance (in 2029) - Do Nothing Scenario		
Good	9,608	60.7%
Fair	3,754	23.7%
Poor	2,475	15.6%

(G) Pipelined Projects Performance		
Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	6
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**6**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	388
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**388**
Add New	Any SHOPP or 2020 PID Work Plan	6

(H) Performance Gap			
Fix Fair to Good	SHOPP for the Last 5 Years	0	0/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**0**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	2,087	417/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**2,087**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*			
Fix Fair to Good	SHOPP	$163,376	60.0%
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$163,376	60.0%
	Maintenance	N/A	N/A
Add New	SHOPP	$163,376	60.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years		
SHOPP	Unfunded Pipelined Projects	$141,462,681
	5-Year Performance Gap	$545,546,244
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$687,008,925**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	80	$261,402	$20,912,170	0	$261,402	-63	$261,402	10	$261,402	$2,614,021
D2	132	$261,402	$34,505,081	0	$261,402	-106	$261,402	7	$261,402	$1,829,815
D3	1,252	$261,402	$327,275,466	0	$261,402	-1,010	$261,402	49	$261,402	$12,808,704
D4	2,731	$261,402	$713,889,215	0	$261,402	-2,136	$261,402	230	$261,402	$60,122,490
D5	251	$261,402	$65,611,934	0	$261,402	-195	$261,402	17	$261,402	$4,443,836
D6	1,086	$261,402	$283,882,712	0	$261,402	-853	$261,402	66	$261,402	$17,252,541
D7	4,664	$261,402	$1,219,179,531	0	$261,402	-3,476	$261,402	1,081	$261,402	$282,575,702
D8	1,706	$261,402	$445,952,033	0	$261,402	-1,261	$261,402	256	$261,402	$66,918,945
D9	10	$261,402	$2,614,021	0	$261,402	-8	$261,402	0	$261,402	$0
D10	470	$261,402	$122,859,001	0	$261,402	-367	$261,402	44	$261,402	$11,501,694
D11	2,078	$261,402	$543,193,625	0	$261,402	-1,584	$261,402	180	$261,402	$47,052,383
D12	1,383	$261,402	$361,519,145	0	$261,402	-1,036	$261,402	147	$261,402	$38,426,113
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**15,843**	**N/A**	**$4,141,393,935**	**0**	**N/A**	**0**	**N/A**	**2,087**	**N/A**	**$545,546,244**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Pavement Class I

(A) Baseline Inventory

27,151	Lane Miles

(B) Projected Inventory (in 2029)

27,151	Lane Miles

(C) Baseline Performance

Good	17,636	65.0%
Fair	9,166	33.8%
Poor	349	1.3%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	16,288	60.0%
Fair	10,590	39.0%
Poor	273	1.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	8.40%	14,820
Into Poor	0.73%	669

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	2,816	10.4%
Fair	23,317	85.9%
Poor	1,018	3.7%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	5,740
	Maintenance through 2018/19	750
	Other (STIP, Local, etc.)	0
	Total	**6,490**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	225
	Maintenance through 2018/19	14
	Other (STIP, Local, etc.)	0
	Total	**239**
Add New	Any SHOPP or 2020 PID Work Plan	0

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	4,670	934/year
	Maintenance for 10 Years	2,520	252/year
	Other	0	N/A
	Total	**7,190**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	48	10/year
	Maintenance for 10 Years	2	0/year
	Other	0	N/A
	Total	**50**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	$800,941	18.0%
	Maintenance	$115,850	17.0%
Fix Poor to Good	SHOPP	$2,408,804	20.0%
	Maintenance	$115,850	17.0%
Add New	SHOPP	$1,497,616	20.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$6,173,836,929
	5-Year Performance Gap	$4,552,410,007
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$341,843,229
	Total	**$11,068,090,165**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	1,050	$1,797,140	$1,886,996,621	0	$1,797,140	356	$811,554	7	$1,722,246	$300,968,811
D2	989	$1,797,140	$1,777,371,103	0	$1,797,140	157	$807,422	0	$805,898	$126,765,180
D3	1,864	$1,797,140	$3,349,868,287	0	$1,797,140	635	$514,384	1	$588,451	$327,222,285
D4	3,783	$1,797,140	$6,798,579,255	0	$1,797,140	1,178	$381,713	4	$762,750	$452,709,097
D5	1,228	$1,797,140	$2,206,887,477	0	$1,797,140	321	$797,170	11	$2,324,976	$281,466,337
D6	2,082	$1,797,140	$3,741,644,729	0	$1,797,140	628	$657,229	1	$4,904,959	$417,645,085
D7	4,553	$1,797,140	$8,182,376,777	0	$1,797,140	797	$1,220,058	19	$3,725,603	$1,043,172,376
D8	4,632	$1,797,140	$8,324,350,808	0	$1,797,140	1,310	$578,084	5	$3,242,839	$773,504,429
D9	1,548	$1,797,140	$2,781,972,161	0	$1,797,140	319	$821,210	0	$738,553	$261,965,995
D10	1,266	$1,797,140	$2,275,178,783	0	$1,797,140	371	$809,032	0	$662,583	$300,150,851
D11	2,697	$1,797,140	$4,846,885,607	0	$1,797,140	489	$614,164	1	$4,091,128	$304,417,501
D12	1,459	$1,797,140	$2,622,026,733	0	$1,797,140	629	$480,944	1	$1,751,549	$304,265,290
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**27,151**	**N/A**	**$48,794,138,342**	**0**	**N/A**	**7,190**	**N/A**	**50**	**N/A**	**$4,894,253,236**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Pavement Class II

(A) Baseline Inventory

16,396	Lane Miles

(B) Projected Inventory (in 2029)

16,396	Lane Miles

(C) Baseline Performance

Good	7,521	45.9%
Fair	8,734	53.3%
Poor	141	0.9%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	9,022	55.0%
Fair	7,048	43.0%
Poor	326	2.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	9.38%	7,056
Into Poor	0.65%	569

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	465	2.8%
Fair	15,221	92.8%
Poor	710	4.3%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	3,946
	Maintenance through 2018/19	1,186
	Other (STIP, Local, etc.)	0
	Total	**5,132**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	205
	Maintenance through 2018/19	26
	Other (STIP, Local, etc.)	0
	Total	**231**
Add New	Any SHOPP or 2020 PID Work Plan	0

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	4,319	864/year
	Maintenance for 10 Years	1,809	181/year
	Other	0	N/A
	Total	**6,128**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	78	16/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**78**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	$713,211	18.0%
	Maintenance	$105,216	17.0%
Fix Poor to Good	SHOPP	$1,134,820	20.0%
	Maintenance	$105,216	17.0%
Add New	SHOPP	$1,361,469	20.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$2,864,659,492
	5-Year Performance Gap	$3,741,039,633
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$222,692,820
	Total	**$6,828,391,946**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	731	$1,633,763	$1,194,280,978	0	$1,633,763	368	$758,570	1	$1,159,268	$280,313,150
D2	1,808	$1,633,763	$2,953,844,061	0	$1,633,763	550	$690,723	4	$1,446,114	$385,682,064
D3	1,874	$1,633,763	$3,061,672,440	0	$1,633,763	766	$655,354	11	$918,951	$512,109,650
D4	2,036	$1,633,763	$3,326,342,096	0	$1,633,763	950	$531,738	9	$1,355,886	$517,354,229
D5	1,298	$1,633,763	$2,120,624,774	0	$1,633,763	685	$739,533	14	$1,465,445	$527,096,109
D6	1,624	$1,633,763	$2,653,231,613	0	$1,633,763	609	$702,694	10	$1,531,406	$443,254,543
D7	1,472	$1,633,763	$2,404,899,590	0	$1,633,763	262	$409,038	4	$1,226,362	$112,073,371
D8	1,715	$1,633,763	$2,801,904,074	0	$1,633,763	552	$684,929	18	$1,493,864	$404,970,496
D9	595	$1,633,763	$972,089,168	0	$1,633,763	201	$976,500	0	$70,579	$196,276,442
D10	1,667	$1,633,763	$2,723,483,435	0	$1,633,763	503	$596,236	5	$1,110,668	$305,460,013
D11	1,061	$1,633,763	$1,733,422,870	0	$1,633,763	380	$529,441	2	$1,892,689	$204,973,093
D12	515	$1,633,763	$841,388,104	0	$1,633,763	302	$245,594	0	$4,271,587	$74,169,295
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**16,396**	**N/A**	**$26,787,183,203**	**0**	**N/A**	**6,128**	**N/A**	**78**	**N/A**	**$3,963,732,454**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Pavement Class III

(A) Baseline Inventory

6,712	Lane Miles

(B) Projected Inventory (in 2029)

6,712	Lane Miles

(C) Baseline Performance

Good	2,853	42.5%
Fair	3,789	56.5%
Poor	70	1.0%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	3,021	45.0%
Fair	3,557	53.0%
Poor	134	2.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	9.57%	2,729
Into Poor	0.98%	373

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	124	1.8%
Fair	6,145	91.6%
Poor	443	6.6%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	537
	Maintenance through 2018/19	540
	Other (STIP, Local, etc.)	0
	Total	**1,077**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	49
	Maintenance through 2018/19	7
	Other (STIP, Local, etc.)	0
	Total	**56**
Add New	Any SHOPP or 2020 PID Work Plan	0

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	169	34/year
	Maintenance for 10 Years	3,473	347/year
	Other	0	N/A
	Total	**3,642**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	1	0/year
	Maintenance for 10 Years	59	6/year
	Other	0	N/A
	Total	**60**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	$584,141	17.0%
	Maintenance	$162,573	17.0%
Fix Poor to Good	SHOPP	$876,922	20.0%
	Maintenance	$162,573	17.0%
Add New	SHOPP	$1,361,469	20.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$449,716,783
	5-Year Performance Gap	$116,554,437
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$671,823,168
	Total	**$1,238,094,388**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	545	$1,633,763	$890,401,003	0	$1,633,763	276	$190,210	3	$190,210	$53,068,704
D2	1,173	$1,633,763	$1,916,404,361	0	$1,633,763	556	$227,320	31	$190,210	$132,286,167
D3	700	$1,633,763	$1,143,634,316	0	$1,633,763	507	$196,015	20	$190,210	$103,183,754
D4	365	$1,633,763	$596,323,608	0	$1,633,763	214	$327,476	1	$190,210	$70,270,049
D5	649	$1,633,763	$1,060,312,387	0	$1,633,763	573	$209,301	2	$621,259	$121,172,059
D6	1,388	$1,633,763	$2,267,663,472	0	$1,633,763	491	$196,210	1	$190,210	$96,529,435
D7	229	$1,633,763	$374,131,798	0	$1,633,763	143	$245,468	2	$190,210	$35,482,378
D8	316	$1,633,763	$516,269,205	0	$1,633,763	168	$192,798	0	$1,534,514	$32,390,041
D9	419	$1,633,763	$684,546,826	0	$1,633,763	252	$214,599	0	$1,538,925	$54,078,921
D10	587	$1,633,763	$959,019,062	0	$1,633,763	274	$196,311	0	$1,537,455	$53,789,230
D11	340	$1,633,763	$555,479,525	0	$1,633,763	187	$190,210	0	$1,465,406	$35,569,347
D12	1	$1,633,763	$1,633,763	0	$1,633,763	1	$557,522	0	$1,465,406	$557,522
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**6,712**	**N/A**	**$10,965,819,325**	**0**	**N/A**	**3,642**	**N/A**	**60**	**N/A**	**$788,377,605**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Relinquishments

(A) Baseline Inventory	
N/A	N/A

(B) Projected Inventory (in 2029)	
N/A	N/A

(C) Baseline Performance		
Good	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(D) Desired State of Repair (DSOR) Target Performance		
Good or New	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(E) Effective Deterioration (by 2029) - Do Nothing Scenario	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	N/A	N/A

(F) Projected Performance (in 2029) - Do Nothing Scenario		
Good	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(G) Pipelined Projects Performance		
Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Add New	Any SHOPP or 2020 PID Work Plan	N/A

(H) Performance Gap			
Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Add New	SHOPP for the Last 5 Years	N/A	N/A

(I) Average Capital Unit Cost and Support Ratio*			
Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Add New	SHOPP	N/A	N/A

(J) Estimated SHOPP and Maintenance Costs for 10 Years		
SHOPP	Unfunded Pipelined Projects	$90,971,020
	5-Year Performance Gap	$13,000,000
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$103,971,020**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Roadway Protective Betterments

(A) Baseline Inventory

113	Locations

(B) Projected Inventory (in 2029)

113	Locations

(C) Baseline Performance

Good	N/A	N/A
Fair	N/A	N/A
Poor	113	100.0%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	113	100.0%
Fair	N/A	N/A
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	N/A	N/A

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	N/A	N/A
Fair	N/A	N/A
Poor	113	100.0%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	22
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**22**
Add New	Any SHOPP or 2020 PID Work Plan	N/A

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	91	18/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**91**	**N/A**
Add New	SHOPP for the Last 5 Years	N/A	N/A

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$6,535,027	47.8%
	Maintenance	N/A	N/A
Add New	SHOPP	N/A	N/A

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$119,957,499
	5-Year Performance Gap	$879,067,059
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$999,024,558**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	7	N/A	N/A	N/A	N/A	N/A	N/A	6	$9,660,078	$57,960,465
D2	16	N/A	N/A	N/A	N/A	N/A	N/A	16	$9,660,078	$154,561,241
D3	6	N/A	N/A	N/A	N/A	N/A	N/A	1	$9,660,078	$9,660,078
D4	46	N/A	N/A	N/A	N/A	N/A	N/A	46	$9,660,078	$444,363,568
D5	5	N/A	N/A	N/A	N/A	N/A	N/A	2	$9,660,078	$19,320,155
D6	2	N/A	N/A	N/A	N/A	N/A	N/A	2	$9,660,078	$19,320,155
D7	11	N/A	N/A	N/A	N/A	N/A	N/A	10	$9,660,078	$96,600,776
D8	5	N/A	N/A	N/A	N/A	N/A	N/A	1	$9,660,078	$9,660,078
D9	2	N/A	N/A	N/A	N/A	N/A	N/A	2	$9,660,078	$19,320,155
D10	11	N/A	N/A	N/A	N/A	N/A	N/A	3	$9,660,078	$28,980,233
D11	0	N/A	N/A	N/A	N/A	N/A	N/A	0	$9,660,078	$0
D12	2	N/A	N/A	N/A	N/A	N/A	N/A	2	$9,660,078	$19,320,155
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**113**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**91**	**N/A**	**$879,067,059**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Safety Roadside Rest Area (SRRA) Rehabilitation

(A) Baseline Inventory

86	Locations

(B) Projected Inventory (in 2029)

86	Locations

(C) Baseline Performance

Good	30	34.9%
Fair	31	36.0%
Poor	25	29.1%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	69	80.2%
Fair	17	19.8%
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	6.00%	18
Into Poor	10.00%	31

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	12	14.0%
Fair	18	20.9%
Poor	56	65.1%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	0
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**0**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	8
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**8**
Add New	Any SHOPP or 2020 PID Work Plan	0

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	6	1/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**6**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	48	10/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**48**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	$12,253,225	104.1%
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$12,253,225	104.1%
	Maintenance	N/A	N/A
Add New	SHOPP	$28,134,766	43.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$115,306,795
	5-Year Performance Gap	$1,350,344,585
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$1,465,651,380**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	6	$40,232,715	$241,396,289	0	$40,232,715	-1	$25,006,381	6	$25,006,381	$150,038,287
D2	20	$40,232,715	$804,654,297	0	$40,232,715	-1	$25,006,381	15	$25,006,381	$375,095,718
D3	11	$40,232,715	$442,559,863	0	$40,232,715	0	$25,006,381	7	$25,006,381	$175,044,668
D4	3	$40,232,715	$120,698,145	0	$40,232,715	1	$25,006,381	0	$25,006,381	$25,006,381
D5	5	$40,232,715	$201,163,574	0	$40,232,715	1	$25,006,381	2	$25,006,381	$75,019,144
D6	10	$40,232,715	$402,327,149	0	$40,232,715	2	$25,006,381	4	$25,006,381	$150,038,287
D7	0	$40,232,715	$0	0	$40,232,715	0	$25,006,381	0	$25,006,381	$0
D8	15	$40,232,715	$603,490,723	0	$40,232,715	-1	$25,006,381	8	$25,006,381	$200,051,050
D9	4	$40,232,715	$160,930,859	0	$40,232,715	-1	$25,006,381	3	$25,006,381	$75,019,144
D10	6	$40,232,715	$241,396,289	0	$40,232,715	-1	$25,006,381	2	$25,006,381	$50,012,762
D11	6	$40,232,715	$241,396,289	0	$40,232,715	2	$25,006,381	1	$25,006,381	$75,019,144
D12	0	$40,232,715	$0	0	$40,232,715	0	$25,006,381	0	$25,006,381	$0
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**86**	**N/A**	**$3,460,013,478**	**0**	**N/A**	**6**	**N/A**	**48**	**N/A**	**$1,350,344,585**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Transportation Related Facilities

(A) Baseline Inventory

4,027,759	Square Feet

(B) Projected Inventory (in 2029)

4,093,085	Square Feet

(C) Baseline Performance

Good	922,591	22.9%
Fair	582,281	14.5%
Poor	2,522,887	62.6%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	2,455,851	60.0%
Fair	1,637,234	40.0%
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	5.00%	461,298
Into Poor	5.00%	291,143

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	461,293	11.5%
Fair	752,436	18.7%
Poor	2,814,030	69.9%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	0
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**0**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	147,310
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**147,310**
Add New	Any SHOPP or 2020 PID Work Plan	65,326

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	1,134	227/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**1,134**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	2,666,720	533,344/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**2,666,720**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	$654	77.9%
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$654	77.9%
	Maintenance	N/A	N/A
Add New	SHOPP	$654	77.9%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$171,653,798
	5-Year Performance Gap	$3,101,900,207
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$3,273,554,005**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	207,612	$1,163	$241,389,411	0	$1,163	-74,174	$1,163	181,861	$1,163	$211,448,855
D2	365,701	$1,163	$425,198,683	0	$1,163	-95,294	$1,163	303,478	$1,163	$352,852,319
D3	489,842	$1,163	$569,536,789	0	$1,163	-145,966	$1,163	389,899	$1,163	$453,333,574
D4	499,318	$1,163	$580,554,486	0	$1,163	-104,550	$1,163	300,336	$1,163	$349,199,132
D5	173,263	$1,163	$201,452,004	0	$1,163	-51,517	$1,163	150,893	$1,163	$175,442,520
D6	289,837	$1,163	$336,991,998	0	$1,163	-76,124	$1,163	194,813	$1,163	$226,508,079
D7	548,552	$1,163	$637,798,606	0	$1,163	-56,053	$1,163	214,716	$1,163	$249,649,196
D8	398,778	$1,163	$463,657,142	0	$1,163	-73,912	$1,163	203,488	$1,163	$236,594,457
D9	165,467	$1,163	$192,387,635	0	$1,163	-25,800	$1,163	94,571	$1,163	$109,957,218
D10	246,213	$1,163	$286,270,596	0	$1,163	-74,730	$1,163	195,592	$1,163	$227,413,818
D11	233,580	$1,163	$271,582,272	0	$1,163	-5,943	$1,163	136,581	$1,163	$158,802,030
D12	212,500	$1,163	$247,072,664	0	$1,163	1,134	$1,163	44,270	$1,163	$52,790,999
HQ	262,422	$1,163	$305,116,718	0	$1,163	-101,869	$1,163	256,222	$1,163	$297,908,010
Statewide Totals	**4,093,085**	**N/A**	**$4,759,009,005**	**0**	**N/A**	**1,134**	**N/A**	**2,666,720**	**N/A**	**$3,101,900,207**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Water and Wastewater Treatment at SRRAs

(A) Baseline Inventory

76	Locations

(B) Projected Inventory (in 2029)

76	Locations

(C) Baseline Performance

Good	7	9.2%
Fair	6	7.9%
Poor	63	82.9%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	61	80.3%
Fair	15	19.7%
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	5.71%	4
Into Poor	10.00%	6

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	3	3.9%
Fair	4	5.3%
Poor	69	90.8%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	0
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**0**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	38
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**38**
Add New	Any SHOPP or 2020 PID Work Plan	0

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	0	0/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**0**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	31	6/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**31**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	$4,356,702	60.0%
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$4,356,702	60.0%
	Maintenance	N/A	N/A
Add New	SHOPP	$4,356,702	60.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$68,620,295
	5-Year Performance Gap	$216,092,427
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$284,712,722**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	6	$6,970,723	$41,824,341	0	$6,970,723	-1	$6,970,723	0	$6,970,723	$0
D2	17	$6,970,723	$118,502,299	0	$6,970,723	-2	$6,970,723	10	$6,970,723	$69,707,234
D3	9	$6,970,723	$62,736,511	0	$6,970,723	-2	$6,970,723	2	$6,970,723	$13,941,447
D4	1	$6,970,723	$6,970,723	0	$6,970,723	0	$6,970,723	1	$6,970,723	$6,970,723
D5	5	$6,970,723	$34,853,617	0	$6,970,723	0	$6,970,723	2	$6,970,723	$13,941,447
D6	11	$6,970,723	$76,677,958	0	$6,970,723	-2	$6,970,723	2	$6,970,723	$13,941,447
D7	0	$6,970,723	$0	0	$6,970,723	0	$6,970,723	0	$6,970,723	$0
D8	14	$6,970,723	$97,590,128	0	$6,970,723	-2	$6,970,723	8	$6,970,723	$55,765,788
D9	3	$6,970,723	$20,912,170	0	$6,970,723	-1	$6,970,723	3	$6,970,723	$20,912,170
D10	4	$6,970,723	$27,882,894	0	$6,970,723	-1	$6,970,723	0	$6,970,723	$0
D11	6	$6,970,723	$41,824,341	0	$6,970,723	0	$6,970,723	3	$6,970,723	$20,912,170
D12	0	$6,970,723	$0	0	$6,970,723	0	$6,970,723	0	$6,970,723	$0
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**76**	**N/A**	**$529,774,982**	**0**	**N/A**	**0**	**N/A**	**31**	**N/A**	**$216,092,427**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

ADA Pedestrian Infrastructure

(A) Baseline Inventory	
180,779	Deficient Elements

(B) Projected Inventory (in 2029)	
180,779	Deficient Elements

(C) Baseline Performance		
Good	N/A	N/A
Fair	N/A	N/A
Poor	180,779	100.0%

(D) Desired State of Repair (DSOR) Target Performance		
Good or New	45,194	25.0%
Fair	N/A	N/A
Poor	135,585	75.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	N/A	N/A

(F) Projected Performance (in 2029) - Do Nothing Scenario		
Good	N/A	N/A
Fair	N/A	N/A
Poor	180,779	100.0%

(G) Pipelined Projects Performance		
Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	27,868
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	29
	Total	**27,897**
Add New	Any SHOPP or 2020 PID Work Plan	N/A

(H) Performance Gap			
Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	19,307	3,861/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**19,307**	**N/A**
Add New	SHOPP for the Last 5 Years	N/A	N/A

(I) Average Capital Unit Cost and Support Ratio*			
Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$23,504	100.0%
	Maintenance	N/A	N/A
Add New	SHOPP	N/A	N/A

(J) Estimated SHOPP and Maintenance Costs for 10 Years		
SHOPP	Unfunded Pipelined Projects	$543,258,300
	5-Year Performance Gap	$907,599,215
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$1,450,857,515**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	4,996	N/A	N/A	N/A	N/A	N/A	N/A	222	$47,009	$10,435,957
D2	6,941	N/A	N/A	N/A	N/A	N/A	N/A	964	$47,009	$45,316,499
D3	14,886	N/A	N/A	N/A	N/A	N/A	N/A	2,080	$47,009	$97,778,338
D4	44,943	N/A	N/A	N/A	N/A	N/A	N/A	4,215	$47,009	$198,142,161
D5	9,700	N/A	N/A	N/A	N/A	N/A	N/A	222	$47,009	$10,435,957
D6	15,513	N/A	N/A	N/A	N/A	N/A	N/A	2,940	$47,009	$138,205,920
D7	34,964	N/A	N/A	N/A	N/A	N/A	N/A	4,022	$47,009	$189,069,459
D8	17,425	N/A	N/A	N/A	N/A	N/A	N/A	2,171	$47,009	$102,056,140
D9	382	N/A	N/A	N/A	N/A	N/A	N/A	-1,165	$47,009	$0
D10	9,179	N/A	N/A	N/A	N/A	N/A	N/A	-845	$47,009	$0
D11	10,211	N/A	N/A	N/A	N/A	N/A	N/A	1,525	$47,009	$71,688,445
D12	11,639	N/A	N/A	N/A	N/A	N/A	N/A	946	$47,009	$44,470,340
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**180,779**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**19,307**	**N/A**	**$907,599,215**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Advance Mitigation

(A) Baseline Inventory	
N/A	N/A

(B) Projected Inventory (in 2029)	
N/A	N/A

(C) Baseline Performance		
Good	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(D) Desired State of Repair (DSOR) Target Performance		
Good or New	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(E) Effective Deterioration (by 2029) - Do Nothing Scenario	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	N/A	N/A

(F) Projected Performance (in 2029) - Do Nothing Scenario		
Good	N/A	N/A
Fair	N/A	N/A
Poor	N/A	N/A

(G) Pipelined Projects Performance		
Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Add New	Any SHOPP or 2020 PID Work Plan	N/A

(H) Performance Gap			
Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Add New	SHOPP for the Last 5 Years	N/A	N/A

(I) Average Capital Unit Cost and Support Ratio*			
Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Add New	SHOPP	N/A	N/A

(J) Estimated SHOPP and Maintenance Costs for 10 Years		
SHOPP	Unfunded Pipelined Projects	$14,899,000
	5-Year Performance Gap	$0
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$14,899,000**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

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Bridge Scour Mitigation

(A) Baseline Inventory

1,694,576	Square Feet

(B) Projected Inventory (in 2029)

1,694,576	Square Feet

(C) Baseline Performance

Good	N/A	N/A
Fair	N/A	N/A
Poor	1,694,576	100.0%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	1,525,118	90.0%
Fair	N/A	N/A
Poor	169,458	10.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	N/A	N/A

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	N/A	N/A
Fair	N/A	N/A
Poor	1,694,576	100.0%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	1,108,063
	Maintenance through 2018/19	5,726
	Other (STIP, Local, etc.)	8,880
	Total	**1,122,669**
Add New	Any SHOPP or 2020 PID Work Plan	N/A

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	452,222	90,444/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**452,222**	**N/A**
Add New	SHOPP for the Last 5 Years	N/A	N/A

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$545	46.0%
	Maintenance	N/A	N/A
Add New	SHOPP	N/A	N/A

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$571,628,760
	5-Year Performance Gap	$359,560,873
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$931,189,633**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	160,834	N/A	N/A	N/A	N/A	N/A	N/A	107,767	$795	$85,685,342
D2	40,042	N/A	N/A	N/A	N/A	N/A	N/A	5,629	$795	$4,475,607
D3	361,527	N/A	N/A	N/A	N/A	N/A	N/A	-32,881	$795	$0
D4	67,946	N/A	N/A	N/A	N/A	N/A	N/A	-6,795	$795	$0
D5	150,899	N/A	N/A	N/A	N/A	N/A	N/A	66,176	$795	$52,616,415
D6	91,698	N/A	N/A	N/A	N/A	N/A	N/A	-9,170	$795	$0
D7	92,031	N/A	N/A	N/A	N/A	N/A	N/A	-927	$795	$0
D8	658,772	N/A	N/A	N/A	N/A	N/A	N/A	211,726	$795	$168,342,950
D9	4,101	N/A	N/A	N/A	N/A	N/A	N/A	3,691	$795	$2,934,707
D10	5,447	N/A	N/A	N/A	N/A	N/A	N/A	2,082	$795	$1,655,394
D11	0	N/A	N/A	N/A	N/A	N/A	N/A	0	$795	$0
D12	61,279	N/A	N/A	N/A	N/A	N/A	N/A	55,151	$795	$43,850,458
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**1,694,576**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**452,222**	**N/A**	**$359,560,873**

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Bridge Seismic Restoration

(A) Baseline Inventory

14,801,682	Square Feet

(B) Projected Inventory (in 2029)

14,801,682	Square Feet

(C) Baseline Performance

Good	N/A	N/A
Fair	N/A	N/A
Poor	14,801,682	100.0%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	10,361,176	70.0%
Fair	N/A	N/A
Poor	4,440,506	30.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	N/A	N/A

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	N/A	N/A
Fair	N/A	N/A
Poor	14,801,682	100.0%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	4,572,160
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	111,182
	Total	**4,683,342**
Add New	Any SHOPP or 2020 PID Work Plan	N/A

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	5,967,331	1,193,466/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**5,967,331**	**N/A**
Add New	SHOPP for the Last 5 Years	N/A	N/A

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$272	43.0%
	Maintenance	N/A	N/A
Add New	SHOPP	N/A	N/A

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$615,366,244
	5-Year Performance Gap	$2,323,560,867
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$2,938,927,111**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	783,074	N/A	N/A	N/A	N/A	N/A	N/A	259,746	$389	$101,139,964
D2	574,760	N/A	N/A	N/A	N/A	N/A	N/A	186,837	$389	$72,750,639
D3	495,129	N/A	N/A	N/A	N/A	N/A	N/A	-144,674	$389	$0
D4	3,468,495	N/A	N/A	N/A	N/A	N/A	N/A	1,531,670	$389	$596,402,055
D5	443,226	N/A	N/A	N/A	N/A	N/A	N/A	61,373	$389	$23,897,434
D6	197,281	N/A	N/A	N/A	N/A	N/A	N/A	-48,840	$389	$0
D7	6,773,462	N/A	N/A	N/A	N/A	N/A	N/A	3,593,561	$389	$1,399,261,699
D8	704,115	N/A	N/A	N/A	N/A	N/A	N/A	182,869	$389	$71,205,578
D9	0	N/A	N/A	N/A	N/A	N/A	N/A	0	$389	$0
D10	960,269	N/A	N/A	N/A	N/A	N/A	N/A	-48,585	$389	$0
D11	243,878	N/A	N/A	N/A	N/A	N/A	N/A	151,275	$389	$58,903,498
D12	157,993	N/A	N/A	N/A	N/A	N/A	N/A	-47,398	$389	$0
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**14,801,682**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**5,967,331**	**N/A**	**$2,323,560,867**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Roadside Rehabilitation

(A) Baseline Inventory

29,937	Acres

(B) Projected Inventory (in 2029)

30,536	Acres

(C) Baseline Performance

Good	6,317	21.1%
Fair	9,575	32.0%
Poor	14,045	46.9%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	18,321	60.0%
Fair	9,162	30.0%
Poor	3,053	10.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	2.92%	2,446
Into Poor	5.83%	5,582

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	4,470	14.6%
Fair	6,439	21.1%
Poor	19,627	64.3%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	14
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**14**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	1,620
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**1,620**
Add New	Any SHOPP or 2020 PID Work Plan	0

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	0	0/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**0**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	14,954	2,991/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**14,954**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	$121,171	48.0%
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$121,171	48.0%
	Maintenance	N/A	N/A
Add New	SHOPP	$121,171	48.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$258,563,096
	5-Year Performance Gap	$2,681,741,980
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$2,940,305,076**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	85	$179,333	$15,243,284	0	$179,333	-9	$179,333	46	$179,333	$8,249,307
D2	373	$179,333	$66,891,117	0	$179,333	-34	$179,333	204	$179,333	$36,583,882
D3	1,429	$179,333	$256,266,503	0	$179,333	-132	$179,333	755	$179,333	$135,396,228
D4	4,463	$179,333	$800,362,074	0	$179,333	-417	$179,333	2,397	$179,333	$429,860,608
D5	1,024	$179,333	$183,636,739	0	$179,333	-96	$179,333	524	$179,333	$93,970,362
D6	2,124	$179,333	$380,902,766	0	$179,333	-190	$179,333	682	$179,333	$122,304,937
D7	9,707	$179,333	$1,740,783,028	0	$179,333	-917	$179,333	5,228	$179,333	$937,551,630
D8	3,112	$179,333	$558,083,526	0	$179,333	-298	$179,333	1,625	$179,333	$291,415,723
D9	11	$179,333	$1,972,660	0	$179,333	0	$179,333	6	$179,333	$1,075,997
D10	729	$179,333	$130,733,577	0	$179,333	-63	$179,333	385	$179,333	$69,043,110
D11	4,513	$179,333	$809,328,712	0	$179,333	-326	$179,333	1,753	$179,333	$314,370,315
D12	2,966	$179,333	$531,900,944	0	$179,333	-255	$179,333	1,349	$179,333	$241,919,883
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**30,536**	**N/A**	**$5,476,104,930**	**0**	**N/A**	**0**	**N/A**	**14,954**	**N/A**	**$2,681,741,980**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Storm Water Mitigation

(A) Baseline Inventory

18,270	Compliance Units

(B) Projected Inventory (in 2029)

18,270	Compliance Units

(C) Baseline Performance

Good	N/A	N/A
Fair	N/A	N/A
Poor	18,270	100.0%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	18,270	100.0%
Fair	N/A	N/A
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	N/A	N/A

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	N/A	N/A
Fair	N/A	N/A
Poor	18,270	100.0%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	2,693
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**2,693**
Add New	Any SHOPP or 2020 PID Work Plan	N/A

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	15,577	3,115/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**15,577**	**N/A**
Add New	SHOPP for the Last 5 Years	N/A	N/A

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$85,982	48.0%
	Maintenance	N/A	N/A
Add New	SHOPP	N/A	N/A

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$723,038,000
	5-Year Performance Gap	$1,982,231,121
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$2,705,269,121**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	795	N/A	N/A	N/A	N/A	N/A	N/A	710	$127,254	$90,350,138
D2	1,512	N/A	N/A	N/A	N/A	N/A	N/A	1,404	$127,254	$178,664,216
D3	1,040	N/A	N/A	N/A	N/A	N/A	N/A	1,027	$127,254	$130,689,565
D4	3,439	N/A	N/A	N/A	N/A	N/A	N/A	2,809	$127,254	$357,455,686
D5	165	N/A	N/A	N/A	N/A	N/A	N/A	138	$127,254	$17,561,013
D6	0	N/A	N/A	N/A	N/A	N/A	N/A	0	$127,254	$0
D7	7,379	N/A	N/A	N/A	N/A	N/A	N/A	6,074	$127,254	$772,939,066
D8	738	N/A	N/A	N/A	N/A	N/A	N/A	576	$127,254	$73,298,140
D9	0	N/A	N/A	N/A	N/A	N/A	N/A	0	$127,254	$0
D10	308	N/A	N/A	N/A	N/A	N/A	N/A	278	$127,254	$35,376,533
D11	2,277	N/A	N/A	N/A	N/A	N/A	N/A	2,027	$127,254	$257,943,281
D12	617	N/A	N/A	N/A	N/A	N/A	N/A	534	$127,254	$67,953,484
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**18,270**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**15,577**	**N/A**	**$1,982,231,121**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Bridge Goods Movement Upgrades

(A) Baseline Inventory	
246,100,957	Square Feet

(B) Projected Inventory (in 2029)	
246,100,957	Square Feet

(C) Baseline Performance		
Good	194,841,279	79.2%
Fair	20,516,731	8.3%
Poor	30,742,947	12.5%

(D) Desired State of Repair (DSOR) Target Performance		
Good or New	184,575,717	75.0%
Fair	36,915,144	15.0%
Poor	24,610,096	10.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario	Average Annual Rate	10-Year Deterioration
Into Fair	0.00%	0
Into Poor	0.00%	0

(F) Projected Performance (in 2029) - Do Nothing Scenario		
Good	194,841,279	79.2%
Fair	20,516,731	8.3%
Poor	30,742,947	12.5%

(G) Pipelined Projects Performance		
Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	1,052,428
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	109,427
	Total	**1,161,855**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	3,090,511
	Maintenance through 2018/19	9,924
	Other (STIP, Local, etc.)	578,550
	Total	**3,678,985**
Add New	Any SHOPP or 2020 PID Work Plan	0

(H) Performance Gap			
Fix Fair to Good	SHOPP for the Last 5 Years	0	0/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**0**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	6,839,720	1,367,944/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**6,839,720**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*			
Fix Fair to Good	SHOPP	$408	40.0%
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$545	40.0%
	Maintenance	N/A	N/A
Add New	SHOPP	$545	40.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years		
SHOPP	Unfunded Pipelined Projects	$958,482,809
	5-Year Performance Gap	$5,214,759,002
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$6,173,241,811**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	5,784,884	$762	$4,410,527,904	0	$762	-623,683	$572	-71,907	$762	$0
D2	5,832,890	$762	$4,447,128,776	0	$762	-576,796	$572	-250,070	$762	$0
D3	22,305,072	$762	$17,005,897,170	0	$762	-890,890	$572	665,167	$762	$507,138,538
D4	52,133,929	$762	$39,748,100,148	0	$762	-2,767,212	$572	1,094,651	$762	$834,586,965
D5	7,627,583	$762	$5,815,443,777	0	$762	-587,256	$572	-58,120	$762	$0
D6	10,989,652	$762	$8,378,762,097	0	$762	-913,823	$572	329,282	$762	$251,052,130
D7	62,924,051	$762	$47,974,736,009	0	$762	-3,453,691	$572	4,394,338	$762	$3,350,343,821
D8	22,224,047	$762	$16,944,121,857	0	$762	-2,293,297	$572	-1,745,952	$762	$0
D9	966,385	$762	$736,794,032	0	$762	-104,281	$572	-70,041	$762	$0
D10	9,947,594	$762	$7,584,273,239	0	$762	-725,870	$572	356,282	$762	$271,637,548
D11	25,535,015	$762	$19,468,479,606	0	$762	-2,304,426	$572	-872,396	$762	$0
D12	19,829,855	$762	$15,118,735,104	0	$762	-2,027,696	$572	-1,317,368	$762	$0
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**246,100,957**	**N/A**	**$187,632,999,718**	**0**	**N/A**	**0**	**N/A**	**6,839,720**	**N/A**	**$5,214,759,002**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Commercial Vehicle Enforcement Facilities

(A) Baseline Inventory

309,395	Square Feet

(B) Projected Inventory (in 2029)

309,395	Square Feet

(C) Baseline Performance

Good	108,490	35.1%
Fair	141,315	45.7%
Poor	59,590	19.3%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	185,637	60.0%
Fair	123,758	40.0%
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	5.00%	54,245
Into Poor	5.00%	70,658

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	54,245	17.5%
Fair	124,902	40.4%
Poor	130,248	42.1%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	9,300
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**9,300**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	3,900
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**3,900**
Add New	Any SHOPP or 2020 PID Work Plan	0

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	7,486	1,497/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**7,486**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	126,348	25,270/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**126,348**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	$1,634	90.0%
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$3,063	90.0%
	Maintenance	N/A	N/A
Add New	SHOPP	$6,535	90.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$26,972,610
	5-Year Performance Gap	$758,618,632
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$785,591,242**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	900	$12,417	$11,174,941	0	$12,417	90	$3,104	450	$5,820	$2,898,500
D2	35,360	$12,417	$439,051,016	0	$12,417	3,341	$3,104	530	$5,820	$13,455,715
D3	13,850	$12,417	$171,969,926	0	$12,417	1,120	$3,104	7,190	$5,820	$45,324,474
D4	81,550	$12,417	$1,012,573,823	0	$12,417	-5,500	$3,104	39,905	$5,820	$232,258,345
D5	0	$12,417	$0	0	$12,417	0	$3,104	0	$5,820	$0
D6	11,000	$12,417	$136,582,613	0	$12,417	1,100	$3,104	5,500	$5,820	$35,426,115
D7	21,950	$12,417	$272,544,395	0	$12,417	-7,105	$3,104	6,190	$5,820	$36,027,544
D8	59,160	$12,417	$734,566,124	0	$12,417	-864	$3,104	24,360	$5,820	$141,782,064
D9	4,350	$12,417	$54,012,215	0	$12,417	375	$3,104	2,235	$5,820	$14,172,386
D10	13,020	$12,417	$161,664,147	0	$12,417	1,262	$3,104	6,550	$5,820	$42,040,283
D11	66,275	$12,417	$822,910,241	0	$12,417	-2,173	$3,104	33,438	$5,820	$194,618,582
D12	1,980	$12,417	$24,584,870	0	$12,417	198	$3,104	0	$5,820	$614,622
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**309,395**	**N/A**	**$3,841,634,311**	**0**	**N/A**	**7,486**	**N/A**	**126,348**	**N/A**	**$758,618,632**

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Operational Improvements

(A) Baseline Inventory

1,056,914	Daily Vehicle Hours of Delay

(B) Projected Inventory (in 2029)

1,056,914	Daily Vehicle Hours of Delay

(C) Baseline Performance

Good	N/A	N/A
Fair	N/A	N/A
Poor	1,056,914	100.0%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	105,691	10.0%
Fair	N/A	N/A
Poor	951,223	90.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	N/A	N/A

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	N/A	N/A
Fair	N/A	N/A
Poor	1,056,914	100.0%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	7,458
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**7,458**
Add New	Any SHOPP or 2020 PID Work Plan	N/A

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	24,589	4,918/year
	Maintenance for 10 Years	0	0/year
	Other	73,767	N/A
	Total	**98,354**	**N/A**
Add New	SHOPP for the Last 5 Years	N/A	N/A

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$22,511	40.0%
	Maintenance	N/A	N/A
Add New	SHOPP	N/A	N/A

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$456,555,480
	5-Year Performance Gap	$774,916,179
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$1,231,471,659**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	134	N/A	N/A	N/A	N/A	N/A	N/A	-121	$25,239	$0
D2	4,000	N/A	N/A	N/A	N/A	N/A	N/A	400	$25,239	$10,095,755
D3	42,000	N/A	N/A	N/A	N/A	N/A	N/A	2,080	$25,239	$52,497,926
D4	260,000	N/A	N/A	N/A	N/A	N/A	N/A	26,000	$25,239	$656,224,073
D5	11,780	N/A	N/A	N/A	N/A	N/A	N/A	1,178	$25,263	$29,759,330
D6	17,000	N/A	N/A	N/A	N/A	N/A	N/A	1,537	$25,238	$38,790,847
D7	434,000	N/A	N/A	N/A	N/A	N/A	N/A	43,336	$25,239	$1,093,774,093
D8	97,000	N/A	N/A	N/A	N/A	N/A	N/A	7,876	$25,239	$198,785,415
D9	0	N/A	N/A	N/A	N/A	N/A	N/A	0	$25,239	$0
D10	11,000	N/A	N/A	N/A	N/A	N/A	N/A	642	$25,282	$16,231,018
D11	100,000	N/A	N/A	N/A	N/A	N/A	N/A	8,729	$25,239	$220,312,521
D12	80,000	N/A	N/A	N/A	N/A	N/A	N/A	6,576	$25,239	$165,974,212
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**1,056,914**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**98,354**	**N/A**	**$2,482,445,188**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Sign Panel Replacement

(A) Baseline Inventory	
87,187	Each

(B) Projected Inventory (in 2029)	
87,456	Each

(C) Baseline Performance		
Good	5,262	6.0%
Fair	0	0.0%
Poor	81,925	94.0%

(D) Desired State of Repair (DSOR) Target Performance		
Good or New	0	0.0%
Fair	87,456	100.0%
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario	Average Annual Rate	10-Year Deterioration
Into Fair	6.67%	3,509
Into Poor	20.00%	0

(F) Projected Performance (in 2029) - Do Nothing Scenario		
Good	1,753	2.0%
Fair	3,509	4.0%
Poor	81,925	94.0%

(G) Pipelined Projects Performance		
Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	0
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**0**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	10,496
	Maintenance through 2018/19	50
	Other (STIP, Local, etc.)	0
	Total	**10,546**
Add New	Any SHOPP or 2020 PID Work Plan	269

(H) Performance Gap			
Fix Fair to Good	SHOPP for the Last 5 Years	0	0/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**0**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	71,379	14,276/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**71,379**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*			
Fix Fair to Good	SHOPP	$9,258	30.0%
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$9,258	30.0%
	Maintenance	N/A	N/A
Add New	SHOPP	$9,258	30.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years		
SHOPP	Unfunded Pipelined Projects	$139,957,798
	5-Year Performance Gap	$859,074,082
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$999,031,880**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	4,185	$12,035	$50,368,106	0	$12,035	-4,185	$12,035	3,740	$12,035	$45,012,357
D2	7,407	$12,035	$89,146,132	0	$12,035	-7,180	$12,035	6,296	$12,035	$75,774,814
D3	6,868	$12,035	$82,659,056	0	$12,035	-6,649	$12,035	6,103	$12,035	$73,451,983
D4	13,895	$12,035	$167,231,740	0	$12,035	-13,020	$12,035	12,583	$12,035	$151,441,309
D5	4,582	$12,035	$55,146,156	0	$12,035	-3,830	$12,035	3,142	$12,035	$37,815,194
D6	7,078	$12,035	$85,186,488	0	$12,035	-6,724	$12,035	6,267	$12,035	$75,425,787
D7	17,346	$12,035	$208,765,870	0	$12,035	-16,903	$12,035	12,271	$12,035	$147,686,267
D8	8,790	$12,035	$105,791,076	0	$12,035	-8,771	$12,035	8,125	$12,035	$97,787,541
D9	1,512	$12,035	$18,197,509	0	$12,035	-1,512	$12,035	1,323	$12,035	$15,922,821
D10	4,623	$12,035	$55,639,607	0	$12,035	-4,514	$12,035	3,213	$12,035	$38,669,707
D11	7,261	$12,035	$87,388,965	0	$12,035	-6,786	$12,035	4,949	$12,035	$59,563,144
D12	3,909	$12,035	$47,046,338	0	$12,035	-3,873	$12,035	3,367	$12,035	$40,523,157
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**87,456**	**N/A**	**$1,052,567,042**	**0**	**N/A**	**0**	**N/A**	**71,379**	**N/A**	**$859,074,082**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Transportation Management Systems

(A) Baseline Inventory

19,853	Each

(B) Projected Inventory (in 2029)

22,465	Each

(C) Baseline Performance

Good	13,389	67.4%
Fair	N/A	N/A
Poor	6,464	32.6%

(D) Desired State of Repair (DSOR) Target Performance

Good or New	20,219	90.0%
Fair	N/A	N/A
Poor	2,246	10.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario

	Average Annual Rate	10-Year Deterioration
Into Fair	N/A	N/A
Into Poor	4.73%	6,333

(F) Projected Performance (in 2029) - Do Nothing Scenario

Good	7,056	35.5%
Fair	N/A	N/A
Poor	12,797	64.5%

(G) Pipelined Projects Performance

Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	N/A
	Maintenance through 2018/19	N/A
	Other (STIP, Local, etc.)	N/A
	Total	**N/A**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	7,698
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	25
	Total	**7,723**
Add New	Any SHOPP or 2020 PID Work Plan	2,612

(H) Performance Gap

Fix Fair to Good	SHOPP for the Last 5 Years	N/A	N/A
	Maintenance for 10 Years	N/A	N/A
	Other	N/A	N/A
	Total	**N/A**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	3,412	682/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**3,412**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*

Fix Fair to Good	SHOPP	N/A	N/A
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$115,965	37.0%
	Maintenance	N/A	N/A
Add New	SHOPP	$115,965	37.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years

SHOPP	Unfunded Pipelined Projects	$1,827,414,044
	5-Year Performance Gap	$542,068,632
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$2,369,482,676**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	211	$158,871	$33,521,829	0	$158,871	N/A	N/A	64	$158,871	$10,167,759
D2	433	$158,871	$68,791,242	0	$158,871	N/A	N/A	20	$158,871	$3,177,425
D3	1,973	$158,871	$313,452,934	0	$158,871	N/A	N/A	144	$158,871	$22,877,457
D4	5,395	$158,871	$857,110,278	0	$158,871	N/A	N/A	1,292	$158,871	$205,261,627
D5	1,002	$158,871	$159,188,971	0	$158,871	N/A	N/A	213	$158,871	$33,839,572
D6	1,180	$158,871	$187,468,050	0	$158,871	N/A	N/A	89	$158,871	$14,139,539
D7	4,302	$158,871	$683,464,025	0	$158,871	N/A	N/A	713	$158,871	$113,275,186
D8	2,204	$158,871	$350,152,188	0	$158,871	N/A	N/A	467	$158,871	$74,192,864
D9	133	$158,871	$21,129,873	0	$158,871	N/A	N/A	-1	$158,871	$0
D10	1,780	$158,871	$282,790,787	0	$158,871	N/A	N/A	274	$158,871	$43,530,717
D11	1,825	$158,871	$289,939,992	0	$158,871	N/A	N/A	-583	$158,871	$0
D12	2,027	$158,871	$322,031,980	0	$158,871	N/A	N/A	136	$158,871	$21,606,487
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**22,465**	**N/A**	**$3,569,042,148**	**0**	**N/A**	**N/A**	**N/A**	**3,412**	**N/A**	**$542,068,632**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Weigh-In-Motion Scales

(A) Baseline Inventory	
141	Stations

(B) Projected Inventory (in 2029)	
142	Stations

(C) Baseline Performance		
Good	28	19.9%
Fair	68	48.2%
Poor	45	31.9%

(D) Desired State of Repair (DSOR) Target Performance		
Good or New	127	89.4%
Fair	15	10.6%
Poor	0	0.0%

(E) Effective Deterioration (by 2029) - Do Nothing Scenario	Average Annual Rate	10-Year Deterioration
Into Fair	10.00%	28
Into Poor	6.47%	44

(F) Projected Performance (in 2029) - Do Nothing Scenario		
Good	0	0.0%
Fair	52	36.9%
Poor	89	63.1%

(G) Pipelined Projects Performance		
Fix Fair to Good	Any SHOPP or 2020 PID Work Plan	1
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**1**
Fix Poor to Good or Fair	Any SHOPP or 2020 PID Work Plan	4
	Maintenance through 2018/19	0
	Other (STIP, Local, etc.)	0
	Total	**4**
Add New	Any SHOPP or 2020 PID Work Plan	1

(H) Performance Gap			
Fix Fair to Good	SHOPP for the Last 5 Years	36	7/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**36**	**N/A**
Fix Poor to Good	SHOPP for the Last 5 Years	85	17/year
	Maintenance for 10 Years	0	0/year
	Other	0	N/A
	Total	**85**	**N/A**
Add New	SHOPP for the Last 5 Years	0	0/year

(I) Average Capital Unit Cost and Support Ratio*			
Fix Fair to Good	SHOPP	$1,806,670	100.0%
	Maintenance	N/A	N/A
Fix Poor to Good	SHOPP	$1,806,670	100.0%
	Maintenance	N/A	N/A
Add New	SHOPP	$1,806,670	100.0%

(J) Estimated SHOPP and Maintenance Costs for 10 Years		
SHOPP	Unfunded Pipelined Projects	$35,841,932
	5-Year Performance Gap	$437,214,122
Maintenance	Unfunded Pipelined Work	$0
	10-Year Performance Gap	$0
	Total	**$473,056,054**

(K) District Breakdown

District	Projected Inventory	Replacement Total Unit Cost*	Estimated Value	New Gap	"Add New" Total Unit Cost*	Fair Gap	"Fix Fair" Total Unit Cost*	Poor Gap	"Fix Poor" Total Unit Cost*	Performance Gap Cost
D1	4	$3,613,340	$14,453,359	0	$3,613,340	1	$3,613,340	2	$3,613,340	$10,840,020
D2	7	$3,613,340	$25,293,379	0	$3,613,340	4	$3,613,340	2	$3,613,340	$21,680,039
D3	12	$3,613,340	$43,360,078	0	$3,613,340	5	$3,613,340	6	$3,613,340	$39,746,738
D4	29	$3,613,340	$104,786,856	0	$3,613,340	9	$3,613,340	16	$3,613,340	$90,333,496
D5	4	$3,613,340	$14,453,359	0	$3,613,340	2	$3,613,340	2	$3,613,340	$14,453,359
D6	7	$3,613,340	$25,293,379	0	$3,613,340	1	$3,613,340	5	$3,613,340	$21,680,039
D7	17	$3,613,340	$61,426,777	0	$3,613,340	3	$3,613,340	11	$3,613,340	$50,586,758
D8	25	$3,613,340	$90,333,496	0	$3,613,340	7	$3,613,340	13	$3,613,340	$72,266,797
D9	2	$3,613,340	$7,226,680	0	$3,613,340	1	$3,613,340	1	$3,613,340	$7,226,680
D10	10	$3,613,340	$36,133,399	0	$3,613,340	1	$3,613,340	8	$3,613,340	$32,520,059
D11	17	$3,613,340	$61,426,777	0	$3,613,340	2	$3,613,340	13	$3,613,340	$54,200,098
D12	8	$3,613,340	$28,906,719	0	$3,613,340	0	$3,613,340	6	$3,613,340	$21,680,039
HQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statewide Totals	**142**	**N/A**	**$513,094,259**	**0**	**N/A**	**36**	**N/A**	**85**	**N/A**	**$437,214,122**

(*) DO NOT use these unit costs or support ratios for planning or project-level estimates. They represent a multi-year, programmatic-level average which includes numerous possible treatments.

Appendix C: 5-Year Maintenance Investment Plan

State statute requires the State Highway System Management Plan (SHSMP) include a 5-year Maintenance Investment Plan. To comply with state statutes, annual funding levels from the 10-Year Maintenance Investment Plan shown in Chapter 4 were used. A SHOPP cost avoidance analysis was performed and supports the funding levels identified in the 5-year Maintenance Investment Plan for the four primary asset classes under pavement, bridge and tunnel health, drainage restoration, and TMS. The analysis considers the historic investments in preventive maintenance and the degree to which those investments reduce the need for more costly capital improvements through the SHOPP. The 10-year Maintenance Investment Plan in Chapter 4 is the recommended Plan for achieving performance targets.

"The State Highway System Management Plan … shall identify projected future State Highway Operation and Protection Program costs that would be avoided by increasing maintenance spending."

California Streets and Highways Code, Section 164.6(c), updated by AB 515

Table C-1.
5-Year Maintenance Investments for SHOPP Cost Avoidance

Objectives	Major Maintenance ($M)	Field Maintenance Crews ($M)	Total ($M)	SHOPP Cost Avoidance ($M)
Pavement	$1,779	$95	$1,874	$5,622
Bridge and Tunnel Health	$630	$445	$1,075	$12,900
Drainage Restoration	$270	$146	$416	$1,664
Transportation Management Systems	$25	$137	$162	-
Total	$2,704	$823	$3,527	-

Table C-1 Notes:

- The estimated SHOPP Cost Avoidance is calculated using cost projection ratios (3:1 pavement, 12:1 bridge, and 4:1 drainage) supported by analyses by the Caltrans Programs and applied in prior 5-year Maintenance Plans. These ratios generally consider preservation treatments costs relative to rehabilitation costs.
- The 5-year costs shown for Major Maintenance and Field Maintenance are calculated as half of the 10-year costs presented in Table 4-2.

Appendix D: Summary of Feedback

California Transportation Commission

In the March 2019 meeting of the California Transportation Commission, the Commissioners approved the transmittal of formal comments for incorporation into the Final 2019 SHSMP. Eighteen comments were provided in a letter dated March 14, 2019 from the Commission to the Caltrans Director, based on a review of the February 2019 Draft SHSMP. Responses are provided in Table D-1 below addressing each comment.

Table D-1: Responses to California Transportation Commission Comments

Comment	Response
1) On page 2 of the Executive Summary, revise the first sentence of the third paragraph to state that the TAMP utilizes Commission adopted performance measures and targets "pursuant to" Senate Bill 486 instead of "as defined" by Senate Bill 486.	This change has been implemented (Executive Summary, pg. 2, 1st sentence, 2nd paragraph, "About the SHSMP" section).
2) Page 3 details the "current" inventory. Please indicate the date.	Throughout the document, we are using the term "baseline" to define the most current and best available inventory/condition data at the time of the SHSMP report preparation. This sentence was revised to conform to this convention (Executive Summary, pg. 3, 1st sentence, 1st paragraph, "Inventory and Conditions for State Highway System" section). The specific date associated with each objective varies. Chapter 5 provides additional information specific to each objective regarding the time frame associated with its baseline data.
3) On page 4, please clarify whether the estimated value ($296 billion) of the State Highway System considers benefits these assets provide to local, interstate, and international economies.	The asset valuation figure represents the estimated replacement cost of these assets. Additional narrative has been added (Executive Summary, pg. 5, inset graphic, "Value of Primary Assets on the SHS" section) to clarify that the replacement value is calculated using the inventory quantity multiplied by the unit replacement cost.
4) On page 5 of the Executive Summary there is a discussion of Projected 10-year Performance Accomplishments from 2019 to 2029 and Projected 10-year Condition based on the TAMP and Senate Bill 1 (SB 1) targets from 2017 to 2027. Add labels to Tables B, C, D and E to clarify the date range for the data contained in each table.	Appropriate dates associated with TAMP and SB1 targets have been added to the table headings for Tables B, C, and D (Executive Summary, pgs. 5-6).
5) On page 5 of the Executive Summary, include in Table D the SB 1 target of achieving a minimum level of service for pavement, potholes, spalls and cracking.	Additional narrative on Level of Service (LOS) has been added to Table C to clarify the required target of 90% level of service (LOS) achieved for maintenance of potholes, spalls, and cracks (Executive Summary, pg. 5).

Table D-1: Responses to California Transportation Commission Comments

Comment	Response
6) Table D on page 5 of the Executive Summary lists the SB 1 performance targets including the requirement to fix an additional 500 bridges over the ten-year period of 2017-2027. Please provide additional discussion and information regarding how Caltrans intends to meet this requirement, including how the fixed bridges are defined and will be quantified.	Additional narrative was added to explain the requirement to fix an additional 500 bridges over the plan period (Executive Summary, pg. 6, 1st paragraph, "Projected 10-Year Condition").
7) Table 2-3 on page 2-10 and Table 4-2 on page 4-6 both contain rounding errors that lead to the Sum column totals appearing to contain minor mathematical errors. These errors propagate to the Sums totaled in the Pipelined Projects, Performance Gap and Remaining Performance columns. Please correct this issue or provide a footnote that explains this rounding anomaly.	A note was added to Table 2-3 (pg. 2-9) and Table 4-2 (pg. 4-6) to acknowledge that totals and sub-totals may not add due to rounding.
8) Section 2.7 on page 2-11 mentions that the improvements to the State Highway System funded through programs outside of the SHOPP and Maintenance Program would exceed several hundred billion dollars. This includes programs such as the State Transportation Improvement Program and the Trade Corridor Enhancement Program. Please discuss how the benefits to the primary asset classifications from the projects in all Commission programs will be quantified. Additionally, the use of the phrase "improvement needs" in this section is unclear and should be clarified.	This paragraph has been updated to clarify the nature of improvement needs through these other programs and how these other programs contribute to SHSMP objectives (pgs. 2-10 and 2-11, 1st paragraph, "Addressing Needs through Other Programs" section). An expanded discussion on project-level contributions through some of these other programs is presented in Section 5.1, "Cross-Cutting Focus Areas" (pg. 5-2), including initiatives in complete streets (pg. 5-3), environmental stewardship (pg. 5-6), freight (pg. 5-8), and climate change (pg. 5-11).
9) The 2017 Plan identified 34 performance objectives, including Zero Emission Vehicles (ZEV) Infrastructure and Hazardous Waste Mitigation in the Sustainability Category, that are not included in the 2019 Plan. The 2017 SHOPP Ten-Year Investment Plan provided $15 million for ZEV infrastructure and $5 million for Hazardous Waste Mitigation to fund projects that were planned. Provide a summary for any projects initiated, and the Capital Outlay Support and Capital Outlay expenditures for these projects.	Additional narrative has been added to describe the programmed projects and their associated costs to support the 2017 SHSMP ZEV objective (pg. 5-12, last sentence, 3rd paragraph, "Reduce Greenhouse Gas Emissions" section). Similarly, additional narrative has been added to describe the programmed projects and their associated costs to support the 2017 SHSMP Hazardous Waste Mitigation objective (pg. 5-7, 2nd paragraph, "Other Environmental Stewardship Activities").
10) On page 4-3, describe the extent to which the SHOPP and Maintenance Investment Strategies consider emerging technologies.	A new bullet item was added to Table 4-1 to acknowledge that Caltrans employs innovative and emerging technologies to realize efficiencies in design, construction, and maintenance activities. Furthermore, a new paragraph was added to expand on emerging technologies and how they impact SHOPP and Maintenance activities (pg. 4-3, 1st paragraph, "4.1 Investment Strategies" section).

Table D-1: Responses to California Transportation Commission Comments

Comment	Response
11) On page 4-5, please provide more detail about how funds are apportioned based on the TAMP to the Caltrans Districts.	An additional sentence was inserted into this paragraph to further clarify that district-level funding is based on outstanding performance gaps, independent of historical district funding levels (pg. 4-4, 1st paragraph, "4.2 SHOPP Investment Plan" section).
12) In Table 4.2 on page 4-7, the Minor Program Investment Plan is stated to be $2.4 billion for the period of 2019 to 2029. This appears to be an increase of $800 million over the next 10 years as compared to the recent funding level of the Minor Program. This level will be included in the State Transportation Improvement Program Fund Estimate assumption that will be considered for approval by the Commission in May 2019. Please ensure that the amount shown in Table 2.3 for Minor Program is updated, if necessary, to reflect the May action.	This will be updated as needed, pending Commission approval.
13) The first sentence on page 5-1 classifies the four primary asset classes adopted by the Commission as "focus areas". Please remove "focus areas" from this sentence.	This change has been implemented (pg. 5-1, 1st sentence, 1st paragraph, "5 Program Objectives" chapter).
14) Pages 5-4 through 5-12 discuss the cross-cutting focus areas of Complete Streets, Environmental Stewardship, and Freight Activities. Describe Caltrans' estimates of Capital Outlay Support and Capital Outlay resources necessary for these activities and the inventory of needs established for each.	Caltrans is pursuing the development of a more comprehensive inventory of needs for these focus areas. These efforts will lead to location-specific details and cost estimates that can then be aggregated and used in future SHSMP investment planning. These cross cutting objectives may be incorporated during project development as applicable. An expanded discussion on these initiatives are presented in Section 5.1, "Cross-Cutting Focus Areas" (pg. 5-2), including complete streets (pg. 5-3), environmental stewardship (pg. 5-6), freight (pg. 5-8), and climate change (pg. 5-11).

Table D-1: Responses to California Transportation Commission Comments

Comment	Response
15) The System Resiliency and Climate Change focus area on page 5-10 discusses greenhouse gas reduction measures and climate change impacts and identifies assets vulnerable to sea level rise, storm surge, coastal erosion, and wildfires. Provide the approximate plan year where these efforts become a major role in maintaining our assets.	Caltrans is in the process of conducting district level vulnerability assessments and developing adaptation plans. These plans will provide initial costs associated with addressing these needs. While these needs are not fully defined at this point, Caltrans anticipates these needs beginning to influence the 2021 SHSMP and beyond. The degree of this influence depends upon the magnitude of the needs established through the vulnerability assessments. Additional narrative has been added to this section to note the current Caltrans guidance which requires considering, where applicable, a range of sea-level rise scenarios for the years 2050 and 2100 during the planning and project development phases of construction projects (pg. 5-13, last sentence, 4th paragraph, "Implementation of Adaptation Measures" section).
16) In Table C-1 on page C-1, describe the basis for the SHOPP Cost Avoidance amounts calculated. Provide additional information or reference other areas in the plan where the costs might be found.	Additional notes have been added to explain the source of the costs presented in Table C-1 and the basis for the calculations (pg. C-1, bottom of page, "Appendix C: 5-Year Maintenance Investment Plan").
17) Revise the name of Appendix D from Feedback to Summary of Feedback.	This change has been implemented (pg. D-1).
18) Provide an appendix that lists Commission Resolutions associated with the State Highway System Management Plan, the SHOPP, and the TAMP.	Appendix A was amended to include relevant references to Commission Guidelines, Resolutions, and Delegations (pg. A-2, "California Transportation Commission: Interim SHOPP Guidelines, Resolutions, and Delegations").

Public Review Comments

The Draft 2019 SHSMP was published on the Caltrans internet for public review, and an online comment submission system was made available between February 15 through March 8, 2019. All California MPOs and RTPAs were invited to participate in the public review. The sole survey response was received from Mono County, however, no changes to the document were recommended.

Appendix E: Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
AB	Assembly Bill
ABC	Accelerated Bridge Construction
ADA	Americans with Disabilities Act
APCS	Automated Pavement Condition Survey
ASBS	Areas of Special Biological Significance
ASTM	American Society for Testing and Materials
BMP	Best Management Practices
CAFE	Corporate Average Fuel Economy
Cal/OSHA	California Division of Occupational Safety and Health
CALGreen	California Green Building Standards
CalSTA	California State Transportation Agency
Caltrans	California Department of Transportation
CAPM	Capital Preventive Maintenance
CCA	Construction Contract Acceptance
CCPI	California Consumer Price Index
CEQA	California Environmental Quality Act
CFAC	California Freight Advisory Committee
CFMP	California Freight Mobility Plan
CHP	California Highway Patrol
CIA	Cooperative Implementation Agreement
CIP	Caltrans Improvement Projects
Commission	California Transportation Commission
CRCP	Continuously Reinforced Concrete Pavement
CSFAP	California Sustainable Freight Action Plan
CU	Compliance Unit
CVEF	Commercial Vehicle Enforcement Facilities
DSOR	Desired State of Repair
DVHD	Daily Vehicle Hours of Delay
ELI	Element Level Inspection
EO	Executive Order

EPA	Environmental Protection Agency
ECWC	Expected Construction Work Complete
FAST Act	Fixing America's Surface Transportation Act
FCI	Facility Condition Index
FCO	Financial Contribution Only
FE	Fund Estimate
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIP	Freight Investment Plan
FY	Fiscal Year
GHG	Greenhouse Gas
GPR	Ground Penetration Radar
HCAS	Highway Cost Allocation Studies
HDM	Caltrans Highway Design Manual
HFST	High Friction Surface Treatments
HM	Highway Maintenance
HOV	High Occupancy Vehicle
HPMS	Highway Performance Monitoring System
HSIP	Highway Safety Improvement Program
IAA	Inter-Agency Agreement
ICM	Integrated Corridor Management
IMMS	Integrated Maintenance Management System
IRI	International Roughness Index
ISO	International Standards Organization
ITS	Intelligent Transportation Systems
JPCP	Jointed Plain Concrete Pavement
LCCA	Life Cycle Cost Analysis
LCP	Life Cycle Planning
LED	Light-Emitting Diode
LEED	Leadership in Energy and Environmental Design
LOS	Level of Service
MAP-21	Moving Ahead for Progress in the 21st Century Act
MASH	Manual for Assessing Safety Hardware
MBP	Mobility Performance Report

MOU	Memorandum of Understanding
MPO	Metropolitan Planning Organization
NBI	National Bridge Inventory
NHFP	National Highway Freight Program
NPDES	National Pollution Discharge Elimination System
NTI	National Tunnel Inventory
OGFC	Open Graded Friction Course
PA&ED	Project Approval and Environmental Documentation
PaveM	Pavement Management System
PAVES-IT	Pavement Analysis and Vehicle Enforcement Strategic Information
PCC	Portland Cement Concrete
PeMS	Performance Measurement System
PID	Project Initiation Document
PPCP	Precast Panel Concrete Pavement
PS&E	Plan, Specification and Estimate
RTL	Ready to List
RICS	Remote Irrigation Control System
RMRA	Rehabilitation Account
RMRP	Road Maintenance and Rehabilitation Program
RWQCB	Regional Water Quality Control Board
SB	Senate Bill
SD	Structurally Deficient
SHA	State Highway Account
SHC	Streets and Highway Code
SHOPP	State Highway Operation and Protection Plan
SHS	State Highway System
SHSMP	State Highway System Management Plan
SHSP	Strategic Highway Safety Plan
SM&I	Structures Maintenance and Investigations
SMART	Structures Maintenance Automated Report Transmittal
SRRA	Safety Roadside Rest Area
STIP	State Transportation Improvement Program
STRAHNET	Strategic Highway Network
SWRCB	State Water Resources Control Board

TAMP	California Transportation Asset Management Plan
TCEP	Trade Corridor Enhancement Program
TMC	Transportation Management Center
TMDL	Total Maximum Daily Load
TMS	Transportation Management System
TOSNET	Traffic Operations Systems Network
TRF	Transportation Related Facility
Trust Fund	Federal Highway Trust Fund
VC	Vertical Clearance
WIM	Weigh-In-Motion
ZEV	Zero-Emission Vehicles

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Executive Team

Brian C. Annis, Secretary, California State Transportation Agency

Christine Inouye, Undersecretary, California State Transportation Agency

Laurie Berman, Director, Caltrans

James E. Davis, Special Advisor to the Director, Caltrans

Michael B. Johnson, State Asset Management Engineer, Caltrans

Caltrans Project Team

Loren Turner, Supervising Transportation Engineer

Hamid Sadraie, Senior Transportation Engineer, SHSMP Project Manager

Dawn Foster, Senior Transportation Engineer

Shalini Chandra, Transportation Engineer

Mara Chaudhari, Transportation Engineer

Youwei Zhou, Transportation Engineer

Melissa Thompson, Staff Services Manager III

Yin-Ping Li, Supervising Transportation Engineer

Jan Winbigler, Senior Transportation Planner

Jennifer Duran, Staff Services Manager I

Michelle Lopez-Hardie, Staff Services Manager I

Mary Alice Morency, Staff Services Manager I

Linda Meadows, Associate Governmental Program Analyst

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California Department of Transportation
1120 N Street
Sacramento, CA 95814
www.dot.ca.gov

California Department of Transportation