Caltrans

Revised CSIS

CAPTI ALIGNMENT METRICS

A companion document of the Caltrans System Investment Strategy (CSIS) to assess alignment with the Climate Action Plan for Transportation Infrastructure (CAPTI)

FEBRUARY 2026

CONTENTS

LIST OF FIGURES

1 – Introduction

This document details the California Department of Transportation's (Caltrans) implementation for one of the key actions of the California State Transportation Agency's (CalSTA) Climate Action Plan for Transportation Infrastructure (CAPTI, July 2021), which is to develop and implement the Caltrans System Investment Strategy (CSIS). CSIS is Caltrans' investment framework for assessing and prioritizing transportation infrastructure projects in alignment with CAPTI Guiding Principles.

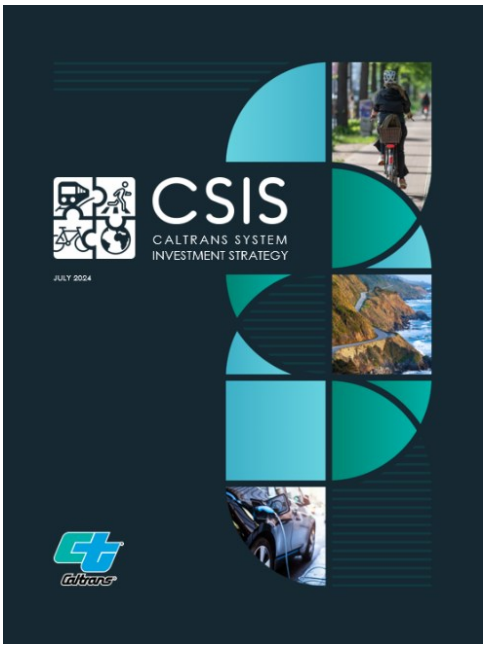

Figure 1: Caltrans System Investment Strategy

1.1 CONTEXT FOR THE REVISIONS TO CAPTI ALIGNMENT METRICS

During the development of CSIS through its release in 2024, Caltrans committed to future refinements based on emerging priorities, evolving data and methodologies, and feedback received through CSIS stakeholder engagement and pilot implementation.

Following its release, CSIS was piloted on Caltrans' Senate Bill (SB) 1 (Beall, 2017) project nominations for Cycle 4 of the Trade Corridor Enhancement Program (TCEP) and Solutions for Congested Corridors Program (SCCP).

This *Revised CAPTI Alignment Metrics* document fulfills that commitment by refining the 11 metrics. We will continue to update these metrics as needed based on new priorities or as updates to data emerge. This revision does not introduce new or additional metrics—it refines methodologies, clarifies data requirements and scoring criteria, and incorporates lessons learned from pilot implementation and stakeholder feedback.

1.2 PURPOSE OF THE REVISED CAPTI ALIGNMENT METRICS

The Caltrans System Investment Strategy is outlined in two key documents:

- *Caltrans System Investment Strategy (CSIS)*
- *Revised CAPTI Alignment Metrics*

Together, these documents define the investment framework used to assess and prioritize projects for various state and federal discretionary grant programs.

The framework operationalizes the 10 CAPTI Guiding Principles through 11 data-driven, performance-driven metrics.

The CAPTI Alignment Metrics assess a project's consistency with the State's climate and equity goals, and the CAPTI Guiding Principles. The metrics evaluate project competitiveness through the lens of CAPTI to inform the project prioritization and nomination process, resulting in greater collaboration with external partners and transparency in the decision-making process. These are the 11 CAPTI Alignment Metrics:

1. Safety
2. Vehicle Miles Traveled (VMT)
3. Access to Destinations
4. Disadvantaged Communities (DAC) - Access to Destinations
5. Disadvantaged Communities (DAC) - Traffic Impacts
6. Passenger Mode Shift
7. Infill Land Use and Natural and Working Lands
8. Freight Sustainability and Efficiency
9. Zero-Emission Vehicle (ZEV) Infrastructure
10. Public Engagement
11. Climate Adaptation and Resiliency

The Public Engagement and Climate Adaptation and Resiliency metrics are qualitative while the other nine are quantitative. As illustrated in **Figure 2**, the 11 metrics assess the extent to which a project aligns with one or more CAPTI principles.

1.3 APPLICABILITY OF CSIS INVESTMENT FRAMEWORK

The CSIS investment framework is applicable to non-State Highway Operation and Protection Program (non-SHOPP) projects that have completed their Project Initiation Document (PID) phase, which are commonly referred to as post-PID projects. CSIS applies to most state grant programs and, where feasible federal, discretionary grant programs that make funding available for multi-modal transportation infrastructure projects.

Program Fit: As part of CSIS, the first tier of evaluation is the Program Fit[1] assessment and rating. The Program Fit assessment is unique to each grant program and applies to all projects seeking Caltrans nominations for any discretionary grant program Refer to the 2024 Caltrans System Investment Strategy for further discussion on program fit.

CAPTI Alignment Metrics: The second tier of evaluation is the CAPTI Alignment Metrics assessment. Projects that have completed the Project Approval and Environmental Document (PA&ED) phase typically have sufficient information on project scope and data for the assessment.

Projects in earlier phases or draft PA&ED phases may also be assessed using preliminary data and estimates. Due to uncertainties in project scope, alternatives, or incomplete analyses, scores may be less precise. However, preliminary estimates can help inform a project's potential CAPTI Alignment Metrics scores and identify opportunities to refine project scope, design, and components.

General CSIS Scoring Cycle: A CSIS scoring cycle is a specific period during which project nominations are evaluated and prioritized under the CSIS investment framework for a particular discretionary grant program.

Each project undergoes an overall evaluation that includes a Program Fit rating and a CAPTI Alignment Metrics total score. Program Fit ratings typically use a multi-level scale tailored to the funding program. Projects are prioritized first by their Program Fit rating, followed by their CAPTI Alignment Metrics scores. Projects with low Project Fit ratings are less likely to proceed further in the nomination process.

The applicable CAPTI Alignment Metrics may vary by grant program based on program objectives and eligible project types. Program-specific guidelines identify which metrics apply to each discretionary grant program.

Note: This document establishes the revised CAPTI Alignment Metrics, including associated methodologies, data requirements, and scoring rubrics. Project prioritization under the CSIS investment framework considers both Program Fit and the CAPTI Alignment Metric scores, along with other considerations discussed in the CSIS policy document.

[1] Program Fit is an assessment of a project's competitiveness for a discretionary funding program. This assessment mirrors the program guidelines by ensuring the project meets the program objectives, eligibility, and requirements, and that the project is competitive under key program criteria.

2 – CAPTI Metric Score & Weight

CSIS acknowledges that a one-size-fits-all approach does not meet the needs of the state's diverse communities. CAPTI Alignment Metrics are designed to respond to different project types and geographical contexts–urban, suburban, and rural–providing a broad and contextual assessment of project-specific benefits and performance.

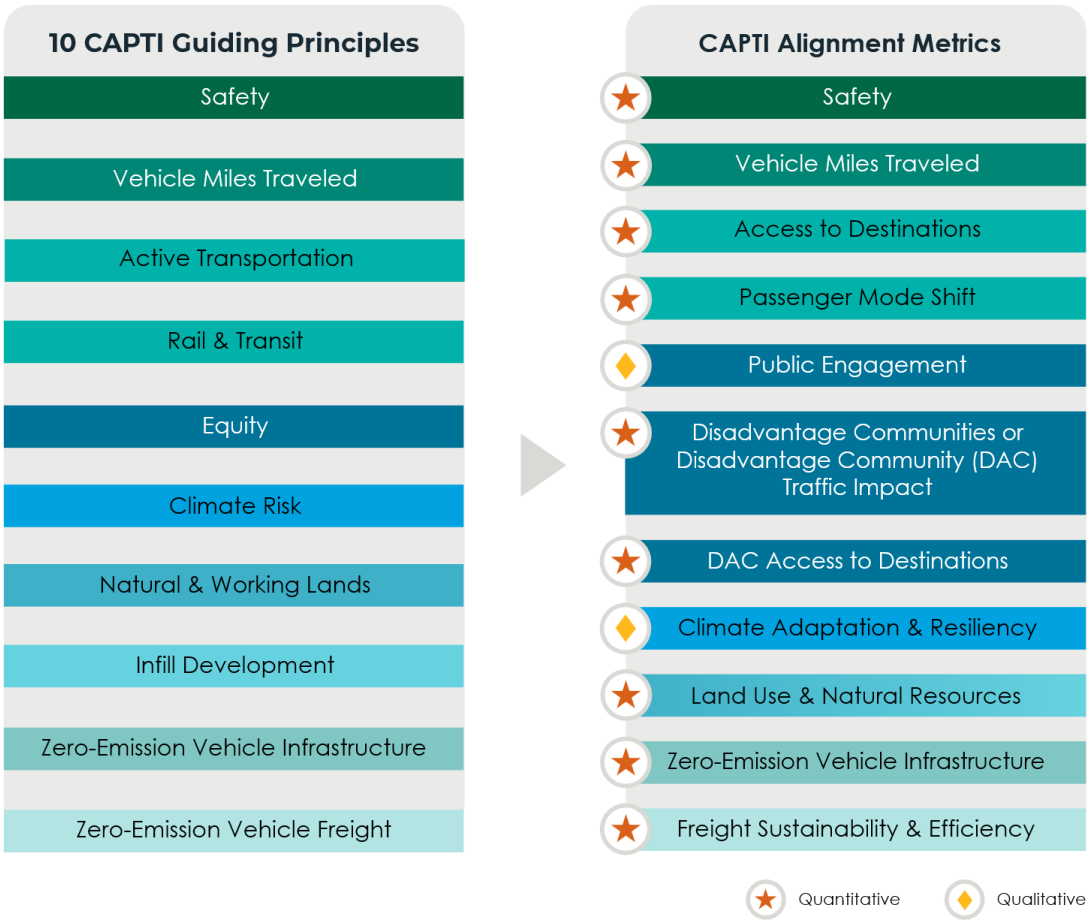

Figure 2: CAPTI Alignment Metrics for CAPTI Guiding Principles

Figure 2 shows the relationship between the CAPTI Guiding Principles and the metrics. Because the metrics align with the CAPTI Guiding Principles, they are called the CAPTI Alignment Metrics. These metrics assess projects for safety improvements, VMT impacts, multimodal connectivity, equitable outcomes for disadvantaged communities, mode shift, infill land uses, zero-emission vehicle infrastructure, and freight efficiency and

sustainability. Nine metrics are quantitative, and two—Public Engagement and Climate Adaptation and Resiliency—are qualitative.

2.1 METRICS DESIGN

The metrics are designed around the following fundamental principles:

Data Availability

- Datasets used for assessment by the Caltrans headquarters (Caltrans HQ) project scoring team should be available statewide.
- Metrics ensure equitable assessment capabilities regardless of geographical location (urban, suburban, or rural).

Applicability to Transportation Infrastructure Projects

- The CAPTI Alignment metrics provide a standardized framework. applicable to all types of transportation projects statewide as they are intended to be broadly applicable.
- However, not all metrics apply to every grant program. By design, some funding programs will only impact select metrics relevant to the funding criteria and project types.
- Projects within each grant program will be assessed only on applicable metrics, as determined by the program's scope and eligible project types.
- Exceptions to the applicability of specific metrics are specific to each grant funding program.
- For example, Active Transportation Program (ATP) projects typically show measurable benefits on metrics, such as Access to Destinations, Infill Land Use and Natural and Working Lands, and Safety. However, ATP projects generally do not impact freight operations. Assessing freight metric would therefore be irrelevant, as all ATP projects would receive nearly identical freight scores (little to no impact).

Array of 11 Metrics

- The array of metrics collectively addresses the CAPTI Guiding Principles.
- Not all projects include every element espoused in the Guiding Principles; therefore, projects are not expected to achieve the full maximum score on all 11 metrics.
- It is inherently difficult to achieve a perfect score of 110. As seen in the pilot, real-world projects scored in the 40-78 point range out of a maximum of 110 points.
- This approach enables all types of projects to earn points and demonstrate consistency with the CAPTI Guiding Principles.

Internal Tension Among Metrics

- Metrics are structured to create deliberate trade-offs where projects can score well on some metrics but not all simultaneously. (For example, projects could score well for reducing traffic impacts to disadvantaged communities by re-routing truck traffic via a bypass project (Disadvantages Communities–Traffic Impacts metric) but also increase regional vehicle miles traveled and score lower on the VMT metric.)
- This tension reflects real-world constraints across diverse project types and geographical contexts—particularly the land use–transportation nexus—and encourages thoughtful prioritization.

Discrete Scoring Regardless of Scoring Cycle

- The metrics are designed to provide a discrete score for each project.
- The project specific scores are not "graded on a curve."
- The overall CAPTI Alignment Metrics score is not weighted or adjusted through other statistical procedures.
- Individual metrics may include factors or weights or may be normalized. These factors are enumerated within each metric.

2.2 SCORING THE METRICS

Each CAPTI Alignment Metric is scored on a 0-10 point scale. A project can score a maximum of 110 points.

Each metric has a defined minimum score and a default score:

- **Minimum score:** The lowest score a project can receive when all relevant data and information is provided and assessed.
- **Default score**: The score assigned when a project does not provide all relevant data and information for the metric.

Default scores are assigned according to the metric's scoring methodology:

- **Metrics that require Affirmative or Positive Demonstration:** The minimum and the default score is 0 points. Without data or information to assess, the project earns 0 points. The following metrics require affirmative or positive demonstration:
    - Safety
    - Access to Destinations
    - DAC- Access to Destinations
    - Infill Land Use and Natural and Working Lands
    - Freight Sustainability and Efficiency
    - Zero-Emission Vehicle Infrastructure

  - Public Engagement
  - Climate Adaptation and Resiliency

- **Metrics with Directional Scoring:** Default score is five points, representing "no measurable change." The following metrics have directional scoring:
  - VMT
  - Passenger Mode Shift
  - DAC – Traffic Impacts

Projects with positive benefits, score between > 5 and 10 points. Projects with negative benefits, score between 0 and < 5 points.

For example, a project with no change in VMT would get a default score of 5 points. However, if such a project adds new travel lanes, elasticity-based models would show negative benefits regarding VMT and the project would score between 0 and < 5 points based on the amount of induced VMT.

2.3 METRIC SCORES

All 11 metrics are valued equally at 10 points each, with no single metric given additional points in the overall score. Individual metrics may have internal scoring criteria that apply factors, multipliers, and weights, as described in the relevant methodology and scoring sections of this document.

Adjusted Scoring for Program-Specific Applicability

When one or more metrics are not applicable to a particular funding program, those metrics are excluded from scoring, and the overall maximum score is reduced accordingly.

- Maximum score with all metrics: 110 points
- Reduced by 10 points for each excluded metric (e.g., 100 points when one metric is excluded, 90 points when two metrics are excluded, and so on).
- All applicable metrics remain equally valued at 10 points each.

3 – CAPTI Quantitative Metrics

There are nine quantitative metrics to assess consistency with the CAPTI Guiding Principles. Each metric section outlines the methodology and data requirements for the analysis, any known constraints, and the scoring rubric.

3.1 SAFETY

The purpose of the safety metric is to assess project-specific safety improvements. Projects receive higher scores if they demonstrate safety improvements, particularly in areas where safety needs have been identified. Projects are scored on a 0–10 point scale based on their projected crash reduction, crash history, and traffic exposure factors.

Methodology

This metric evaluates project safety through three components:

- **Safety Impact:** Measures the effectiveness of proposed safety countermeasures using Crash Reduction Factors (CRFs).
- **Crash History:** Accounts for observed safety needs in the project area, with emphasis on fatal and serious injury (FSI) crashes.
- **Crash Exposure:** Evaluates how the project affects potential risk through changes in vehicle miles traveled (VMT). Reduction in VMT would decrease exposure to roadway related safety risks.

Data Requirements

Applicants must provide the following information:

- **Location Data:** Project geographic location data using the publicly available intake form.
- **Crash Data:** Applicants must work with a registered civil (transportation) engineer or registered traffic engineer to provide the following information:

  Crash data must cover a five-year lookback period from the most recent year of available crash data for the area near the project's proposed safety infrastructure. Provide both on-system and off-system crash data, as applicable. Off-system data can be obtained from the Transportation Injury Mapping System (TIMS) or other local agency data, if applicable. Provide the following counts of crashes over a five-year lookback period near the project's proposed safety infrastructure, starting from the most recent year of available crash data:

  - All relevant roadway crashes

  - Fatal and serious injury crashes
  - Injury and/or complaint of pain crashes
  - Pedestrian and bike crashes
- **Safety Countermeasures:** Identify proven safety countermeasures aligned with the California Strategic Highway Safety Plan challenge areas that address the dominant crash patterns.
  - Focus on the 28 FHWA Proven Safety Countermeasures, available at https://dot.ca.gov/programs/safety-programs/proven-safety-countermeasures/countermeasures.
  - Extended Countermeasures: There is an option to add other countermeasures that are not on the FHWA list if the crash reduction factors are appropriately documented. Refer to Appendix C in this document.
- **Crash Reduction Factors (CRFs):** Identify and report context-appropriate CRFs associated with each project countermeasure for expected percent reduction in crashes. CRFs can be defined as expected percentages reduction in crashes and are not to be confused with the CMFs (Crash Modification Factors). The CRF should be applicable to all crashes including pedestrian and bike crashes.
  - Cite the relevant technical reference for each CRF from Caltrans or FHWA. Caltrans CRFs should come from the latest Local Roadway Highway Manual, and Caltrans' extended list of countermeasures.
  - Project sponsor engineers may also report other four- or five-star-rated CRFs from the Crash Modification Factors (CMF) Clearinghouse that are included in the project scope.
  - For projects with multiple countermeasures, the metric scoring team will select the three most impactful countermeasures and derive an aggregate project CRF using the Existing and Alternative Methods for Combining Multiple CMFs (FHWA, 2011) or equivalent methods.

The metric scoring team will verify the crash counts for a 30-meter buffer around the project location. The team will also verify that all countermeasures and their associated CRFs are included. Countermeasures with CRFs above 0.5—indicating crash reductions greater than 50 percent—will undergo additional validation. This verification may include review of source data, countermeasure type(s), and validation of calculation methodology.

Metric Constraints

Automobile and roadway safety research has a longer history with more robust and available data on crashes, crash reduction factors, and countermeasures, compared

to non-vehicular modes. To address this gap, the safety metric includes an extended list of countermeasures with enhanced representation of active transportation CRFs.

Non-roadway projects (e.g., transit, freight rail, or port projects) may lack demonstrable crashes or proven safety countermeasures. Transit projects typically have no safety countermeasures unless they include roadway modifications.

Projects receive a CRF-equivalent of 1.0 for any portion of the project scope that is separated from roadway vehicular traffic, such as transit, rail, or active transportation elements. For example, if 60% of a project consists of non-roadway infrastructure separated from traffic, that 60% receives a CRF of 1.0. This approach reflects the significant safety benefits of infrastructure that does not interact with roadway vehicles.

Observed crash history data may not capture actual safety needs. Crash data may be limited due to these reasons:

1. Data availability issues, such as skewed underreporting of incidents by geography or race/ethnicity.
2. Small sample sizes at the project-area level that create significant variation (e.g., crash risk may present as near-misses and close calls).
3. Limited bicycle and pedestrian use of facilities deemed too dangerous, suppressing the crash history.

Scoring Rubric

Projects are evaluated for their potential to improve safety conditions across all modes. The scoring rubric prioritizes the quality and appropriateness of proposed safety improvements as the primary criterion. Safety need, as demonstrated by observed crash history, serves as a supplemental factor that can boost scores when projects address documented crash issues with appropriate countermeasures.

Projects are scored through a four-step process:

1. **Safety Impact Score**: This step calculates the score by multiplying the aggregate project CRF by 10. Higher scores are assigned to countermeasures that have demonstrated greater effectiveness in reducing the number and severity of crashes.
    - Projects that eliminate conflicts between users of different modes (e.g., separated bike paths, grade separation, transit services) would receive the maximum score of 10 points under the Safety metric.
    - For roadway projects containing non-roadway passenger travel components (e.g., off-road multi-use path, passenger rail), the proportion of the project made up of these components receives full crash reduction credit, based on the assumption that facility users are moved from the

roadway to off-roadway or other modes. The remaining proportion uses the aggregate CRF from the roadway safety elements.

2. **Crash History Score**: A crash history factor is added to the score based on the documented project safety need. This factor represents a normalized, weighted sum of crashes across severity levels, with nearly 96 percent weight assigned to FSI crashes based on monetization estimates from FHWA[2]. This crash history factor is multiplied by 5, reflecting the following scoring logic:
    - A project with no proven safety countermeasures and no observed need scores 0 points.
    - A project with no proven safety counter measures but maximum observed need scores 5 points.
    - In practice, every project will include at least one safety improvement element, so crash history or safety need represents a factor that complements the primary criterion.
3. **Crash Exposure Score:** Projects receive an adjustment of -4 to +4 points based on the net change in the VMT. This adjustment accounts for the relationship between potential exposure and crash risk. The adjustment is calculated as VMT change divided by 10 million VMT.
    - Projects that reduce VMT by 10 million receive + 4 points.
    - Projects that increase VMT by 10 million receive -4 points.
    - Projects will receive proportionate points between +4 and -4 points based on increases or reductions in VMT (e.g., if a project increases annual VMT by 5 million, then it will have two points deducted from safety impact and crash history score.)
4. **Total Score**: The aggregate safety score is normalized, with a maximum score capped at 10 points.

[2] FHWA Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2025 Update II, Table A-1: Value of Reduced Fatalities, Injuries, and Crashes lists the following monetized value by crash type. Fatal Crash: $14,806,000; Injury Crash: $329,500; PDO Crash: $9,500.

Table 1: Safety Metric Score Values

Safety Component	Scoring Method	Score Range
Safety Impact	Aggregate project CRF x10	0 (no crash reduction countermeasures) to 10 points (proposed countermeasure would eliminate conflict between users of different modes)
Crash Exposure	Annual Net VMT Change	-4 (net increase of 10 million VMT or more) to +4 points (net decrease of 10 million VMT or more).
Crash History	[(Weighted sum ÷ 600[3]) × 5] • FSI × 0.96 • Injury/pain × 0.03 • Property damage × 0.01	0 (no observed history) to 5 points (maximum observed crashes)
Total Score	Total Score = Safety Impact Score + Crash Exposure Score + Crash History Score (The aggregate safety score is normalized with a maximum of 10 points.)	

3.2 VEHICLE MILES TRAVELED (VMT)

The VMT metric assesses a project's net effect on regional VMT[4] for the purpose of prioritizing projects that reduce VMT. Projects are scored on a 0–10 point scale based on their net effect on VMT.

The scoring of this metric is based on the result of project-level VMT analysis that is completed during project development. If the project has identified VMT mitigation strategies, VMT reduction from the mitigation measures is factored into the project's net VMT calculations. Unlike how VMT is evaluated under the California Environmental Quality Act (CEQA), the CAPTI Alignment Metric for VMT does not evaluate VMT based

[3] The 80th percentile for projects assessed in SB 1 Cycle 4.

[4] Net VMT can be defined as the change in vehicle miles traveled resulting from a proposed project, an increase or decrease from the baseline. This includes induced VMT from capacity expansion, VMT reductions from project elements, or mitigation measures.

on a threshold of significance, nor does it consider the project's significance of impact determination under CEQA.

Methodology

The VMT metric measures a project's net effect on VMT, including induced VMT[5] and/or VMT reduction associated with transportation projects. Applicants will provide annual VMT estimates developed as part of the project's environmental review process. Estimates are verified and confirmed in consultation with the Caltrans Director's Office of Sustainability, VMT Reduction Branch. If necessary, additional information gathered from the project's location and scope provided during the nomination process may be used to verify the estimates.

If a full VMT estimate has not been developed (e.g., the project has not yet completed environmental review), the project will be scored based on the estimated range of potential VMT increase or reduction from either the draft environmental document or Project Initiation Document (PID). For projects with multiple alternatives under study, the lowest score (i.e., the alternative that induces the most VMT) in the range will be selected.

If VMT mitigation[6] is part of a project, the project sponsor should provide information on the nature of the mitigation, the estimated VMT reduction, and the source of information for calculating the reduction. These mitigations will be factored into the project's net effect on VMT to calculate the project's overall VMT score.

Projects that do not increase VMT are not required to estimate the VMT reduction in the environmental process. However, applicants are encouraged to provide estimated VMT reduction based on travel demand model (TDM) outputs, estimated ridership, or other usage figures in order to receive additional points for the VMT metric.

Data Requirements

To assess the VMT metric, the required information will vary depending on whether the project reduces or increases VMT.

- **VMT-Reducing Projects:** Provide a VMT estimate based on the Caltrans SB 743 Program Mitigation Playbook and/or the California Air Pollution Control Officers Association GHG Handbook. If an estimate has not been prepared, contact the metric scoring team for assistance.

[5] Induced VMT can be defined as additional vehicle miles traveled generated when a project's capacity improvements make driving more convenient, leading to increases in vehicle travel.

[6] VMT mitigations are measures or elements designed to reduce VMT as part of CEQA requirements to reduce the significant impacts. Voluntary VMT reduction measures, such as Travel Demand Management (TDM) programs, active transportation or transit improvements may also be structured as mitigations.

- **VMT-Increasing Projects With No Final Environmental Document:** Provide the approved PID and/or any draft environmental documents or analysis.
- **VMT-Increasing Projects With a Final Environmental Document Predating SB 743:** Provide a VMT estimate following methodologies described in the most recent Caltrans Transportation Analysis Framework document available on the Caltrans SB 743 Implementation Resources page. This may include using elasticity-based methods such as the National Center for Sustainable Transportation (NCST) Calculator if the project is in an applicable county, and/or a TDM that has been reviewed by the Caltrans Director's Office of Sustainability, VMT Reduction Branch, and deemed adequate for estimating induced travel.
- **VMT Mitigations or Other VMT-Reducing Elements:** If VMT-reducing elements are identified—either as part of the project scope or as mitigation measures—provide information on the nature and specifics of the mitigations measures, the estimated VMT reduction, and the sources used to calculate the reduction.
- **No VMT Impact:** The project type must be non-VMT-inducing (e.g., zero-emission vehicle infrastructure), or the applicant must provide data and analyses to support "a no VMT" impact determination.

The metric scoring team will verify the VMT estimates based on project location and scope.

Metric Constraints

Evaluating the scope of VMT mitigations and inclusion into a project may not adequately capture the full scope of VMT reductions or additions. TDM models across different jurisdictions vary in methodology and data quality, and, therefore, VMT estimates produced by different TDMs may not compare equally across the board. Projects with environmental documents approved prior to SB 743 may not have estimates of induced VMT.

Scoring Rubric

For the VMT metric, a neutral score of 5 points is assigned to projects that do not have any effect on net VMT. The project's score is scaled from > 5 to 10 points for projects that reduce VMT, with 10 points corresponding to a reduction of 10 million VMT annually, and from 0 to < 5 points for projects that increase VMT, with 0 points corresponding to an increase of 10 million induced VMT annually.

Table 2: VMT Metric Score Values

Score	Description
>5 to 10	Scaled from > 5 to 10, with a score of 10 representing a 10 million annual VMT reduction.
5	No VMT change.
0 to <5	Scaled from 0 to < 5, with a 0 representing a 10 million annual VMT increase.

3.3 ACCESS TO DESTINATIONS

The Access to Destinations metric assesses the change in people's ability to reach work and non-work destinations across different modes of transportation. Projects receive higher scores if they increase access to jobs and essential services for more people and across multiple modes.

The metric measures the expected population-weighted average change (pre- and post-project) in the number of destinations (work and non-work[7]) across four modes (pedestrian, bicycle, transit, and automobile) that are within a two-hour travel time buffer of a proposed transportation project. Access is defined as the ease with which people may reach destinations such as jobs, stores, parks, schools (sometimes referred to as "opportunities"). "Ease" is measured in terms of travel time, with some adjustments to account for how travelers use the system[8] (SSTI, 2021).

Projects are scored on a 0–10 point scale based on population-weighted changes in access to destinations.

Methodology

Overall Metric

The Access to Destinations metric measures the population-weighted average change in the number of destinations that can be accessed across four modes, meaning a project's score is determined by how much it changes access provided by a given mode, as well as how many modes are impacted. For example, a project may increase the frequency of a local bus service. Another project may provide the same level of transit benefits and construct a bike/ped bridge over a nearby highway. The second

[7] Non-work destinations are also referred to "points of interest", or POIs. Examples include grocery stores, medical facilities, schools, attractions, etc.

[8] https://ssti.us/wp-content/uploads/sites/1303/2020/12/Measuring-Accessibility-Final.pdf

project would receive a higher score, since it increases the number of destinations that are accessed by three modes (transit, bike, ped), whereas the first project only increases the number of destinations accessed by one mode, transit.

The analysis is conducted for two destination types: jobs and non-work destinations (schools, grocery stores, etc.). Destinations are weighted by travel time using an exponential decay function, so that destinations that take longer to reach are weighted less than those that can be reached within a shorter amount of time. A decay function is calibrated for each project-specific mode to best capture the specific access benefits provided in each unique project context.

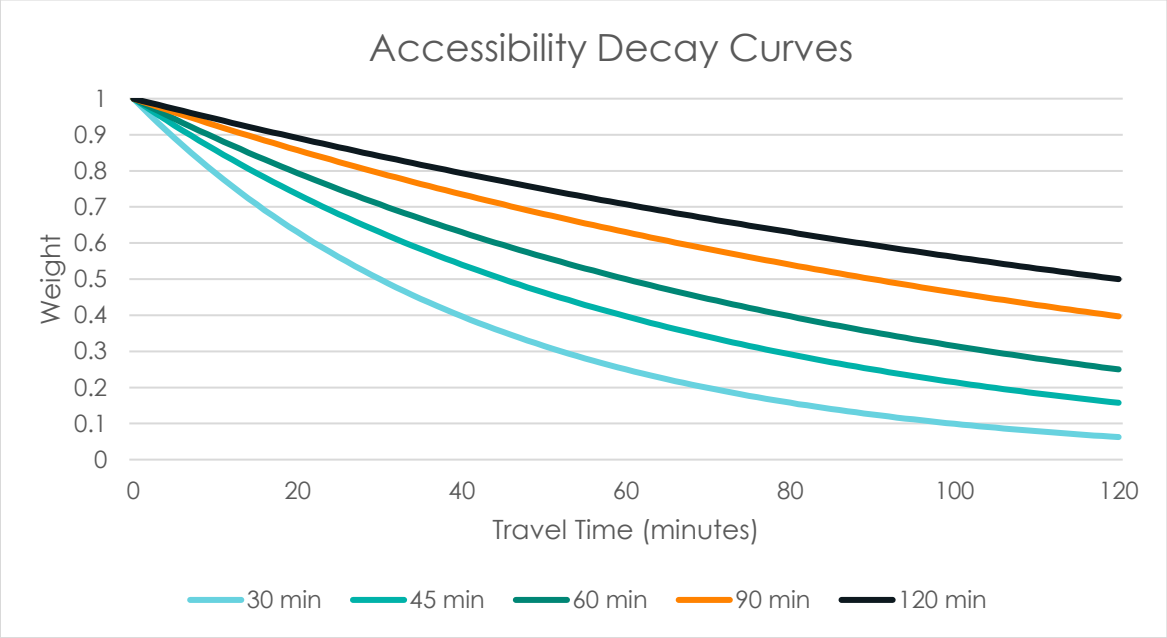

Figure 3: Exponential Decay Curves

In practice, a specific decay curve will produce optimal results (the highest score) for a given project depending on the project's characteristics and surrounding land use context. For example, a steep decay curve (i.e., 30 minutes) would be best suited for modeling a neighborhood-scale pedestrian project, where most of the expected benefits are realized by shorter trips (like walking to the corner store). Conversely, a longer decay curve (i.e., 120 minutes) would be best for projects that serve longer trips, such as an intercity rail project where most of the benefits are realized by longer trips. To account for this effect, the analysis is conducted for five decay curves (30, 45, 60, 90, and 120 minutes), and the curve producing the highest absolute change in the number of destinations is used for project analysis purposes. **Figure 3** illustrates the exponential

decay curves for all modes, which are also used for the Disadvantaged Communities – Access Destinations metric described in the next section.

This approach also resolves the issue of fixed time cutoffs, where access benefits below a certain threshold are not captured. For example, within a one-hour threshold without decay-weighting, a transportation project that reduces travel time from 61 minutes to 59 minutes would result in one additional destination that can be accessed. However, a destination that went from 59 minutes to 30 minutes would have no impact on the metric, despite seeing a much larger decrease in travel time. Decay-weighting ensures that all destinations (and by extension project benefits) are measured.

Calculations are performed for all origins in a given region, with all destinations in the surrounding region considered[9]. For each project mode, baseline and build scenarios are computed, and the difference is calculated for each destination type by subtracting the number of destinations in the baseline scenario from the number of destinations in the build scenario for each origin. These change values are then averaged within a fixed buffer area around the project alignment[10] and weighted by the relevant population in each origin.

Transportation Networks by Mode

The following sections discuss individual modal and land use modeling methodology and assumptions in further detail.

Pedestrian Mode

For analyzing a pedestrian's access to destinations, Open Street Map (OSM) data is utilized to perform routing calculations based on the presence of network links where walking is allowed. Currently, the analysis doesn't explicitly factor in the presence of sidewalks unless specifically identified in the analysis process.

For project analysis purposes, project components that either add new pedestrian network links and/or increase the quality of existing links are considered. For routing purposes, network links are either considered traversable or non-traversable. In some cases, projects include the addition of sidewalks in locations where sidewalks are lacking, but where walking is technically allowed in the underlying OSM network. In these cases, the baseline scenario is modified to prohibit walking on these links to

[9] Origins and destinations are operationalized as 216 by 216-meter grid cells.

[10] Analysis buffers are drawn based on the distance that someone could hypothetically travel within a two-hour window utilizing a given mode. This approach is straightforward for pedestrian and biking modes as these have fixed speed assumptions. Transit and automobile modes have variable speeds, therefore, average speeds are calculated using average observed speeds. The buffer areas used for this analysis, by each mode are Biking: 24km, Walking: 7.2km, Transit: 48km, Auto: 90km.

ensure the benefits of the added sidewalk links are captured. An analysis is run using both the baseline and modified networks to isolate the accessibility changes attributable to the project. For all analysis involving walking, a fixed walk speed assumption of 3.6 kilometers/hour is used.

Bicycle Mode

For analyzing the number of destinations that can be accessed via bicycle, OSM data is utilized to perform routing calculations based on the presence of network links where cycling is allowed as well as the Level of Traffic Stress (LTS) of said links. LTS is calculated using a simplified methodology that can be operationalized with limited data. For routing purposes, low-stress network links (LTS 2 and below) can be traversed at normal bicycle speed (12 kilometers/hour). High-stress links (LTS 3 and above) can only be traversed at walking speed (3.6 kilometers/hour), assuming that a cyclist would walk with their bicycle on the side of the road if conditions were high-stress.

For project analysis, project components that either reduce the LTS on an existing network link to low-stress and/or create new low-stress network links are considered. An analysis is run using both the baseline and modified networks to isolate the accessibility changes attributable to the project.

Transit

For analyzing the number of destinations that can be accessed via transit, General Transit Feed Specification (GTFS) data is utilized to perform routing calculations based on scheduled fixed-route transit service in California. For each Origin-Destination pair, total travel time is calculated, including the access/egress walk legs, time waiting for transit, in-vehicle travel time, and transfer time if applicable.

For each transit analysis, 1,200 trips are simulated for each origin-destination pair using randomly generated departure times during the AM peak period and the 50th percentile (median) travel time. This adjusts for variance in travel time caused by trip start time and which specific transit routing is used (where there are multiple routing options).

For project analysis purposes, project information is translated into GTFS modifications, which are then applied to the overall network. An analysis is run using both the baseline and modified networks to isolate the accessibility changes attributable to the project.

Automobile Mode

For analyzing the number of destinations that can be accessed via auto, OSM data is utilized to perform auto routing calculations based on auto-accessible roadway network links and posted speed limits. If alternative speed assumptions are provided for certain links, they can be incorporated into the analysis.

For project analysis purposes, project components that either change auto speeds on the existing network or add/remove network links are analyzed. Project sponsors must provide estimated baseline and build speed assumptions for applicable network links as well as geographic data on any new or removed network links. By default, AM peak period speeds are modeled, but the metric can consider other time periods on a case-by-case basis if a non-AM peak period is more relevant to the project. Speed changes are analyzed in relation to the full network link, so individual lane speeds are averaged and weighted by AADT. This is mainly applicable in the case of managed lane projects, where individual managed and general-purpose lane speeds are typically calculated.

An analysis is run using both the baseline and modified networks to isolate the accessibility changes attributable to the project.

Land Use

Destinations

Employment location (jobs) data is accessed via the U.S. Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) dataset, which is compiled using administrative data from the federal government. The estimated number of jobs in each Census block is interpolated into a regular grid which is used to perform the calculations. For this metric, all job types are considered, although jobs can be stratified by industry as well as various characteristics of the job holder. Jobs are treated as a destination type in the metric.

Non-work destination data was purchased from the data vendor HERE in 2022. Destinations were cleaned and classified as "core" and "other", with other destinations receiving half the weight of core destinations. Core destinations are those of higher importance, such as medical services, grocery stores, and educational facilities. Each core destination is counted as one destination for measurement purposes. Other destinations, while still important, don't have the same importance as core destinations since they are not essential, or aren't visited regularly. As an example, a coffee shop would be an "other" destination. Every "other" destination is counted as one half for measurement purposes. A complete list of non-work destinations can be found on page 42 of the Caltrans Transportation Equity Index (EQI) documentation. Non-work destinations are treated as a destination type in the metric.

Population Data

While destination data represents what and how much people can access, population data represents who is the beneficiary of improved access. This is relevant in two keys ways. First, population data can be used to understand which groups specifically benefit from access improvements. In the CSIS framework, access improvements for the total population, workers, and low-income residents are quantified. Secondly,

population data can ensure that access benefits serve a maximum number of people as possible. For example, an access-enhancing project (i.e., a new infill rail station) would provide more access if located in a higher density residential area, rather than in a sparsely populated area.

Total population data is accessed via the U.S. Census Bureau's American Community (ACS) Survey 5-Year Estimates B01003 table, at the block group-level. Block group-level data is then interpolated into a regular grid where it is used to weigh the analysis results.

For job accessibility analyses, changes in job access are weighted by employee residential location. This data is also accessed via the LEHD dataset and is available at the census block-level. The estimated number of employees in each Census block is interpolated into a regular grid which is used to weight job accessibility analysis results.

Custom Land Use Data

For most projects, the standardized land use datasets discussed above will produce reasonable results. However, there are cases where a planned transportation project is dependent on, or enables, a complementary land use project. For example, a new rail station at an infill site might be proposed to serve future housing development. If this land use project has not been delivered, it will not be accurately reflected in Census data and may negatively impact the project score. If such land use projects exist, custom land use scenarios can be developed to ensure future project benefits are accounted for.

Modal Score Combination and Threshold Setting

The Access to Destinations metric calculates the population-weighted change in access to destinations, expressed as the number of additional destinations accessible for the average resident/worker, post-project implementation. For project scoring purposes, thresholds were developed to scale analysis outputs to the CSIS scoring scale, where increases that are greater or equal to the threshold value receive full points.

Since these outputs are not on the same scale across modes, destination types, and decay curves, a specific threshold was developed for each scenario[11]. These thresholds are defined as 1 percent of the population-weighted statewide average number of destinations that can be accessed by a given mode/destination/decay curve combination. **Table 3** shows all threshold values utilized in the Access to Destinations metric. Each project is assessed using all decay curves and results are scaled from 0 to 10 points using the applicable threshold. As previously discussed, the decay curve

[11] While a relative metric (percent change) is normalized across modes, destination types, and decay curves, absolute changes in the number of destinations are not. For example, the number of additional jobs accessed by a given auto project will be much higher than for a bike project in most cases, since it is possible to drive much further within two hours than it is to bike.

producing the highest change in the number of destinations is utilized for CSIS Access to Destinations analysis purposes.

Table 3: Access to Destinations Decay Curve Thresholds

Mode	Cutoff[12]	Avg. Job Access	Avg. POI Access	Job Threshold	POI Threshold
Pedestrian	30	20,995	255	209.9	2.5
Pedestrian	45	33,611	402	336.1	4.0
Pedestrian	60	43,388	516	433.9	5.2
Pedestrian	90	56,761	672	567.6	6.7
Pedestrian	120	65,243	770	652.4	7.7
Bike	30	83,984	979	839.8	9.8
Bike	45	131,674	1,518	1,316.7	15.2
Bike	60	168,330	1,931	1,683.3	19.3
Bike	90	218,216	2,491	2,182.2	24.9
Bike	120	249,749	2,844	2,497.5	28.4
Transit	30	148,025	1,717	1,480.3	17.2
Transit	45	262,304	3,043	2,623.0	30.4
Transit	60	354,400	4,113	3,544.0	41.1
Transit	90	483,408	5,612	4,834.1	56.1
Transit	120	566,530	6,578	5,665.3	65.8
Auto	30	2,049,624	23,983	20,496.2	239.8
Auto	45	2,899,968	34,232	28,999.7	342.3
Auto	60	3,506,418	41,598	35,064.2	416.0

[12] Cutoff refers to the decay curve cutoff parameter, which controls the steepness of the curve. For example, a 45 minute cutoff would equate to a curve where a value of a destination would be one-half at 45 minutes of travel time. For more information on decay curves, see Figure 3.

Auto	90	4,291,222	51,180	42,912.2	511.8
Auto	120	4,769,969	57,047	47,699.7	570.5

Though accessibility is analyzed on a mode-by-mode basis, many transportation projects include components that impact the number of destinations that can be accessed by multiple modes. For example, a highway project may aim to decrease auto travel times along a corridor, while also providing faster or additional transit service or low stress bike facilities. In such cases, a separate analysis is conducted for each mode.

Modal-specific scores are then combined across modes using a simple average. If a project doesn't impact a given mode, its modal score is set to zero points to ensure that any additional modal access to destinations can only increase the overall metric score. Overall, 8 individual scores are averaged (4 modes times 2 destination types), and the final total metric score is capped at 10 points.

However, individual modal scores are not capped at 10 points if their increase in the number of destinations exceeds the applicable thresholds. Typically, projects perform well by increasing the number of destinations accessed by multiple modes, and/or significantly increasing the number of destinations accessed by a single mode to an extent where it outweighs the zeros of the non-applicable modes in the overall average.

For example, Project A may impact all 4 modes, producing 8 individual scores of 7.5 points. Therefore, Project A would receive an average score of 7.5 points. Project B would only increase the number of destinations accessed by transit, but do so by a lot, resulting in 2 transit scores of 50 (for work and non-work destinations), with all other modal scores set at 0 points. When averaged, the overall project score would score 10 points, despite having impacts for only one mode.

Data Requirements

The following information is required to run the Access to Destinations metric for a proposed transportation project:

- **Location Data**: Provide project geographic location data using the publicly available intake form.
- **Project Mode(s)**: Identify the mode(s) included in the project scope and affected by the project. For example, a new class I bike/ped path would likely impact bike and ped modes and possibly access to transit modes if it improves first/last mile connections.
- **Transit Schedule Information (for transit only)**: If a project is anticipated to impact transit service, provide schedule information for both the existing and proposed

transit service. This information should include frequency, speed (can be expressed as stop times), and new alignments/stops if applicable.

- **Auto Speed Data (for auto projects only)**: If a project is anticipated to impact auto speeds, both baseline and build auto speeds for the impacted network links must be provided. If the project has a completed benefit-cost model, the same speed assumptions can be used.
- **Change in Land Use (optional)**: If a project is serving a location with an expected near-term[13] change in land use (i.e., new housing, jobs, or non-work destinations), those can be provided by the project sponsors to adjust the relevant scores. For future land use to be considered, approximate changes in the number of people, jobs, and or non-work destinations must be provided using the publicly available intake form.

Metric Constraints

The Access to Destinations metric focuses on the transportation-land use components of access, but it has certain limitations in capturing access in the broader sense of the term. For example, access to healthcare services involves much more than physical proximity, as access to these facilities is often determined by insurance status, income, and other non-transportation factors.

The current metric measures pedestrian access based on existing facilities, regardless of the presence of sidewalks. If there are no sidewalks and a project proposes to add sidewalks, the model assumes pedestrians can walk along a facility where they could not before. Future revisions to the metric will develop a pedestrian LTS approach so that more nuanced network enhancements can be analyzed more accurately.

For auto access, baseline network speeds are derived from posted speed limit data from OSM. For a given project or scenario, the speed assumptions can be replaced with observed speed data from a data provider and/or speed data provided by the applicant to account for differences between build and no-build speeds. This helps capture the travel-time savings benefits of operational improvements.

Lastly, the metric utilizes a simplistic approach to modeling bicycle facilities due to a lack of statewide facility data. For bike access, improvements to existing facilities are measured in terms of LTS, where a project can convert a formerly high-stress facility into a low-stress one. Future revisions to this metric may take a more nuanced approach to LTS, rather than simply measuring the difference between the high- and low-stress networks.

[13] "Near-term" is defined as groundbreaking within one year of project opening.

Scoring Rubric

Table 4: Access to Destinations Metric Score Values

Score	Description
> 0 to 10	Population-weighted average change in access is scaled from 0 to 10 points, where 10 points corresponds to an increase in population-weighted access >= i[14]
0	No change or decrease in population-weighted access.

3.4 DISADVANTAGED COMMUNITIES (DAC) – ACCESS TO DESTINATIONS

The DAC – Access to Destinations metric assesses a project's ability to provide transportation access to economic opportunities and other destinations for DACs. Projects are scored on a 0–10 point scale based on population-weighted percentage changes in access to destinations for people living in disadvantaged communities.

This metric is similar to the Access to Destinations metric but differs in two ways. One difference is that while the Access to Destinations metric measures the population-weighted average change in the number of accessible destinations attributable to a project, this metric measures change in relative terms, as a population-weighted percent change. This ensures that even small changes in the number of destinations—if significant relative to a community's baseline—can yield a high score. The other difference is that this metric uses DAC population weights, rather than worker and total population weights, to specifically measure changes for DAC populations instead of the population at large.

For the purposes of this metric, DACs are defined in a manner consistent with the Caltrans Transportation Equity Index (EQI) and refer to all people living in Assembly Bill (AB) 1550-defined low-income households. This approach ensures that all low-income residents are captured, even if they live in higher-income areas.

[14] *i* refers to the applicable threshold value for a given mode/destination type/decay curve combination, shown in Table 3.

Methodology

Overall Metric

This metric measures the DAC population-weighted percent change in access to destinations across four modes (bike, ped, transit, and auto) for two destination types (jobs and non-work destinations). An average is calculated across all 8 change values, and the overall average is rescaled from 0 to 10 points, where 0 points represents a decrease in access or no change in access, and 10 points represents an increase of 1 percent or greater. For a given project, modes that do not affect access to destinations are assessed as 0 percent change and still contribute to the overall average, so additional modal components can only increase the overall score.

Similar to the Access to Destinations metric, analysis is run using multiple decay functions (30, 45, 60, 90, and 120 minutes) and the highest percentage-change value is used. For a more detailed discussion on decay functions and calculations, refer to Section 3.3—Access to Destinations.

DAC Weighting Factor

Population weighting is a key aspect of the DAC - Access to Destinations analysis and accounts for where impacts occur and which populations are most affected. The process for calculating the DAC weighting factor is shown in **Figure 4.**

One of the primary differences between the Access to Destinations metric and this metric is the population weighting approach.

Figure 4: DAC Population Weighting

The Access to Destinations metric uses two population weighting factors: workers' home locations and total population.

Whereas this metric uses a single weighting factor: the residential locations of DAC residents, defined as estimated members of AB 1550[15] low-income households.

The DAC weighting factor is calculated based on three primary components: 1) the county in which the census block group is located, 2) household income levels, and 3) average household size. American Community Survey (ACS) data are used to estimate the number of low-income households within each block group, and the number of residents is estimated by applying an average household-size expansion factor.

County-specific income thresholds set by the California Department of Housing and Community Development (HCD) are used, in part, to establish low-income status. This allows estimates to account for local cost of living and ensures that lower-income residents in high-cost areas are captured.

The analysis results are weighted by the DAC weighting factor, which measures the extent to which DAC residents benefit from increases in the number of destinations. If a project's benefits disproportionately serve DACs, it will receive a higher score; if the benefits primarily serve more affluent areas, it may receive a lower score.

Data Requirements

To assess the DAC – Access to Destinations metric, the following information is required:

- **Location Data**: Provide project geographic location data using the publicly available intake form.
- **Project Mode(s)**: Identify the mode(s) included in the project scope and affected by the project. For example, a new class I bike/ped path would likely impact bike and ped modes and possibly access to transit modes if it improves first/last mile connections.
- **Transit Schedule Information (for transit only)**: If a project is anticipated to impact transit service, provide schedule information for both the existing and proposed transit service. This information should include frequency, speed (can be expressed as stop times), and new alignments/stops if applicable.
- **Auto Speed Data (for auto projects only)**: If a project is anticipated to impact auto speeds, both baseline and build auto speeds for the impacted network links must be provided. If the project has a completed benefit-cost model, the same speed assumptions can be used.

[15] AB 1550 defines low-income households as those at or below 80 percent of the statewide median household income and/or below the Department of Housing and Community Development (HCD)-defined low-income limit.

- **Change in Land Use (optional)**: If a project is serving a location with an expected near-term[16] change in land use (i.e., new housing, jobs, or non-work destinations), those can be provided by the project sponsors to adjust the relevant scores. For future land use to be considered, approximate changes in the number of people, low-income residents, jobs, and other non-work destinations must be provided using the publicly available intake form.

Metric Constraints

This metric is similar to the Access to Destinations metric (**Section 3.3**) in terms of metric constraints.

Scoring Rubric

Points are assigned based on the following ranges:

Table 5: DAC Access to Destinations Metric – Score Values

Score	Description
>0 to 10	Percent change is scaled using this score range, where 10 points corresponds to >=1% increase in DAC population-weighted access.
0	0% or < 0% change in DAC population-weighted access.

3.5 DISADVANTAGED COMMUNITIES (DAC) – TRAFFIC IMPACTS

The DAC–Traffic Impacts metric evaluates a project's potential to create new burdens or exacerbate existing burdens on disadvantaged communities (DACs), in the form of additional automobile and truck traffic exposure. Projects are scored on a 0–10 point scale based on truck-weighted Annual Average Daily Traffic (AADT) impacts to disadvantaged communities.

Methodology

Overall Metric

The DAC–Traffic Impacts metric quantifies the change in projected truck-weighted AADT that could impact DACs, based on the Caltrans Transportation Equity Index (EQI) Traffic Exposure Screen. Truck-weighted AADT is defined as AADT where truck traffic is weighted 6 times greater than auto traffic, consistent with the EQI methodology. This is

[16] "Near-term" is defined as groundbreaking within one year of project opening.

based on emission figures from the California Air Resources Board (CARB) and may be refined in a future version of the EQI. DACs are defined as Census blocks that are either low-income (per AB 1550) and/or intersect a Tribal Land and are at or above the 80th percentile for truck-weighted traffic proximity and volume, consistent with the EQI Traffic Exposure Screen.

Figure 5 illustrates the methodology to assess a project's potential to create new burdens or exacerbate existing burdens (measured as projected truck-weighted Annual Average Daily Traffic) on disadvantaged communities (DACs).

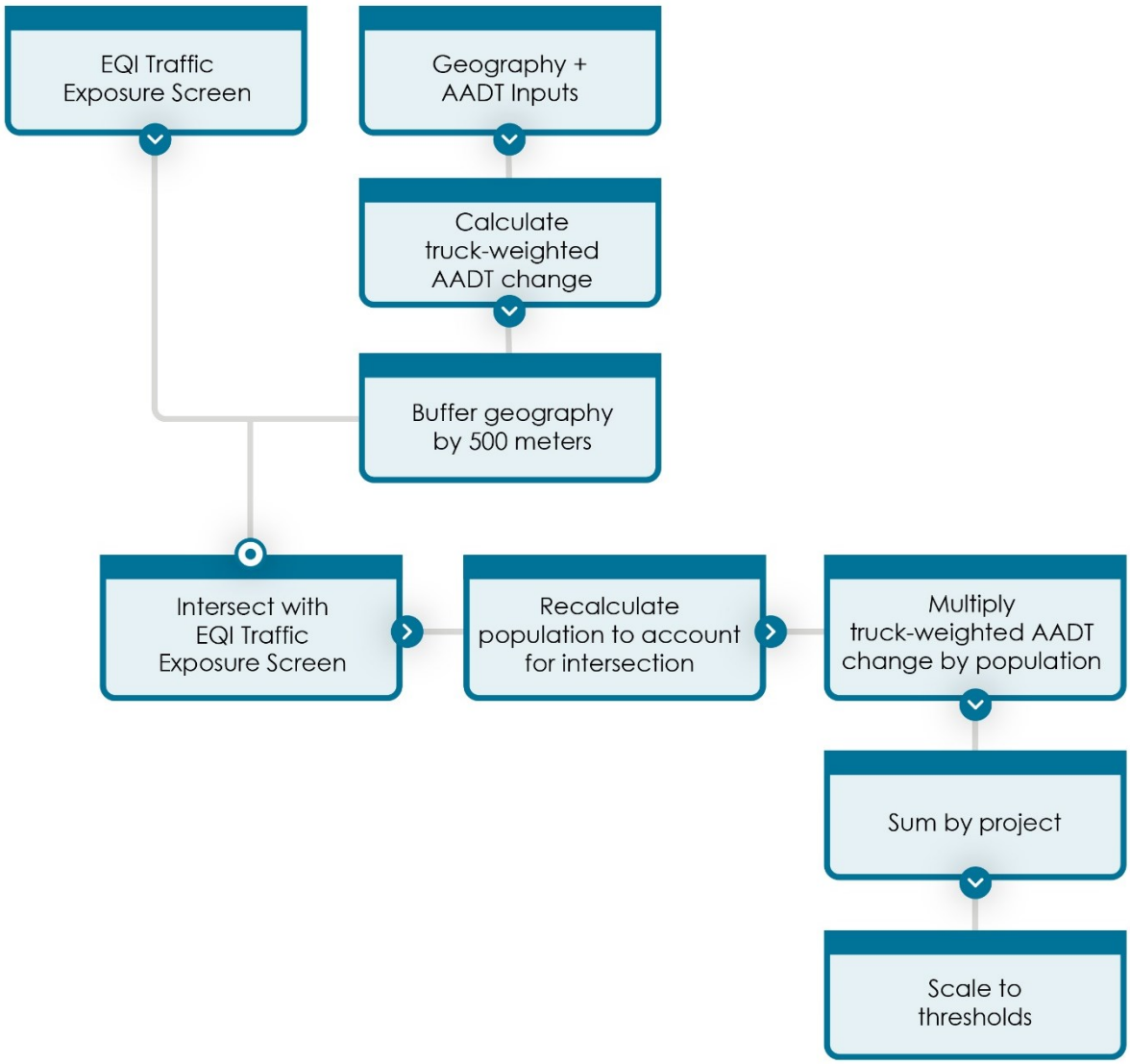

Figure 5: Methodology Flowchart

To evaluate the effects of additional traffic on DACs, a project's auto-component locations are buffered by 500 meters and intersected with the EQI Traffic Exposure Screen. The truck-weighted change in AADT is then multiplied by the number of people residing in each intersected EQI DAC and summed to calculate a truck-weighted AADT impact score.

Projects that are not within 500 meters of a DAC will receive a neutral score on this metric, regardless of the change in AADT. Projects that do not change truck-weighted AADT but are within 500 meters of a DAC will also receive a neutral score.

Projects score poorly by increasing truck-weighted AADT within 500 meters of screened communities, especially those with higher population densities. Projects score well by doing the opposite — decreasing truck-weighted AADT within 500 meters of higher-density screened communities. When a project diverts traffic away from a heavily populated DAC but doesn't reduce the traffic (i.e., a bypass project), it can score positively, as the metric is primarily concerned with the geographic location of traffic in relation to DACs, not the total amount of traffic on its own.

Threshold Development

Since the DAC –Traffic Impacts metric is a quantitative measure of the interaction between changes in traffic burden and the location of impacted DACs, thresholds were developed to account for both factors. The truck-weighted AADT impact score threshold of three was developed using hypothetical project assumptions based on observed data. The assumption is a 10 percent increase in truck-weighted AADT along a one-mile stretch of busy[17] urban highway, surrounded by low-income, high-density[18] residential development.

A project with these assumptions would yield a raw truck-weighted AADT impact score of 293,174,653. For simplicity, this score is rounded to 300,000,000 and divided by 100,000,000 to produce a truck-weighted AADT impact score of 3.

Project AADT impact scores range from 0 to 10 points, where 0 points represent an increase in truck-weighted AADT impact score of 3 or greater, and 10 points correspond to an AADT impact score decrease of 3 or greater.

[17] "Busy" is defined as the 80th percentile AADT value for highway segments in the state. This figure is 133,000 AADT. Assuming a 15 percent truck share, a 10 percent increase in truck-weighted AADT here is 23,275 AADT.

[18] High-density is defined as the 80th percentile block group population density, which is 13,602 people per square mile.

Figure 6 illustrates the development of truck-weighted AADT impact score threshold.

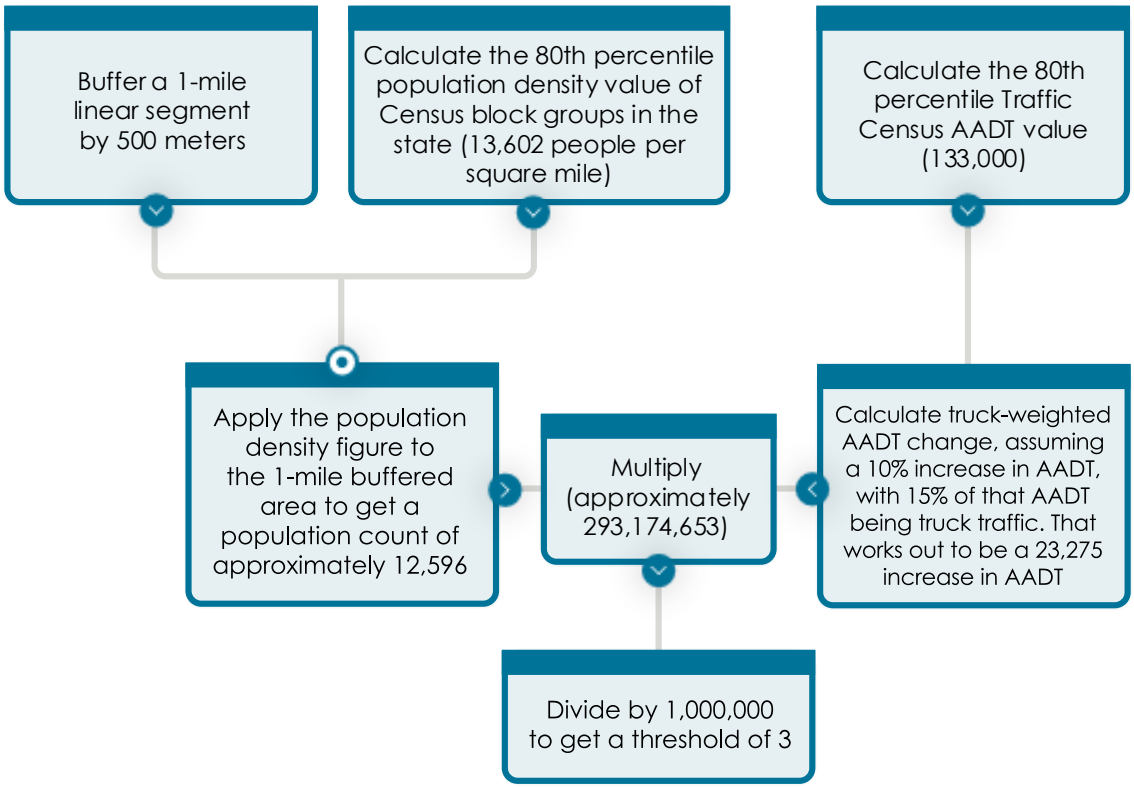

Figure 6: Threshold Development

Data Requirements

To assess the DAC –Traffic Impacts metric, the following information is required:

- **Truck & Non-Truck AADT:** Project sponsors must provide projected AADT for cars and trucks in the no-build and build scenarios. Typically, these estimates come from either a Traffic Operations Analysis Report (TOAR) or a Cal B/C model. Other traffic data sources may be appropriate but will need to be evaluated by the metric scoring team to ensure a fair comparison. If the estimate is provided as a range, the lowest-scoring end of the range will be used for this metric.
- **Project Location:** Project location data must be provided to measure where traffic impacts are occurring relative to DAC populations.

Metric Constraints

- Projects that increase capacity, or otherwise substantively change the transportation network will likely impact traffic patterns. In reality, these impacts are regional and are not constrained to the project segment. However, the

largest impacts are typically felt in and around the project limits. Because this metric relies on traffic data and spatial project-location data, it is calibrated to location-scale impacts and does not capture broader regional impacts unless they are specifically reflected in the input data. For some project types—such as those intended to divert traffic away from a given route—it may be necessary to identify both the project location and expected traffic diversion route. Lastly, project components that are intended to reduce traffic (i.e., transit) may not have estimated traffic reduction data available on the roadway segment level. If this data is available, projects can receive points for reducing traffic burdens.

- This metric does not distinguish between zero-emission vehicle (ZEV) traffic and non-ZEV traffic. While ZEVs may lessen some traffic impacts, they still emit particulates from tire and brake wear and produce noise[19]. Furthermore, truck traffic is weighted by a factor of 6 relative to auto traffic and does not account for difference in truck type. These weighting assumptions are consistent with the EQI. Future versions of the EQI may be updated to better account for the nuances between different types of vehicles and trucks, as well as the presence of ZEVs.

Scoring Rubric

Table 6: DAC Traffic Impacts Metric - Score Values

Score	Description
>5 to 10	Change in truck-weighted AADT impact score is scaled from > 5 to 10 points, with 10 points corresponding to a decrease in truck-weighted AADT impact score of 3 or greater.
5	No change in AADT anticipated, or no impact on DACs.
0 to <5	Change in truck-weighted AADT impact score is scaled from 0 to < 5 points, with 0 points corresponding to an increase in truck-weighted AADT impact score of 3 or greater.

[19] https://dot.ca.gov/programs/esta/sb-743/resources/10-years-sb743

3.6 PASSENGER MODE SHIFT

The Passenger Mode Shift metric quantifies a transportation project's potential to shift travelers from single occupancy vehicles (SOVs) to higher occupancy vehicles and non-auto modes. Projects are scored on a 0–10 point scale based on the change in ratio between non-auto access to destinations and auto access to destinations.

Mode shift is primarily measured as the change in ratio between non-auto access to destinations and auto access to destinations. Additionally, it considers certain qualifying mode shift-supporting project components that cannot be directly quantified through the Access to Destinations metric analysis.

The metric assumes that an increase in non-auto (walk, bike, and transit) access to destinations relative to automobile access to destinations encourages and enables an increased use of non-auto modes. Conversely, an increase in automobile access to destinations relative to non-auto access would encourage more driving.

For example, a project that only increases automobile access to destinations without increasing bike, ped, or transit access to destinations will see a negative change in mode shift ratio, as the utility of non-auto modes decreases relative to auto as a result of the project. A project that increases non-auto access to destinations without increasing automobile access to destinations will see the opposite effect—an increase in the mode shift ratio since the utility of non-auto modes increases relative to auto. In reality, many projects contain elements that impact access to destinations for both auto and non-auto, so the metric determines which impacts are more significant.

Many parts of the state have very low baseline mode shift ratios, where residents can reach fewer than 5 percent of accessible auto destinations by non-auto modes. In some urbanized areas with dense land uses and high frequency transit networks, such as downtown San Francisco and Los Angeles, this ratio can be higher. The metric considers change in ratio, so projects in these lower baseline mode shift ratio areas can still score well, if the change is significant.

Some projects include mode shift-supportive components that cannot be directly quantified using access to destinations analysis. For example, a highway project may include transit fare subsidies as part of its vehicle miles traveled (VMT) mitigation plan, which would not directly affect the access to destinations as analyzed within the CSIS context. However, lower transit fares encourage transit use and support mode shift away from SOV travel. Therefore, additional points are considered under this metric's methodology based on the presence and expected effectiveness of these components. The scoring rubric for this metric list such project-eligible components and associated additional points.

Methodology

Overall Metric

Access to Destinations Analysis

The metric is measured by calculating the population-weighted average change in mode shift ratio across three modes (transit, bike, and ped) for both work and non-work destinations. The mode shift ratio is calculated as follows for each given non-auto mode **i**:

$$\frac{(\text{Number of Decay} - \text{Weighted Destinations Accessible by Non} - \text{Auto Mode } \mathbf{i})}{\text{Number of Decay} - \text{Weighted Destinations Accessible by Auto}}$$

This ratio is calculated for each origin point in the region for both the baseline and build scenarios. The baseline ratios are then subtracted from the build ratios to get the change in ratios. Lastly, a population-weighted average of the change in ratio values is calculated within the study area.

While the Access to Destinations and DAC – Access to Destinations metrics define a mode's study area as a fixed buffer around that mode's component locations, the Passenger Mode Shift metric defines a mode's study area as a fixed buffer around a combination of both non-auto and auto component locations. For example, if a project included a new High Occupancy Toll (HOT) lane and increased transit service, the following study areas would be used:

- A 48 km buffer around the combined new HOT lane and impacted transit service.
- A 24 km buffer around the new HOT lane (to measure the decrease in bicycle mode shift ratio).
- A 7.2 km buffer around the new HOT lane (to measure the decrease in pedestrian mode-shift ratio).

Similar to the approach used in the Access to Destinations metric, mode shift scores are calculated using five decay functions (30, 45, 60, 90, and 120 minutes), but the median average change value is used for scoring instead of the maximum.

The population-weighted average change in ratios is calculated for all three non-auto modes (transit, bike, and ped) and two destination types (work and non-work), yielding six ratios. Thereafter, an average of six ratios is calculated. If a given ratio is zero, that score still contributes towards the final average, so additional non-auto modal components serve to increase the overall average.

Lastly, the average change in mode shift ratio is scaled from 0 to 10 points, with 0 points corresponding to a decrease in mode shift ratio of 0.0013 or greater, 5 points

corresponding to no change in mode shift ratio, and 10 points corresponding to an increase in mode shift ratio of 0.0013 or greater.

Project Components for Additional Points

Though several mode shift-supportive project components can be adequately captured using the Access to Destinations analysis (which is the preferred method given its precision and applicability to all modes), some project components may not get adequately captured by Caltrans' methodology but may provide benefits towards mode shift. For example, transit fare reduction can have a direct benefit on mode shift but is currently not captured using the Access to Destinations analysis. Conversely, the construction of high-quality bike facilities is adequately captured using the Access to Destinations analysis.

On occasion, projects will include components that cannot be captured using the Access to Destinations analysis but are mode shift supportive. These project components are often part of VMT mitigation plans, as they also provide quantifiable VMT reduction benefits. Additional points are assigned in the passenger mode shift metric if these types of project components are present, based on greenhouse gas (GHG) reduction measures in the California Air Pollution Control Officers Association (CAPCOA) Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. The number of available points for each component type is based on the effectiveness of each component, as quantified in CAPCOA.

After the project's score is calculated using the mode shift ratio, points are added based on the presence of additional mode shift-supportive components. A maximum of 3 points can be added, and the final score is capped at 10 points. **Table 7** below shows the eligible project components for additional points, as well as the number of available points associated with each component.

Only components that are included in a certified environmental document will be counted towards the final score.

Table 7: CAPCOA Mode Shift Supportive Components

Measures/Components	Added Points
Implement Conventional Carshare Program	.33
Implement Electric Carshare Program	.33
Implement Pedal (Non-Electric) Bikeshare Program	.33
Implement Electric Bikeshare Program	.33
Implement Electric Scooter Share Program	.33
Reduce Transit Fares	.33
Provide Community-Based Travel Planning	.33
Implement Commute Trip Reduction Program (Voluntary)	.33
Implement Commute Trip Reduction Marketing	.33
Provide End of Trip Bicycle Facilities	.33
Implement Subsidized or Discounted Transit Program	.33
Provide Ridesharing Program	.33
Implement Employee Parking Cash Out	.67
Limit Residential Parking Supply	.67
Unbundle Residential Parking Costs from Property Costs	.67
Price Workplace Parking	1
Provide Employee-Sponsored Vanpool	1
Implement Commute Trip Reduction Program (Mandatory Implementation and Monitoring)	1
Implement Market Price Public Parking (On-Street)	1

Data Requirements

To assess the Passenger Mode Shift metric, the following information is required:

- **Location Data**: Provide project geographic location data using the publicly available intake form.
- **Project Mode(s)**: Provide the mode(s) affected by the project scope. For example, a new class I bike/ped path would likely impact bike and ped modes and possible transit if it improved first/last mile connections.
- **Transit Schedule Information (for transit only)**: If a project is anticipated to impact transit service, provide schedule information for both the existing and proposed transit service. This information should include frequency, speed (can be expressed as stop times), and new alignments/stops if applicable.
- **Auto Speed Data (for auto projects only)**: If a project is anticipated to impact auto speeds, both baseline and build auto speeds for the impacted network links must be provided. If the project has a completed benefit-cost model, the same speed assumptions can be used.
- **Change in Land Use (optional)**: If a project is serving a location with an expected near-term change in land use (i.e., new housing, jobs, or non-work destinations), those can be provided by the project sponsors to adjust the relevant Passenger Mode Shift metric scores. For scoring purposes, new land use projects that are in or through the entitlements phase will be considered. For future land use to be considered, approximate changes in the number of people, jobs, and or non-work destinations must be provided using the publicly available intake form.
- **List of additional mode shift-supportive project components and supporting documentation (if applicable)**.

Metric Constraints

The Mode Shift metric is not designed to be a predictive model. Instead, it quantifies how non-auto access changes relative to auto access to measure a project's mode shift potential. Furthermore, the additional component list may not be comprehensive, and their point value is generalized based on the anticipated effectiveness of each component.

Scoring Rubric

A project's population-weighted change in mode shift ratios is calculated, and points are assigned as described in **Table 8**. Where applicable, additional points will be added to the base score shown in **Table 8**; however, no more than 3 additional points may be added, and the final score is capped at 10.

Table 8: Mode Shift Metric Score Values

Score	Description
>5 to 10	Change in ratio is scaled between > 5 and 10, where 10 points corresponds to a >= 0.0013 change in the average population-weighted mode shift ratio across the region.
5	No change in population-weighted mode shift ratio.
0 to <5	Change in ratio is scaled between < 5 and 0, where 0 points corresponds to a <= -0.0013 change in the mode shift ratio.

3.7 INFILL LAND USE AND NATURAL AND WORKING LANDS

The Infill Land Use and Natural Working Lands metric addresses two CAPTI principles: 1) promote compact infill land uses for walkable communities to reduce the burden of transportation costs, and 2) protect natural and working lands from conversion to more developed or intense land use. Projects are scored on a 0–10 point scale based on their potential to either benefit infill land use (projects in urban areas) or protect natural and working lands (projects in non-urban areas).

Methodology

This metric evaluates infill land use and natural and working lands through two separate, context-specific components. The Infill Land Use and Natural and Working Lands metric is designed to reward project-related benefits in different contexts: urban/suburban projects are rewarded for advancing infill transit-oriented development consistent with state housing laws, while rural projects can demonstrate benefits by avoiding impacts to natural and working lands.

Infill land use development promotes use of underutilized or undeveloped lands within established urban and non-urban communities, which are considered transportation-efficient places. Transportation infrastructure that supports infill development advances walkable communities with affordable housing while reducing automobile dependency and vehicle miles traveled (VMT) through increased transit availability.

Local and regional conservation planning that concentrates development within existing communities helps prevent the conversion of natural and working lands. Transportation investments aligned with conservation principles prioritize projects that avoid impacts on natural and working lands, minimize or mitigate unavoidable impacts, or otherwise protect these lands from development pressures.

1. Infill Land Use

The infill land use component of the metric assesses how urban and suburban project spur or support infill development through High Quality Transit Areas (HQTA) or other multimodal components. The two criteria are as follows:

- **Creates New HQTAs:** Projects that create new HQTAs trigger infill-friendly policies, including elimination of parking minimums, CEQA streamlining, and other pro-housing provisions. This infill development enables higher-density land uses, particularly affordable housing, to develop near transit—creating the conditions for increased transit ridership and mode shift away from automobile dependence.
- **Includes Multimodal Components:** Projects that do not create new HQTAs are evaluated on transit improvements, active transportation infrastructure, and housing—placemaking elements that support infill development.

2. Natural and Working Lands

The natural and working lands component of the metric measures how rural projects protect natural and working lands through avoiding, minimizing, and mitigating impacts on natural resources using the following criteria:

- **Spatial Analysis:** A spatial analysis is used to identify environmentally sensitive elements such as special habitats, prime and other farmlands, wetlands, state conservation areas, riparian areas, and others within 200 meters of the project alignment.
- **Protection and Conservation Measures**: These measures assess the inclusion of natural resources protection measures, best management practices (BMPs), other avoidance and minimization measures, and mitigation measures for protection of farmlands, agriculture and forestry, and biological resources. Such measures also include partnerships with resource agencies and Tribal nations for common goal of protection of natural and working lands.

Data Requirements

To assess this metric, the following information is required:

1. **Location Data:** Provide project geographic location data using the publicly available intake form.
2. **Infill Land Use (Urban and Suburban Projects)**
    - **High Quality Transit Areas (HQTAs)**
        - Documentation of whether the project creates new HQTAs, as defined by California Public Resources Code (PRC) sections 21155 and 21064.3,

including estimated square miles of new HQTA (mileage estimates are calculated by the CSIS scoring team).

- **Multimodal Project Components**
  - For projects that do not create new HQTAs, a detailed description of multimodal project components is needed and should include the following:
    i. Transit operation components (service increases, dedicated lanes, signal priority, station improvements, etc.).
    ii. Active transportation infrastructure (pedestrian/bike bridges, dedicated bike lanes, sidewalk enhancements, crossings, etc.).
    iii. Housing and placemaking elements (affordable housing support, pedestrian plazas, mobility hubs, public structures, etc.).

3. **Transit Schedule Information**: For projects with transit elements, provide the specific transit operator, routes to be augmented, and service changes (e.g., routes, frequency, hours of operation) that the project will implement or enable.
4. **Project Mode(s)**: Clearly identify non-single-occupancy vehicle (SOV) infrastructure.
5. **Natural and Working Lands Protection:** Project elements that support protection of natural/undeveloped and working lands in addition to ecological enhancements.
6. **Environmental Measures and Mitigations:** Documentation of avoidance and minimization actions, mitigation measures and other best practices for preservation of natural and working lands, provided in the project narrative and the environmental review documents.

The project team will verify the project location data and conduct spatial screening to determine whether the project intersects Urbanized Areas or non-Urbanized Areas. The team will also validate HQTA creation and assess the quality and appropriateness of multimodal components and natural resource protection and conservation measures.

Metric Constraints

Infill development potential depends on local land use policies that align with state housing policies to spur growth. Market conditions and local land use entitlements are not within the purview of transportation funding approvals; however, this metric is designed to support infill development. In other words, this metric assesses a project's contribution to creating enabling conditions for infill development, rather than guaranteeing development outcomes.

Natural and working lands protection relies on spatial proximity analysis and documented mitigation measures. Projects may have conservation benefits that extend beyond the 200-meter buffer zone but are not captured in this metric. The metric assesses measurable, project-specific avoidance, minimization actions and mitigation measures.

Scoring Rubric

Projects are evaluated based on their geographical context (urban, suburban, or rural). The scoring approach differs for urban/suburban projects (Infill Land Use) and rural projects (Natural and Working Lands) to reflect the distinct land use objectives in each setting.

Projects are scored through the following process:

1. Spatial Screening

Caltrans categorizes projects as urban, suburban, or rural based on their geographic location.

- **Urban/Suburban Projects**: Projects that overlay or intersect Urbanized Areas (as defined by Caltrans and FHWA on the Caltrans Open Data Portal) are evaluated using the Infill Land Use component.
- **Rural Projects:** Projects that do not intersect with an Urbanized Area are evaluated using the Natural and Working Lands component.

Spatial screening is conducted using the Caltrans Open Data Portal/FHWA Urbanized Areas dataset rather than the Site Check tool dataset to categorize urban and rural land uses.

2. Infill Land Use Scoring

Transportation projects that intersect Urbanized Areas are scored as follows:

2.1 New High Quality Transit Areas (HQTA)

The highest scoring projects create new HQTAs, as defined by PRC sections 21155[20] and 21064.3[21]. HQTAs trigger infill-friendly policies, including elimination of parking minimums, CEQA streamlining, and other pro-housing policies. Transportation projects can catalyze infill development by supporting or creating new HQTAs. This is the most direct way that transportation infrastructure supports infill development.

[20] California Code, PRC 21155

[21] California Code, PRC 21064.3.

HQTAs can be created in the following ways:

- Increase service frequency of bus service along a bus corridor to less than every 20 minutes in the morning and afternoon peak periods (Monday through Friday, 6:00 a.m. to 9:00 a.m. and 3:00 p.m. to 7:00 p.m.).
- Create a major transit stop via one or more of the following actions:
    - Create or enhance rail stations and ferry terminals with bus connections.
    - Create bus rapid transit stations as defined by PRC 21060.2[22].
    - Establish bus stops at the intersection of two or more major bus routes.

Scoring will use the HQTAs data from the Caltrans Open Data Portal to assess whether a transit service change would create new HQTA. Projects that create new HQTA are scored 8 to 10 points, with 10 points corresponding to 10 square miles of new HQTA.

2.2 Multimodal Components

Multimodal Projects that do not create new HQTAs, including projects that fully overlap with existing HQTAs, will be scored based on their inclusion of new transit, active transportation, and other housing and placemaking components that provide or support multimodal travel options and promote infill development in an urbanized environment.

2.3 Transit Operations

Projects receive scoring credit for plans to construct or implement one or more of the following transit operations components. Higher credit is assigned to components with greater transit benefits. A project can earn up to three credits for including all components. The total transit operations credit is multiplied by three, giving it three times the influence of other multimodal components in the scoring calculation. In effect, this 3x multiplier weighs transit operations heavier than other multimodal components in the final score.

[22] California Code, PRC 21060.2.

Table 9: Transit Operation Credits for projects that do not create new HQTAs

Benefits	Credits	Transit Operation Components
High	1	Transit service increase commitment or new transit stops (that does not create new HQTA)
Med-High	0.8	Dedicated transit lanes, operational station improvements (e.g., bus islands/bulbs), existing bus service running on future HOV/HOT lanes
Medium	0.6	Transit Signal Priority (TSP), other transit operations technology
Med-Low	0.4	Customer experience station improvements (e.g., ADA/Universal Design, digital signage)
Low	0.2	Microtransit, vanpool service

Active Transportation: Projects receive scoring credit for plans to construct or implement one or more of the following active transportation components. Higher credit is assigned to components that provide greater active transportation benefits. A project can earn up to three credits for including all components. The total active transportation credit is multiplied by two, giving it twice the influence of other multimodal components in the scoring calculation. In effect, the 2x multiplier weights active transportation as the second-most influential factor (after transit operations) in the final score.

Table 10: Active Transportation Credits for projects that do not create new HQTAs

Benefit	Credits	Active Transportation Components
High	1	Major pedestrian/bike bridge
Med-High	0.8	Dedicated biking infrastructure (Class I, IV lanes)
Medium	0.6	Wider sidewalks, enhanced crossings
Med-Low	0.4	Bike lanes (Class II, III)
Low	0.2	Bike parking, charging, other amenities; reduction of auto parking

Other Housing and Placemaking Elements: Projects receive scoring credit for plans to construct or implement one or more of the following placemaking and housing components. Higher credit is assigned to components that provide greater housing and placemaking benefits. A project can earn up to three credits for including all components. The total housing and placemaking credit is not multiplied, making it the base-weighted component among the multimodal components in the scoring calculation.

Table 11: Other Housing and Placemaking Credits for projects that do not create new HQTAs.

Benefit	Credits	Other Housing and Placemaking Components
High	1	Infill affordable housing/affordable housing fees
Med-High	0.8	Pedestrian plazas/parks from closing roadway to cars
Medium	0.6	Mobility hubs, other road diet
Med-Low	0.4	Transit shelters, other public placemaking structures
Low	0.2	Signage/wayfinding program

3. Natural and Working Lands Scoring

Projects that do not intersect an Urbanized Area (rural projects) are scored according to the following:

Natural Habitats and Conservation Areas

The highest-scoring projects are those that, when located near or within environmentally sensitive areas—such as wetlands, farmlands, or habitats—apply best management practices for avoidance and minimization and, if those measures do not adequately reduce negative effects, implement mitigation measures. This is the most direct way transportation infrastructure can protect natural resources and can indirectly support the protection of natural and working lands.

The assessment begins with spatial screening using an existing tool, Site Check ✓ (ca.gov),[23] to determine proximity and potential overlap with natural habitats. The Site Check tool is used to identify whether a transportation project is located in environmentally sensitive areas, such as wetlands, farmlands, or special habitats. Collectively, these data represent natural and conservation areas and enable spatial analysis for:

- Special Habitats
- Prime Farmland or Farmlands of Statewide Importance
- Wetlands
- State Conservancy Areas
- Riparian Areas

Analysis Approach: Caltrans will identify if any of these natural and conservation areas are within 200 meters of the project alignment(s) drawn in the ArcGIS Editor form. Projects with centerline alignment outside the 200-meter buffer of a protected or natural area would score a neutral five points.

Projects with centerline alignment within a 200-meter buffer of a protected or natural area are scored based on the inclusion of natural resource protection elements identified in the project documents, including the CEQA/NEPA environmental review.

A project's environmental review documents enumerate avoidance, minimization, and mitigation measures related to agricultural and forestry, biological resources, water quality, and soils and drainage. Measures may include wildlife bridges or aquatic passage elements in culverts; natural infrastructure solutions such as bioswales, rainwater storage systems, and permeable pavements; the establishment of conservation areas or environmental mitigation banks; and explicit partnerships with resource agencies and Tribal nations on environmental preservation. The inclusion of any of these elements should be documented in project planning or environmental documents.

For additional reference, please see the California Transportation Plan (CTP 2050), Chapter 5, Section 12: Expand Protection of Natural Resources and Ecosystems. **Table 13** lists examples of recommended actions. Note that this list is not exhaustive;

[23] Site Check is a free and publicly available mapping tool funded by the California Department of Housing and Community Development as part of the technical assistance for Senate Bill 2, the Building Homes and Jobs Act. Site Check data is hosted by Databasin and is available on the Governor's Office of Land Use and Climate Innovation's (LCI) website. Note that LCI will also develop an urban infill site layer and update other relevant data layers by June 2027 per SB 131.

there are additional avoidance, minimization, and mitigation measures beyond those listed here that cannot be fully enumerated.

4. Total Score

The total score is calculated based on the applicable component (Infill Land Use or Natural and Working Lands Protection), with a maximum score capped at 10 points.

Table 12: Infill Land Uses - Score Values

Score	Description
8 to 10	Projects creating new HQTA are scored on a range from 8 to 10 points, with 10 points corresponding to 10 square miles of new HQTA.
0 to <8	Projects that do not create new HQTA are scored with the following equation: **3 x [Transit operation credits] + 2 x [Active Transportation credits] + [Other Housing/Placemaking element credit].** Inclusion of all the components would yield an intermediate score of 18. However, because most projects are reasonably expected to include only one or two components in each category, non-HQTA projects receive a final score capped at 8 points.

Table 13: Natural and Working Lands Metric - Score Values

Score	Description
5 to 10	Rural projects with centerline alignment within the 200-meter buffer of a protected/natural area will receive 5 to 10 points based on the inclusion and quality of avoidance, minimization, and mitigation measures documented in their environmental documents.
5	Rural projects with centerline alignment outside the 200-meter buffer of a protected or natural area receive a neutral score of 5 points.
0	Rural projects with centerline alignment within the 200-meter buffer of a protected or natural area that do not include natural resource protection elements will score 0 points.

3.8 FREIGHT SUSTAINABILITY AND EFFICIENCY

The Freight Sustainability and Efficiency metric comprises of two individual sub-metrics, each scored from 0 to 5, resulting in a total of 10 points.

- The **Freight Sustainability** sub-metric assesses a project's inclusion of sustainable freight elements.
- The **Freight Efficiency** sub-metric assesses a project's ability to improve goods movement throughput and delay.

Methodology

Freight Sustainability

The freight sustainability sub-metric is scored based on the projects' inclusion of sustainable freight elements. Qualifying sustainable freight elements were identified and evaluated for their alignment with the California Sustainable Freight Action Plan (CSFAP), the California Freight Mobility Plan (CFMP), the California State Rail Plan (CSRP), and CAPTI.

Examples of sustainable freight elements include bridge improvements that improve goods-movement efficiency; grade separation between roadways and freight rail; track improvements that reduce conflicts between freight and passenger rail; truck parking facilities; truck-only lanes; and technology-based solutions. A complete list of qualifying sustainable freight elements is provided below in the scoring rubric below.

Each sustainable freight element is assigned 1 to 5 points based on factors related to promoting sustainable freight transportation, such as the element's ability to reduce criteria and toxic air pollutants, avoid or mitigate environmental justice impacts on communities, integrate multimodal design that enables mode shift from highway to rail or vessel, and improve the safety and resiliency of the freight network.

Freight Efficiency – Roadway Projects

Freight efficiency for roadway projects is evaluated based on the project area's existing Truck Travel Time Reliability Index (TTTRI), existing truck traffic volume, and the estimated truck travel time improvements the project would enable. Each variable is described below.

TTTRI: TTTRI measures the consistency of commercial truck travel times on the Interstate system, calculated as the worst travel time divided by the median travel time over a 12-month period. An index value of 1.0 is the lowest possible value and means truck travel speeds are perfectly uniform. A higher index value indicates higher delays and inconsistent travel times for trucks and goods, which correlate to higher fuel usage and emissions, increased shipping costs, and increased risk for crashes.

The metric scoring team will perform TTTRI calculations using Streetlight data. For each street segment in the project corridor, 50th and 95th percentile truck travel times are downloaded from Streetlight using the Segment Analysis tool. In the downloaded table of travel times and segment lengths, the TTTRI is calculated as follows:

1. Level of Truck Travel Time Reliability (LOTTR) = [95th Travel Time Percentile] / [50th Travel Time Percentile]
2. Weighted LOTTR = [LOTTR] x [Line Zone Length (miles)]
3. Across all segments, get the sum of Weighted LOTTR and the sum of Line Zone Length
4. TTTRI = [Sum of Weighted LOTTR] / [Sum of Line Zone Length]

Existing Truck Volume: The metric scoring team will obtain truck volumes using Streetlight data. For this metric, truck volume is defined as the annual average daily volume of medium- and heavy-duty trucks[24] entering the project area. Truck volume will be obtained in the same time intervals as truck speeds. For example, if truck speed is reported separately for peak and off-peak periods, truck volume will be obtained for each corresponding time period.

Alternatively, truck volume by time period can be provided by the project sponsor where Streetlight data might not be the most reliable provider of this information. This may include rural areas with low or seasonal truck traffic, or areas with near-completion freight-oriented development that would substantially increase truck traffic by the project's opening year.

Truck Travel Time: Estimated truck travel time savings are estimated by Caltrans using the Bureau of Public Roads (BPR) volume-delay function, which is applied to all projects that derive truck travel time savings from increased capacity. The BPR formula is shown below:

$$t = t_0\left(1 + \alpha\left(\frac{v}{c}\right)^{\beta}\right)$$

Where:

- t = Estimated travel time under current conditions, with the project
- t_o: Free flow travel time on project segment
- v: Observed volume on the project segment
- c: The maximum capacity that the link can handle

[24] Defined as Class 5 (two axle, six tire, single unit) trucks and above.

- alpha: Delay curve steepness parameter, set to .15
- beta: Another delay curve steepness parameter, set to 4

For projects that reduce truck travel times through other means (i.e., new interchanges, ITS, etc.), applicants will also provide truck speeds or truck travel times through the project area under Opening Year No Project and Opening Year with Project conditions. Truck speed or truck travel time may be estimated using a travel demand forecast model or a traffic operations analysis software such as the Highway Capacity Software (HCS), SimTraffic, Vissim, or Sidra. Peak and off-peak period truck speed should be reported separately. If off-peak data is not available, travel time improvements will be calculated using peak period data only. Applicants may identify the specific hours during which the project site experiences peak conditions (e.g., 7 a.m. to 9 a.m., 4 p.m. to 6 p.m.).

With the three input values above, the project's Truck Efficiency Improvement Index is calculated and converted to points, as described in the scoring rubric section.

Freight Efficiency – Rail Projects

Freight efficiency for rail projects is evaluated based on a project area's existing freight train volume and the projects' improvement to freight rail throughput and/or delay in the horizon year[25]. Each variable is described below.

Existing Freight Train Volume: Applicants will provide the average daily freight train volume of the project area. The existing volume reflects on the level of use, demand, and potential need for improvements.

Freight Rail Throughput: Applicants will provide freight rail throughput under Horizon Year No Project and Horizon Year With Project conditions. Throughput data should be reported in Twenty-Foot Equivalent Units (TEUs). Standard conversions are provided if a project's source data uses other units, such as number of trains, tons, or containers.

Freight Rail Delay: Applicants will provide freight rail delay under Horizon Year No Project and Horizon Year With Project conditions.

The three input values above are each scored individually. Points earned for Freight Rail Throughput and Freight Rail Delay may be combined to reach the maximum allowable score.

[25] For rail projects, Horizon Year data was selected as freight rail projects are designed to meet long-term economic growth and operational needs; growth in passenger vehicle travel has very minimal effect on freight rail operations.

Data Requirements

To assess the Freight Sustainability and Efficiency metric, the following information is required:

- **Location Data:** Provide project geographic location data using the publicly available intake form.
- **Sustainable Freight elements** identified in the scoring rubric.

Roadway Projects

- **TTTRI** provided by Caltrans.
- **Existing Truck Volume by Time Period** provided by Caltrans or Project Applicant.
- **Truck Travel Time by Time Period** for Opening Year No Project and Opening Year with Project conditions.

Rail Projects

- **Existing Average Daily Freight Rail Volume**.
- **Freight Rail Throughput** for Horizon Year No Project and Horizon Year With Project conditions.
- **Freight Rail Delay** for Horizon Year No Project and Horizon Year With Project conditions.

Metric Constraints

Due to data collection and processing differences, Streetlight traffic volume data may be different than volume data collected from other sources. Applicants have the option to provide their own data if Streetlight data does not adequately capture travel patterns unique to the project area (e.g., rural areas or seasonal traffic). Truck volume and travel time improvements by time of day most accurately capture truck efficiency improvements; however, data at this level of detail may not always be available. Travel time improvements on roadways may be eroded by induced VMT over time. Freight rail volume and operational data may not be available to the general public or public agencies.

Scoring Rubric

Freight Sustainability

The freight sustainability score is calculated based on the project's inclusion of the following sustainable elements. If multiple elements are included, points for each element are summed. The maximum possible score is 5 points.

Table 14: Freight Sustainability Metric Score Values

Points	Sustainable Elements
5	• New or rehabilitated bridges that shorten travel distance by creating a more direct route, by addressing existing asset's poor conditions, or by accommodating oversized **freight trains**. • New grade separation **between roadway and freight rail**. • Inland ports, short line rail, access to industrial land uses and freight distribution hubs, and other inland intermodal improvements. • On-dock, near-dock, and short line rail, transload infrastructure, terminal, and other intermodal improvements. • Double tracking, siding, and other improvements to reduce freight and passenger rail conflicts.
4	• New or rehabilitated bridges that shorten travel distance by creating a more direct route, by addressing existing asset's poor conditions, or by accommodating oversized **trucks**. • New grade separation **between roadways**. • Truck-only lanes. • New or expanded truck parking facility that addresses the statewide truck parking deficit.
3	• Truck climbing lanes. • Positive train control (PTC) technology that serves freight trains. • Intelligent transportation systems (ITS) and other technology to improve the efficiency of freight, including traffic signal prioritization, ramp management and metering, truck queue management and appointment systems, and active traffic and demand management (ATDM). • Real-time traffic, truck parking, roadway and weather condition, border wait time, and other transportation information, detection, and advanced warning systems that enhance decision-making and freight network resiliency.
2	• Electronic screening and credentialing systems, including weigh-in-motion (WIM) technology and smart roadside commercial motor vehicle monitoring. • Border security technologies that improve truck movement, such as non-intrusive technology.

Freight Efficiency – Roadway Projects

The freight efficiency score for roadway projects is calculated based on the project's Truck Efficiency Improvement Index, calculated as follows:

1. No Project Truck Vehicle Hours Traveled (VHT) = [Peak Period Truck Volume] x [No Project Peak Period Truck Travel Time] + [Off-Peak Period Truck Volume] x [No Project Off-Peak Period Truck Travel Time] [26]
2. With Project Truck VHT = [Peak Period Truck Volume] x [With Project Peak Period Truck Travel Time] + [Off-Peak Period Truck Volume] x [With Project Off-Peak Period Truck Travel Time] [27]
3. Truck Efficiency Improvement Index = [TTTRI] x ([No Project Truck VHT] – [With Project Truck VHT])

A score of 0 to 5 points is calculated based on the Truck Efficiency Improvement Index, with an index of 0 corresponding to 0 points (e.g., the project does not result in any truck travel time improvement), and an index of 300 corresponding to 5 points.

Table 15: Freight Efficiency Metric for Rail Projects Score Values

Score	Description
0 to 5	Truck Efficiency Improvement Index is scaled from 0 to 5 points, with an index of 0 corresponding to 0 points, and an index of 300 corresponding to 5 points.

Freight Efficiency – Rail Projects

Rail projects may receive up to 5 points for freight efficiency improvements, calculated in two parts.

Part 1: Projects are assigned up to 1 point based on the project area's existing freight train volume, with 50 daily freight trains corresponding to 1 point.

Part 2: Projects are assigned up to 4 points based on the projects' improvement to freight rail throughput and/or delay.

[26] Applicants may define the specific hours for each time period and provide data for more than two time periods, such as AM, Mid-Day, PM period.

[27] Applicants may define the specific hours for each time period and provide data for more than two time periods, such as AM, Mid-Day, PM period.

- An increase in freight rail throughput of 730,000 TEUs[28] annually corresponds to 4 points.
- A decrease in freight rail delay of 2,000 hours annually corresponds to 4 points.

Points received for Part 1 and Part 2 are combined to calculate up to 5 points for freight rail efficiency improvement. For Part 2, projects may receive partial points for freight rail throughput or delay improvements. Partial points received under each category may be combined to reach up to 4 points.

Table 16: Freight Efficiency Metric for Rail Projects Score Values

Score	Description
Part 1	
0 to 1	Existing freight rail volume is scaled from 0 to 1 point, with 0 freight trains corresponding to 0 points, and 50 freight trains corresponding to 1 point.
Part 2	
0 to 4	• Increase in freight rail throughput is scaled from 0 to 4 points, with 0 TEU increase corresponding to 0 points, and 730,000 TEUs increased annually corresponding to 4 points. • Decrease in freight rail delay is scaled from 0 to 4 points, with 0 hours of decrease corresponding to 0 points, and 2,000 hours decreased annually corresponds to 4 points. • Points received from freight rail throughput and freight rail delay may be combined to reach up to 4 points.
Total Freight Efficiency Score for Rail Projects	
0 to 5	• Points received for Part 1 and Part 2 are combined to calculate the total freight efficiency improvement for rail projects, up to 5 points.

Example Roadway Project

A project located on a freeway corridor with a TTTRI of 1.75 and a peak period truck volume of 3,000 proposes improvements to reduce truck travel time by 3 minutes during the peak period and includes freight ITS elements to support those efficiencies.

[28] Applicants may use conversion rates derived from their operational data or use the following standard rates: 1 Train = 520 TEU; 1 Container = 1.8 TEU; 1 TEU = 7.8 Ton.

The project's score will be calculated as follows:

- Truck Efficiency Improvement Index = 1.75 x 3,000 trucks x $\frac{3 \text{ minutes}}{60 \text{ minutes/hour}}$ = 263
- Project freight efficiency score = 263 / 300 * 5 points = **4.38 points**
- Project will receive **3 points** for the inclusion of freight ITS, a sustainable freight element.
- Project total score = 4.38 + 3 = **7.38 points**.

Example Rail Project

The example project is in a freight rail corridor that serves 25 freight trains per day. The project proposes double tracking through the project area, which would increase freight rail throughput by 400,000 TEUs and reduce freight rail delay by 500 hours annually.

The project's score will be calculated as follows:

- Part 1: Existing freight rail volume score = 25 trains / 50 trains = **0.5 points**
- Part 2: Freight Rail Efficiency
- Freight rail throughput: (400,000 TEUs / 730,000 TEUs) * 4 points = **2.19 points**
- Freight rail delay: (500 hours / 2,000 hours) * 4 points = **1 point**
- Total Rail Freight Efficiency Score = 0.5 + 2.19 + 1 = **3.69 points**
- Project will receive **5 points** for double tracking, a sustainable freight element.
- Project total score = 3.69 + 5 = **8.69 points**

3.9 ZERO-EMISSION VEHICLE (ZEV) INFRASTRUCTURE

The ZEV Infrastructure metric assesses the extent of ZEV infrastructure investments in a project.

The metric is based on the type of ZEV infrastructure and the vehicular traffic volume near the project site.

Methodology

The level of investment in ZEV infrastructure is evaluated on a scale of 0 to 10 points. For passenger vehicle charging infrastructure (Level 2 and Level 3 charging ports), the ZEV metric intends to measure whether the project proposes an adequate number of chargers to serve the potential charging demand in the project area; therefore, the number of passenger vehicle chargers required for a project to receive 10 points is scaled based on the vehicular traffic volume on nearby highway segments. Highway

traffic volume is selected as an obtainable data source that reflects the project area's population density, the urban/rural setting, and the potential demand for ZEV charging. To receive 10 points, projects near a higher-volume corridor would need to install more chargers, whereas projects near a lower-volume corridor would achieve the same score with fewer chargers. The same logic applies to medium- and heavy-duty truck charging, for which the number of chargers required is scaled based on the highway truck volume near the project site.

Less common ZEV technologies, such as hydrogen and ZEV transit infrastructure, are scored based on the number or capacity of the fueling or charging infrastructure required. The scoring threshold was determined with consideration to the cost, difficulty of implementation, and desirability of the infrastructure type.

For projects that propose multiple ZEV infrastructure types (e.g., passenger vehicle chargers and medium- and heavy-duty truck chargers), each type will be scored separately then summed into a final ZEV metric score. The maximum possible score for this metric is 10 points.

All charger installations will follow federal and state regulations and requirements.

Data Requirements

To assess the ZEV Infrastructure metric, the following information is required:

- **Charging Ports:** Provide information on the number of charging ports, power levels, and locations.
- **Highway Segment Annual Average Daily Traffic (AADT):** The metric scoring team will obtain AADT and truck AADT data using Streetlight. Highway volume will be obtained from class 1 or class 2 highway segment nearest to the project site. If no class 1 or class 2 highway is present within 10 miles of the project site, volume from the nearest class 3 or class 4 facility may be used.

Metric Constraints

The metric does not account for areas where ZEV infrastructure cannot be installed (i.e., lack of power sources) and does not account for all types of ZEV technologies. Although highway traffic volume generally correlates with the population density and vehicle charging demand, it may not fully capture demand for vehicle charging at unique hotspots. Locations of existing and planned ZEV infrastructure are not considered.

Scoring Rubric

The score is calculated by establishing a ratio of ZEV infrastructure to the number or capacity required to obtain 10 points, as shown in the table below:

Table 17: ZEV Metric Score Values

ZEV Infrastructure Type	Number or Capacity Required to Obtain 10 Points
Level 2 Charging Ports	Charger requirement is scaled based on AADT: • Four charging ports for areas with 6,000 or less AADT on nearby highway • One additional charging port for each 3,300 increase in AADT • Seventy charging ports at the maximum for areas with AADT above 220,500
Level 3 Charging Ports	Charger requirement is scaled based on AADT: • Four charging ports for areas with 6,000 or less AADT on nearby highway • One additional charging port for each 11,000 increase in AADT • Twenty-four charging ports at the maximum for areas with AADT above 215,000
Medium- and Heavy-Duty Truck Charging Ports	Charger requirement is scaled based on Truck AADT • Four charging port for areas with 500 or less Truck AADT on nearby highway • One additional charging port for each 3,000 increases in Truck AADT • Eight charging ports at the maximum for areas with Truck AADT above 9,500 • Hydrogen: 4,000 kg of site per day capacity with two nozzles
ZEV Infrastructure Type	**Number or Capacity Required to Obtain 10 points**
Rail/Transit ZEV Infrastructure	• Six medium- and heavy-duty truck charging ports • Hydrogen: 4,000 kg of site per day capacity with two nozzles
Rail/Transit ZEV Rolling Stock	• One ZEV locomotive • Ten battery-electric buses • Five hydrogen buses

As an example, a project located near a highway segment of 30,000 AADT proposes four Level 2 charging ports, four Level 3 charging ports, and one medium- and heavy-duty charging port for transit. The project's score would be calculated as shown in the table below. Although the sum of the individual scores exceeds 10 points, the project would receive the maximum possible score of 10 points for the ZEV metric.

Table 18: ZEV Metric Example Project Score

ZEV Infrastructure Type	Number of Charging Ports Required to obtain 10 points	Number of Charging Ports Proposed	Ratio of proposed to required charging ports	Points received
Level 2 Charging Ports	12	4	0.33	3.3
Level 3 Charging Ports	7	4	0.57	5.7
Medium- And Heavy-Duty Charging Ports for Transit Vehicles	6	1	0.16	1.6
			Total Points Received	**10.6**
			Total Score	**10**

4 – CAPTI Qualitative Metrics

The CSIS investment framework includes two qualitative metrics – Public Engagement and Climate Adaptation and Resiliency – to meet the overall intent of the CAPTI Guiding Principles. These qualitative metrics aim to measure a project's responsiveness to its unique community and climate needs, guiding investments towards a more equitable outcome.

The evaluation for these qualitative metrics is conducted by a project review committee (PRC) comprised of Caltrans HQ staff, including subject matter experts. As described in the CSIS, new PRCs are established for each program and funding cycle.

4.1 PUBLIC ENGAGEMENT

The Public Engagement metric measures the adequacy, appropriateness, quality, and effectiveness of engagement activities during project development. Projects receive higher scores if they demonstrate meaningful engagement with diverse stakeholders, particularly disproportionately impacted disadvantaged communities, including low-income communities. Projects are scored on a 0-10-point scale based on their engagement plan, outreach actions undertaken, and responsiveness to public input.

This metric also addresses the equity goals in CTP 2050 and CAPTI, with emphasis on equitable engagement demonstrated by the representation and involvement from disadvantaged, low-income, and Black, Indigenous, and People of Color (BIPOC) communities. Meaningful engagement should extend beyond the standard public scoping and meeting requirements under the environmental review process for CEQA and NEPA and should include substantive community involvement in shaping project scope, design, and outcomes.

Methodology

This metric is assessed with a checklist approach that evaluates the quality of public engagement and actions undertaken. This metric is flexible for all project types, locations, and the size of the project. The performance-based metric considers three key areas of assessment:

1. **The Public Engagement Plan (PEP), or Equivalent:** Assesses whether the project has a documented engagement approach that is tailored to the project and community-specific context and needs. The PEP should clearly outline the overall approach and purpose of engagement. The PEP should also address community history and past sentiments and demonstrate consideration and implementation of community input in project scope and design.

2. **Public Engagement Actions Undertaken:** Evaluates the timing, frequency, audience, and methods used for outreach and engagement. Projects should clearly demonstrate past and planned engagement from pre-planning through various phases of project development with the appropriate audiences for the project (i.e., local governments, community leaders, disadvantaged communities, underrepresented groups, advocacy groups, Tribal Organizations, etc.). Projects should provide ample and easily accessible opportunities for the public and members of disadvantaged groups to engage in the process.
3. **Project Responsiveness to Public Input:** Assesses whether the project design or scope was or will be responsive to the input received during the public engagement process. Responsiveness may include refinements or modifications to the project's design, scope, timing, aesthetics, or other elements.

Data Requirements

To assess the Public Engagement metric, the following information is required:

1. **Public Engagement Plan or equivalent document**: Provide a document that describes the outreach and engagement methods tailored to the project. This document should also include the history of engagement undertaken through prior project phases.
2. **Outreach & Engagement Undertaken:** Provide evidence to demonstrate the adequacy, appropriateness, quality and effectiveness of engagement activities, which should include the following:
    - Summary of stakeholder and community meetings or events occurred and planned throughout project development. This may include but is not limited to open houses, pop-up events, community charrettes, city and or county council meetings, and regional agency board meetings.
    - Meeting and event materials: This may include but is not limited to fact sheets, meeting/event agendas and minutes, flyers (all languages used), presentations, public comments, project website, focus group notes, summary of feedback, polling results, list of organizations contacted, contact list, and photos of event.
    - Documentation of project sponsor meetings that include local partners/stakeholders. This may include but is not limited to technical advisory committees and citizen advisory committees.
    - Documentation of community meetings that include disadvantaged and vulnerable communities, Tribal Organizations, and other interest groups.
    - Feedback surveys that document the responses to public engagement.

3. **Responsiveness to Public Input:** Provide documentation demonstrating how the input influenced the project, such as the following:
    - Meeting minutes
    - Responses to comments
    - Follow-up stakeholder/public meetings
    - Surveys or correspondence showing community support
    - Documentation of project scope or design changes made in response to the input

Metric Constraints

This metric acknowledges that there will be varying levels of engagement depending on the project type, size, location, audience, and other factors. A larger, more complex project may require a more comprehensive public engagement plan and process, while a smaller project may not necessitate an extensive engagement process. Regardless of the project size and other factors, the project should demonstrate a strong public engagement effort that is appropriate for the project through well-documented activities, events, and outcomes.

Due to the qualitative approach of this metric, project scores are assigned based on information and materials made available to the Project Review Committee (PRC). Therefore, it is important that the applicant provides all pertinent information, including measurable components (number of meetings/events, outreach methods, participants, comments received, etc.) and narratives to demonstrate meaningful public engagement.

Engagement activities that are not documented or documents and materials that are not submitted to the PRC will not be scored.

Scoring Checklist

Projects are evaluated on a continuous scale of 0 to 10 points, with 0 points corresponding to a project that does not include any engagement checklist items and 10 points demonstrating engagement that meets and exceeds the engagement checklist items enumerated below.

Each checklist item is evaluated qualitatively based on the quality and comprehensiveness of the documentation provided. Projects may earn full points, partial, or no points for each item depending on how well the engagement activities and documentation demonstrate meaningful, effective engagement. Simply checking a box without compelling evidence of quality engagement will result in partial or no credit for that item. Scores assess both the evidence of the required elements and the

degree to which these show community involvement within the context and scope of the project.

Table 19: Public Engagement Metric - Score Values

Public Engagement Plan (PEP), or equivalent (2 points total)
The project has a published Public Engagement Plan (or equivalent): • PEP identifies prior engagement conducted. (0.5 point) • PEP identifies community-specific context and key stakeholders, including local and regional partners. (0.5 point) • PEP identifies disproportionately impacted disadvantaged, low-income, and Black, Indigenous, and People of Color (BIPOC) communities. (0.5 point) • PEP identifies multiple outreach strategies and engagement methods that are appropriate and adequate for the community-specific context and key stakeholders identified above. (0.5 point)
Public Engagement Actions Undertaken (4 points total)
Diverse group of community members and stakeholders were included in the engagement (e.g., meetings, focus groups, surveys). • Local and regional partners, local businesses, and the general public were engaged. (0.5 point) • Disadvantaged, low-income, and BIPOC communities were included. (0.5 point) • Tribal organizations and leaders were included. (0.5 point) • Community-Based Organizations[29] (CBOs) were included. (0.5 point) Project enumerates multiple methods of outreach conducted that were appropriate and adequate for the community-specific context and key stakeholders involved (e.g., fact sheets, meeting agendas and minutes, flyers in multiple languages as appropriate, presentations, public comments, project webpage, focus group notes, summary of feedback, polling results, photos). • At least three methods were used. (0.5 points) • More than five methods were used. (0.5 point)

[29] A Community-Based Organization (CBO) is a non-profit group established by local people to address the specific needs of their community at the grassroots level. CBOs do not include lobbyist or special interest groups.

- Time and location of outreach events were appropriate for the community (e.g., evenings/afterwork hours, accessible meeting venues, online meetings). (0.5 point)
- The number of events held was appropriate for the project's scale and impact (considering factors such as project complexity, population affected, stakeholder interests, and other community concerns). (0.5 point)

Project Responsiveness to Public Input (4 points total)

Project is responsive to community input.

- Comments from members of the public were collected during engagement. (0.5 point)
- The project scope incorporated input from community members and stakeholders identified above. Responsiveness is demonstrated through consideration of input, whether that results in public comments expressing support for the project or in modifications and refinements to the project scope. (1 point)
- The project incorporated feedback from low income, tribal organizations and leaders, BIPOC communities and/or CBOs. (1 point)

Project has documented support (e.g., letters of support, resolutions, meeting minutes showing endorsement) from the diverse group of community members and stakeholders that were engaged, such as agency partners, tribal organization(s), and multiple community groups (businesses, CBOs, etc.).

- The project has documented support from agency partners. (0.5 point)
- Project has documented support from at least four community groups. (0.5 point)
- The project has documented support from at least two disadvantaged groups such as tribal organizations and leaders, and CBOs. (0.5 point)

4.2 CLIMATE ADAPTATION AND RESILIENCY

The purpose of the Climate Adaptation and Resiliency metric is to assess how well projects evaluate climate risks to transportation infrastructure and communities, in addition to how well they incorporate adaptation strategies to enhance resilience. Projects receive higher scores if they identify historic and forecasted climate stressors and vulnerabilities, develop comprehensive adaptation strategies, and prioritize resilience for at-risk infrastructure and communities. Projects are scored on a 0-10-point scale based on climate risk assessment and adaptation strategies incorporated into project scope and design.

Climate risks refer to vulnerabilities of physical transportation infrastructure to climate stressors, such as sea level rise, storm surge, cliff retreat, wildfire, extreme temperatures, flooding, or other extreme weather events, in addition to potential impacts to facility performance, users, and nearby economic, environmental, or community resources from these stressors. Climate adaptation is defined as steps taken to modify the project components and prepare the community to minimize or avoid these risks from climate change stressors. Resiliency is an ability to recover and adapt to adverse climate events.

While greenhouse gas emissions, air quality, and VMT-related assessment are commonly included in the environmental documents, this metric specifically evaluates a project's assessment of climate stressors and vulnerabilities to infrastructure and communities, and the extent to which a project applies adaptation measures that could reduce or ameliorate climate risks.

Methodology

The metric evaluates climate adaptation and resiliency through three components:

1. **Climate Risk Assessment**: Measures how well the project identifies and assesses historic and forecasted climate stressors (e.g., sea level rise, storm surge, cliff retreat, wildfire) and their potential impacts on transportation infrastructure, facility users, and surrounding communities. Projects must use relevant climate change data sources to evaluate stressors and vulnerabilities to both infrastructure and communities, particularly disadvantaged and vulnerable populations. This can also include discussion of how potential exposure to climate stressors could affect the system's performance for goods movement, economic prosperity, and roadway safety.
2. **Adaptation Strategies:** Evaluates whether projects include appropriate adaptation measures (such as nature-based solutions) that correspond to identified climate risks and vulnerabilities. Strategies should be consistent with the state, regional, and local climate adaptation and hazard mitigation plans and referenced in project scoping documents. Projects receive higher scores when adaptation and resiliency is the primary project objective backed by project scope and design.
3. **Disaster Management and Emergency Response:** Assesses how larger projects address emergency preparedness, response, and recovery considering all phases of the FEMA emergency management cycle. Projects that incorporate multimodal evacuation strategies in alignment with other State and federal transportation policies and goals (i.e., transit, active transportation, etc.) beyond roadway widening receive higher scores.

Consistency with Climate Policies and Plans

Projects must demonstrate consistency with state climate change goals and strategies from CAPTI, the California Transportation Plan (CTP) 2050, Caltrans 2024-2028 Strategic Plan, AB 1482, AB 2800, Executive Order (EO) B-30-15, EO N-82-20, and the California Climate Adaptation Strategy. Projects should also align with relevant regional and local climate change assessments, adaptation plans or policies, and hazard mitigation plans where applicable.

Projects should demonstrate climate adaptation measures and strategies consistent with Caltrans' guidance in the Adaptation Strategies for Transportation Infrastructure and the State Climate Resilience Improvement Plan for Transportation.

Climate Data Sources and Guidance

Climate risk assessment requires appropriate data sources based on the project location and type of infrastructure. The following sections describe the available sources and data for facilities on and off the state highway system.

Projects on the State Highway System (SHS)

- **District Climate Change Vulnerability Assessments:** Identify and provide data about current and forecasted climate stressors that are most likely to adversely impact the project's infrastructure assets, performance, and user safety.
- **District Adaptation Priorities Reports:** Identify all assets in the project's study area for their assigned priority level(s).

Analysis Approach: Project-level climate risk assessments or similar studies evaluating segment(s) should reference the District Adaptation Priorities Reports to identify all assets within the study area for their assigned priority level(s) and evaluate their vulnerability to climate stressors identified in the District Climate Change Vulnerability Assessments.

Projects off the State Highway System (SHS)

When the project scope and limits include facilities off the SHS, project sponsors may utilize other state or federal climate data sources to identify climate hazards, exposures, and stressors. The following are additional data and information sources:

- Historical climate event data and extreme weather records
- Local or regional climate assessments with granular level data
- Academic or research institution climate projections

Analysis Approach: Past climate events and weather events may supplement identification of climate vulnerabilities. Where available, project sponsors should use

location-specific data at the local or regional level to improve assessment accuracy and context.

Non-Highway Projects

Climate stressors projections and hazards identification for non-highway projects, such as passenger and freight rail, seaport, transit, or active transportation projects, are not available through Caltrans Climate Change Vulnerability Assessments and the Adaptation Priority Reports. Alternative sources include the following:

- Cal-Adapt.org
- Local climate data sources and tools
- Other regional or project-specific climate change studies/plans/reports

Analysis Approach: Non-highway projects may use other resources, such as Cal-Adapt.org, other local climate data sources and tools, or project-specific studies to identify and assess vulnerability to climate change stressors. Project sponsors should provide documentation references to the studies and data sources. Where possible, include images such as screenshots of analyses performed using climate change tools listed below or photographs from past impacts to support an initial climate risk assessment.

Data Quality

Climate Change Integration: Datasets must incorporate climate change in their methodology to be eligible for this metric. Historic data alone is insufficient unless combined with climate change projections.

Supplementary Data: When a dataset does not include climate change projections, it may be combined or used in tandem with other climate change resources, such as Cal-Adapt.org, to assess project-related climate vulnerability.

Addressing Data Gaps: When certain climate stressors, such as wind events, land subsidence and others are not available in Cal-Adapt.org or other studies and tools, provide the following:

- Historical documentation of such climate events
- Analysis of effects on transportation infrastructure, users, or surrounding economic, environmental, or community assets
- Visual evidence (photographs, images, damage reports, etc.) of transportation facilities impacted by these events

Recommended Resources

The following resources provide climate data, vulnerability assessments, and adaptation guidance:

- Caltrans District Climate Change Vulnerability Assessments
- Caltrans District Climate Change Adaptation Priorities Reports
- Adaptation Strategies for Transportation Infrastructure
- Caltrans Climate Change Emphasis Area Guidance for Corridor Planning
- State Climate Resilience Improvement Plan for Transportation
- Climate Mapping for Resilience and Adaptation
- Cal-Adapt

Data Requirements

To assess the Climate Adaptation & Resiliency metric, the following information is required:

1. **Preliminary Climate Risk Assessment:** Using existing resources, provide a preliminary assessment that identifies climate stressors, risks, and vulnerabilities to transportation Infrastructure and communities, including the following:
    - Historic and forecasted climate stressors applicable to the project (e.g., sea level rise, flooding, extreme temperatures, wildfire, storm surge)
    - Vulnerable transportation assets (roadways, bridges, culverts) and their potential exposure
    - Vulnerable communities, particularly disadvantaged, low-income, and BIPOC communities
    - Climate data sources and tools used for the assessment (see Methodology – Climate Data Sources and Guidance section)
    - When data is unavailable in standard tools, provide historical documentation of climate events and their effects on transportation infrastructure, users, or communities
2. **Adaptation Strategies:** Provide documentation of climate adaptation strategies that correspond to the identified climate risks and vulnerabilities, including:
    - Specific adaptation strategies for vulnerable transportation assets (e.g.: drainage improvements, asset hardening, roadway elevation)
    - Nature-based solutions that are incorporated into project scope and design
    - Strategies to enhance resilience for vulnerable communities

- References to adaptation strategies in project scoping documents
- Consistency with state, regional, and local climate adaptation plans and hazard mitigation plans

3. **Disaster Management and Emergency Response (if applicable):** For projects with emergency management components, provide:
    - Description of how the project addresses emergency preparedness, response, and recovery
    - Multimodal evacuation strategies
    - Nexus to documented evacuation routes (reference applicable General Plan Safety Element, Community Wildfire Protection Plan, Local Hazard Mitigation Plan]
    - Solutions that prioritize alternatives to roadway widening through ITS, intersection improvements, etc.

The metric scoring team will evaluate submissions based on the quality and comprehensiveness of the documented context-specific solutions and resiliency measures.

Metric Constraints

The metric has limitations related to data availability and assessment methodologies:

1. Data: Climate stressor data and vulnerabilities are available for the State Highway System facilities through Caltrans District Vulnerability Assessments and Adaptation Priority Reports. The Adaptation Priorities Reports do not include adaptation strategies for every climate stressor for all transportation assets. Projects off the SHS and non-highway projects may have limited location-specific climate projections and must rely on other tools such as Cal-Adapt.org. Some climate stressors (such as wind events, land subsidence) may lack standardized projection data.
2. Complexity: Climate risk assessment requires balancing standardized methodologies with project-specific context. What constitutes an "appropriate" or "adequate" preliminary assessment varies based on project scale, location, complexity, and available data. Smaller projects may have limited resources for comprehensive climate analysis compared to major infrastructure investments.
3. Evolving Climate Science: Climate science, projection methodologies, and adaptation strategies continue to evolve. Growing scientific and technological understanding of climate and related climate change, stressors, vulnerabilities, and adaptation measures will continually influence this metric and future updates.

Scoring Checklist

Projects are scored on a 0–10-point scale based on two components:

- **Assessment of Stressors/Risks**: 2 points
- **Adaptation and Resiliency Strategies**: 8 points

Climate Risk Assessment (Prerequisite)

A climate risk assessment using existing resources/data is required before a project can earn points. The assessment must do the following:

- Identify applicable historic and forecasted stressors (e.g., sea level rise, storm surge, riverine flooding, extreme temperature, wildfire) that are likely to occur within the expected service life of the project.
- Provide documentation of findings.

Use District Climate Change Vulnerability Assessments for high-level data about current and forecasted stressors for projects on the SHS. Projects off the SHS can use other state and federal resources such as Cal-Adapt.org. Where data is lacking, project sponsors can provide narrative details and imagery of past climate-related weather events.

Assessment of Stressors/Risks (2 points total)

Projects that complete the prerequisite Climate Risk Assessment can earn up to two points based on their vulnerability assessments.

Table 20: Climate Adaptation and Resiliency Metric - Score Values for Climate Risk Assessment

Criterion	Description	Points
Vulnerable Transportation Infrastructure	Identify assets (e.g., roadways, bridges, culverts) in the study area that are vulnerable to potential impacts, including their assigned priority levels according to the District Adaptation Priorities Reports. For facilities that are likely to be exposed but not identified in the respective Adaptation Priorities Report, discuss how climate stressors could potentially impact asset performance (throughput) and user safety.	1
Vulnerable Communities	Evaluate climate impacts to vulnerable communities, including low-income, disadvantaged, and Black, Indigenous, People of Color (BIPOC) communities, and tribal governments/communities.	1

Scoring Adjustments/Interpretation Guidance:

The above two points are earned for a complete assessment of stressors to the **infrastructure and the community**. Only stressors that could reasonably affect the project study area should be considered applicable. Projects should document their rationale if excluding commonly applicable stressors.

Projects with partial assessment of stressors will get scored adjusted proportionately as follows:

- If the project identifies some, but not all applicable stressors to **both** the infrastructure and communities, the total score will be proportionately adjusted:
    - For example, if a project is likely to be impacted by temperature and riverine flooding, but it only assesses temperature (i.e., half of the applicable stressors) for vulnerable infrastructure and communities, the project would score only half of the total two points, or one point.
    - For example, if a project is likely to be impacted by temperature and riverine flooding, but it assesses temperature (i.e., half of the applicable stressors) for vulnerable infrastructure only but not vulnerable communities, the project would score only half of the total 1 point, or 0.5 point.

Adaptation and Resiliency Strategies (8 points total)

Consistency with Climate Change Risk Assessments / Adaptation Plans (Prerequisite)

Project scope and design must be consistent with the climate risk assessment and adaptation plans to earn points for adaptation and resiliency strategies.

Based on climate risks, vulnerable assets, and vulnerable communities identified above, project should utilize appropriate the adaptation strategies described in the Adaptation Strategies for Transportation Infrastructure, the State Climate Resilience Improvement Plan for Transportation, and other state, regional, or local adaptation policies and plans (such as "Green Streets" on page 58 of Design Information Bulletin 94).

Projects can earn up to eight points based on the inclusion of appropriate adaptation strategies described in the scoring guidelines below.

Table 21: Climate Adaptation and Resiliency Metric - Score Values for Adaptation Strategies

Criterion	Description	Points
Strategies for Transportation Infrastructure	Project incorporates strategies to harden assets (e.g., roadways, bridges, culverts) against each historic and forecasted stressor identified in the Climate Risk Assessment.	1
	Nature-based adaptation strategies are incorporated into the project scope.	1
	Disaster management (emergency evacuations, response, and recovery) prioritizes solutions other than roadway widening, such as ITS, contraflow measures, providing additional ingress/egress/street connectivity, intersection geometric improvements (e.g., larger turning radii), or access to shelter-in-place locations. Reference Design Information Bulletin Number 93 - Evacuation Route Design Guidance.	1
	Adapting transportation infrastructure to climate stressors or climate events is a primary objective of the project.	1
Strategies for Vulnerable Communities	Communities identified as vulnerable in the Climate Risk Assessment have been considered and engaged throughout the project planning, scoping, and design process.	1
	Adaptation strategies will improve the resilience of these communities to climate stressors (e.g., shade trees/structures, porous pavement, nature-based solutions, multimodal evacuation strategy).	1
	The project demonstrates reasonable nexus to an evacuation route (or other route likely to be used for evacuation) that is documented in a Community Wildfire Protection Plan, Local Hazard Mitigation Plan, and/or the Safety element of a local General Plan, AND the project demonstrates it is prepared to handle emergency operations.	1
	Enhancing community resilience to climate stressors or climate events is a primary objective of the project.	1
	Enhancing community resilience to climate stressors or climate events is a primary objective of the project.	1

Scoring Adjustments/Interpretation Guidance

The maximum eight points are earned for comprehensive inclusion of adaptation and resiliency measures into the project scope and design. Only adaptation and resiliency measures that could reasonably affect the project study area should be considered applicable.

The scoring rubric for adaptation and resiliency is structured to be flexible and accommodate different combinations of stressors, vulnerabilities, exposure levels, infrastructure facilities and asset types, and affected communities. Not all transportation assets in the Adaptation Priorities Reports are prioritized for adaptation against every climate stressor reflected in the relevant Climate Change Vulnerability Assessments. The scoring rubric recognizes this data limitation and the evolving nature of climate science for adaptation and resiliency measures. Projects may address a subset of stressors that are relevant to the specific project context. Projects are encouraged to document their rationale for excluding applicable adaptation and resiliency measures.

Projects with partial inclusion of adaptation and resiliency measures will be scored proportionately. If the project identifies adaptation strategies for some, but not all, applicable stressors, the eight criteria are scored with partial points, as applicable.

- For example, if a project is likely to be impacted by temperature and riverine flooding but only provides adaptation strategies for temperature (i.e., half of the applicable stressors), the project would score only half of the total points in some of the criteria.
- Additionally, if communities near the project are vulnerable to stressors such as temperature and wildfire, but the project provides community resilience strategies only for temperature (i.e., half of the applicable stressors), the project would score only half of the total points in some of the criteria.

Appendices

APPENDIX A – ACRONYMS

AADT	Annual Average Daily Traffic
ACS	American Community Survey
AFC	Alternative Fuel Corridors
BIPOC	Black, Indigenous, and People of Color
CAPTI	Climate Action Plan for Transportation Infrastructure
CARB	California Air Resources Board
CBO	Community-based organization
CEQA	California Environmental Quality Act
CMF	Crash Modification Factor
CRF	Crash Reduction Factor
CSFAP	California Sustainable Freight Action Plan
CSIS	Caltrans System Investment Strategy
DAC	Disadvantaged Community
EQI	Equity Index
FSI	Fatal and Serious Injury
FHWA	Federal Highway Administration
GHG	Greenhouse Gas
GTFS	General Transit Feed Specification
HCD	California Department of Housing and Community Development
HERE	A data vendor producing Points of Interest data
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
HQTA	High Quality Transit Areas
LEHD	Longitudinal Employer-Household Dynamics
LTS	Level of Traffic Stress
NCST	National Center for Sustainable Transportation

NEPA	National Environmental Policy Act
OSM	Open Street Map
PID	Project Initiation Document
POI	Points of Interest
SHS	State Highway System
SOV	Single Occupancy Vehicle
TDM	Transportation Demand Model
TIMS	Transportation Injury Mapping System
TOAR	Traffic Operations Analysis Report
TTTRI	Truck Travel Time Reliability Index
VMT	Vehicle Miles Traveled
ZEV	Zero-Emission Vehicle

APPENDIX B – GLOSSARY

Access to Destinations: The ability to reach destinations, generally defined as employment and non-work destinations, via the auto, transit, pedestrian, and bicycle networks. Factors affecting Access to Destinations include density and location of destinations, travel times by mode (including first- and last-mile walks for transit), and "level of traffic stress" for cycling.

California Sustainable Freight Action Plan Typologies: Project elements defined by the California Sustainable Freight Action Plan that support sustainable freight. These are: Alternative Fuel Infrastructure, Bridge Improvements, Bridge Replacements, and Intermodal At-grade Crossing Reduction, Modal (Non-highway Mode) Freight Mobility, Freight Safety, Resiliency, and Security, Freight Technology-based Approaches, Sustainable Trucking, and Other Modal and Sustainable Approaches. Other modal and sustainable approaches will require additional review by the Headquarters Freight team to determine alignment with the California Sustainable Freight Action Plan Typologies.

Conveyal: A web-based software tool for calculating Access to Destinations for custom transportation and land use scenarios.

Disadvantaged Community: Members of communities of color and underserved communities that experienced fewer benefits and a greater share of negative impacts associated with our state's transportation system. Within the context of this document, it is defined in a manner consistent with the Caltrans EQI, which includes all people that are part of a low-income household (defined by AB 1550).

Extreme Weather/Events: Defined differently based on the climate stressors or impacts being called out. For example, for an extreme heat day or warm night is defined as a day in a year when the daily max/minimum temperature exceeds in the 98th percentile of daily max/min temperatures based on observed historical data from 1961-1990 between April and October. Generally, an extreme weather event is an occurrence that is significantly different from typical weather at a specific location for that time of year. There is flexibility for what can be considered an "extreme event". More examples "extremes" can be found at https://cal-adapt.org/tools/.

Heavy Duty Chargers: Chargers designed for the use of heavy-duty vehicles, such as trucks or buses.

Location Data: The location and extent of a project, stored in Geographic Information System. To accurately capture standardized Project Geographic Data, a single Survey123 form has been developed by Caltrans HQ and will be distributed to project sponsors.

Longitudinal Employer-Household Dynamics: The US Census Longitudinal Employer Household Dynamics survey program produces a dataset with origin-destination employment statistics to identify counts of jobs and workers within each Census block.

Low Income: A Census block group is designated as a 'low-income' community if either 1) its median household income was at or below 80 percent of the statewide median household income, OR 2) its median household income was at or below the 2022 county low-income limit established by the California Department of Housing and Community Development. This definition is consistent with AB 1550.

Metric: Performance criteria where a numerical score is assigned to a project based on a set of thresholds or ranges.

Points of Interest: Non-work destinations, including grocery stores, medical facilities, schools, attractions, etc.

Population-Weighted Access to Destinations: Raw Access to Destinations scores weighted by population to reflect the number of people who would benefit from an improvement, and to avoid showing benefits to zero-population areas. Population weighting may be based on the entire population or the population in a disadvantaged community, depending on the metric.

Program Fit: An assessment of a project's competitiveness for a discretionary funding program in which the project is being considered. This assessment mirrors the program guidelines by ensuring the project meets the program objectives, eligibility, and requirements, and competitive under key program criteria.

Project Sponsor: A project advocate (local/state agency, or private entity) that acquires and ensures adequate project funding.

Rural: An area that does not intersect a US Census Urbanized area.

Scoring Cycle: A particular time period in which project nominations are being evaluated and prioritized under the CSIS framework for a specific competitive program.

APPENDIX C: EXTENDED SAFETY COUNTERMEASURES

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Channelization: Intersection Side Swipe/Head-On								0.2	To reduce or prevent sideswipe and head-on collisions
Curve Delineation: Visibility: Night Super Elevation								0.4	To improve night visibility
Curve Delineation: Curve Delineation	0.15	0.39	0.39	0.39	0.39	0.15	10		
Curve Delineation: Flashing Beacon for Curves	0.2	0.38	0.38	0.38	0.38	0.2	10		
Curve Delineation: Post Mounted All F+SI								0.16	To reduce run-off-road collisions 16% (fatal and injury All types)
Curve Delineation: Post Mounted Single Vehicle ROR								0.2	To reduce run-off-road collisions 20% (single vehicle run-off-road)
Curve Delineation: Install/Improve delineation								0.25	To reduce run-off-road collisions 25-30% nighttime (single vehicle run-off-road)
Curve Delineation: Combo - CHEV,CURVE signs and GROUND MOUNT delineation								0.36	To improve run off road collisions 29-42% ROR, rear-end, sideswipe, over-turn, hit object)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Curve Delineation: Enhanced shoulder or in-lane for sharp curves								0.25	To reduce run-off-road collisions 25-30% nighttime (single vehicle run-off-road)
Improve Vehicle Control: Night Collisions: Slope Flattening								0.36	To prevent or reduce night collisions 13-60% (All Types)
Improve Vehicle Control: Broadside HFST Night Crashes								0.12	To reduce or prevent broadside related collisions 12% (Nighttime - All types)
Improve Vehicle Control: Broadside Localized Drainage								0.37	To prevent or reduce broadside collisions 6-80% (left-turn, angle)
Improve Vehicle Control: Broadside HSFT All Crashes								0.42	To reduce or prevent broadside related collisions 42% (All Types)
Improve Vehicle Control: Broadside Truck Escape Ramps								0.5	To prevent or reduce broadside collisions 35-67% (All severe types)
Improve Vehicle Control: In-Lane Rumble Bars								0.25	To reduce or prevent pedestrian related collisions 25% (Vehicle-pedestrian)
Improve Vehicle Control: Centerline Rumble Strip	0.2	0.2	0.2	0.2	0.2	0.2	10		

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Improve Vehicle Control: Flatten to 3:1 or flatter								0.2	To improve roadside departure and recovery 20-40% (ROR, Fixed Object, Over-turn)
Improve Vehicle Control: Safer Slopes and Ditches 4:1 to 6:1 ROR F+SI All Crashes								0.29	To prevent or reduce run-off road collisions 29% (F+I All Types)
Improve Vehicle Control: Barrier and Attenuation Systems								0.29	To improve safety recovery 29% (F+I All Types)
Improve Vehicle Control: Flatten to 4:1 or flatter ROR, Fixed Object, Overturn								0.3	To improve roadside departure and recovery 20-40% (ROR, Fixed Object, Over-turn)
Improve Vehicle Control: Safer Slopes and Ditches 3:1 to 4:1 slopes								0.42	To prevent or reduce run-off road collisions 42% (F+I All Types)
Improve Vehicle Control: Super Elevation								0.4	To reduce run-off-road collisions 40% (single vehicle run-off-road and wet)
Improve Vehicle Control: HFST Single Vehicle Wet ROR Single Vehicle and Wet Surface								0.55	To reduce run-off-road collisions 40% (single vehicle run-off-road and wet)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Improve Vehicle Control: HFST Single Vehicle Wet ROR Curve Related								0.24	To reduce dry pavement related run off road collisions 24% curve related crashes
Improve Vehicle Control: Eliminate Shoulder Drop-Offs Grading								0.11	To prevent or reduce run off road collisions (All Types) and 11% (Fatal)
Improve Vehicle Control: Sinusoidal Rumble Strip								0.2	To reduce or prevent lane departure collisions
Improve Vehicle Control: Yielding or breakaway roadside hardware - light poles, signs, bridge rails								0.25	To improve roadway departure and recovery
Improve Vehicle Control: Improved highway geometry for horizontal curves								0.45	To Improve roadway departure 40-50% (Rear-end, ROR, Fixed Object, Over-turn)
Improve Vehicle Control: Adequate Drainage								0.36	To increase friction on roadway and minimize or reduce wet pavement collisions 10-62% (wet, night, all)
Improve Vehicle Control: FRICTION increasing pavement								0.65	To Improve Surface Friction for Wet Collisions 40-95% (Wet, All Types)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Improve Vehicle Control: Rock Fall Mitigation								0.46	To prevent rear-end, sideswipe, speed collisions between truck 46%(Trucks)
Improve Vehicle Control: Pavement Grooving								0.2	To Improve Surface Friction for Wet Collisions 20% (Wet, All)
Intersection Improvements: Remove Obstacles								0.3	To reduce or prevent collisions at intersections 30% (All types)
Intersection Improvements: Modify Traffic Signals - Increase Yellow Time, All Collisions								0.33	To reduce or prevent collisions at intersections 11-56% (All Types)
Intersection Improvements: Improve location of signal heads								0.15	To reduce or prevent broadside collisions at intersections 15% (Left-turn)
Intersection Improvements: Install ADV WARN Signs and Markings								0.57	To reduce or prevent broadside collisions at intersections 57% (All types)
Intersection Improvements: REALIGN Stop Bar F+SI								0.23	To reduce or prevent collisions at intersections 13-60% fatal and injury when all combined
Intersection Improvements: REALIGN Stop Bar All Crashes								0.33	To reduce or prevent left turn collisions at intersections 33% (All Types)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Intersection Improvements: All-Way Stop Control (w/o flashing beacons)								0.44	To reduce or prevent broadside collisions at intersections 44% (All Types)
Intersection Improvements: Traffic Signal if Warranted (Warrant 7), Intersection Running								0.65	To reduce or prevent speed related intersection running related collisions 65% (broadside)
Intersection Improvements: Traffic Signal if Warranted (Warrant 7), Broadsides								0.44	To reduce or prevent broadside collisions at intersections 44% (All Types)
Intersection Improvements: Signalized Intersection								0.6	To reduce or prevent broadside collisions at intersections 60% (left-turn)
Intersection Improvements: All-Way Stop Control (with flashing beacons)								0.78	To prevent or reduce broadside collisions 78% (All severe types)
Intersection Improvements: Traffic Signal if Warranted (Warrant 7), Rock Encroachments								0.25	To control rock fall events and minimize rock encroachments on highway
Intersection Improvements: Retroreflective tape around signal head								0.15	To reduce or prevent collisions at intersections 15% (All types)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Intersection Improvements: INCREASE size of signs								0.15	To reduce or prevent collisions at intersections 15% (right-angle)
Intersection Improvements: Optical Speed Bars in Lanes								0.19	To reduce or prevent collisions at intersections 19% (All types)
Intersection Improvements: Doubled up (left and right side), OVERSIZE ADV "Stop Ahead" signs								0.23	To reduce or prevent collisions at intersections 13-60% fatal and injury when all combined
Intersection Improvements: REMOVE vegetation, parking, obstructions limiting sight distance - F+SI								0.23	To reduce or prevent collisions at intersections 13-60% fatal and injury when all combined
Intersection Improvements: Increase Curb Radius								0.3	To reduce or prevent left turn collisions at intersections
Intersection Improvements: REMOVE vegetation, parking, obstructions limiting sight distance - Nighttime								0.33	To reduce or prevent collisions at intersections 13-60% nighttime (All types) when all combined

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Intersection Improvements: Install/Improve Lighting Nighttime								0.33	To reduce or prevent collisions at intersections 13-60% nighttime (All types) when all combined
Intersection Improvements: Restricted Crossing U-Turn (RCUT)								0.51	To reduce or prevent rear-end collisions at intersections 36-62% (rear-end, angle)
Intersection Improvements: GROOVE exist pavement								0.54	To reduce or prevent left turn collisions at intersections
Intersection Improvements: Right-turn-on-red restrictions								0.45	To improve sharp radius turning
Intersection Improvements: Signal to Roundabout								0.41	To prevent or reduce broadside collisions and other intersection related collisions 41% (All Types).
Intersection Improvements: Provide right-turn lane, Broadsides								0.55	To reduce or prevent broadside collisions at intersections 55% (right angle)
Intersection Improvements: Yellow Retroreflective tape around signal head								0.15	To reduce or prevent broadside collisions 15% (All Types)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Intersection Improvements: Provide left-turn lane, Broadsides								0.27	To reduce or prevent broadside related collisions 20-35% (All types)
Intersection Improvements: Restrict parking near corners								0.46	To reduce or prevent broadside related collisions 37-56% (All Types)
Intersection Improvements: Local Road Stop Controlled to Roundabout								0.81	To reduce or prevent broadside related collisions 80.2% (All types)
Intersection Improvements: Two-Way Left Turn Lane, Headlight Glare Reduction								0.25	To control glare from opposing traffic headlights
Intersection Improvements: Traffic Signal if Warranted (Warrant 7), Truck Collisions								0.75	To reduce run away truck collisions 75% (All)
Intersection Improvements: Traffic Signal if Warranted (Warrant 7), Broadsides								0.72	To reduce or prevent broadside collisions at intersections 72% (broadside)
Intersection Improvements: Open Graded Asphalt Concrete								0.72	To reduce or prevent broadside collisions at intersections 72% (broadside)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Intersection Improvements: All Way Stop								0.01	To reduce run-off-road collisions __% (single vehicle run-off-road, overturn, hit object F+I)
Intersection Improvements: Diverging Diamond Interchange								0.78	To prevent or reduce run off road collisions 78% (ROR, Single-vehicle, fixed object, overturn F+I)
Intersection Improvements: Remove/relocate objects in risk locations								0.2	To improve roadside departure and recovery
Intersection Improvements: Raised Pedestrian Crossing	0.35	0.35	0.35	0.35	0.35	0.35	20		
Intersection Improvements: Roundabout	0.35	0.79	0.79	0.79	0.35	0.35	20		
Intersection Improvements: Sidewalk (Walkways)	0.65	0.65	0.65	0.65	0.65	0.65	20		
Intersection Improvements: INSTALL ACCEL or DECEL Lane								0.2	To reduce rear-end and broadside collisions related to turning

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Intersection Improvements: INSTALL Left Turn Lane, Rear-End and Sideswipe								0.2	To reduce rear-end and sideswipe collisions related to turning 20% (sideswipe, broadside, rear-end)
Intersection Improvements: INSTALL Two Way Left Turn Lane, Rear-End and Sideswipe								0.26	To reduce rear-end and broadside collisions related to turning 26% (All types)
Intersection Improvements: INSTALL Right Turn lane, Rear-End and Broadside								0.29	To reduce rear-end and broadside collisions related to turning 21-39% (All types)
Intersection Improvements: Increase curb radii								0.3	To reduce rear-end and sideswipe collisions related to turning 30% (rear-end, dry weather, 3- and 4-way stop-controlled)
Intersection Improvements: Restrict Parking near driveway								0.35	To reduce rear-end and sideswipe collisions related to turning 35% (All Types)
Intersection Improvements: INSTALL Traffic Diverter – Prevent Left								0.4	To reduce rear-end and sideswipe collisions related to turning 25-60% (Broadside, rear-end, sideswipe)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Intersection Improvements: Install Right Turn Lane, Speed Related								0.2	To reduce or prevent speed related collisions 20% (All types)
Intersection Improvements: Install Left Turn Lane, Wet Collisions								0.36	To increase friction on roadway and minimize or reduce wet pavement collisions 10-62% (wet, night, all, 4-way stop-controlled)
Intersection Improvements: Convert Two Way to All Way Stop Control								0.32	To Improve Surface Friction for Wet Collisions 32% (Wet, All)
Intersection Improvements: Remove sight obstructions								0.36	To increase friction on roadway and minimize or reduce wet pavement collisions 10-62% (wet, night, all, 4-way stop-controlled)
Intersection Improvements: Traffic Signal if Warranted (Warrant 7), Wet Collisions								0.36	To increase friction on roadway and minimize or reduce wet pavement collisions 10-62% (wet, night, all, 4-way stop-controlled)
Lighting: Install/Improve Street Lighting								0.82	To prevent or reduce broadside collisions 82% (All severe types)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Lighting: MODIFYING lighting								0.16	To prevent or reduce wrong way collisions 16% (All Types)
Lighting: Enhanced Lighting, Sidewalks								0.35	Minimize pedestrian crossings movement collisions 35% (pedestrian-bicycle)
Lighting: INSTALL intersection lighting All Collisions								0.29	To improve pedestrian safety 29% reduction in total collisions
Median Improvements: Median U-Turn (MUT)								0.28	To reduce or prevent collisions at intersections 28% (All types)
Median Improvements: Glare Screen								0.15	To reduce or prevent lane departure collisions 10-25% (All Types)
Median Improvements: INSTALL Cable barriers								0.46	To prevent or reduce wrong way collisions
Median Improvements: Cable Median Barrier (Volume/Width Criteria)	0.25	0.25	0.25	0.25	0.25	0.25	20		

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Median Improvements: Concrete Median Barrier (Volume/Width Criteria)	0.25	0.25	0.25	0.25	0.25	0.25	20		
Median Improvements: Metal (e.g., Thrie Beam) Median Barrier (Volume/Width Criteria)	0.25	0.25	0.25	0.25	0.25	0.25	20		
Median Improvements: 12" Median Rumble Strip								0.96	Reduce the number and severity of cross-median collisions
Median Improvements: INSTALL Concrete barriers								0.96	Reduce the number and severity of cross-median collisions 96% (Cross Median Fatal and Injury)
Median Improvements: INSTALL Thrie-Beam Barrier								0.96	Reduce the number and severity of cross-median collisions 100% (Cross Median Fatal and Injury
Median Improvements: Multiple Median Fencing								0.3	To reduce or prevent lane departure collisions 10-50% (ROR)
Median Improvements: INSTALL Median Channelizers								0.52	To reduce wet pavement related run off road collisions 52% Wet related

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Median Improvements: Cable Barrier High Tension, ROR								0.75	To reduce run-off-road collisions 75-95% (single vehicle run-off-road, overturn, hit object F+I)
Median Improvements: Concrete Barrier, ROR								0.95	To reduce run-off-road collisions95-100 (single vehicle run-off-road, overturn, hit object F+I)
Median Improvements: Concrete Guardrail								0.25	To reduce run-off-road collisions 25% (single vehicle run-off-road, overturn, hit object F+I)
Median Improvements: Cable Barrier High Tension, Wet Collisions								0.36	To warn of reduced friction roadway and minimize or reduce wet pavement collisions 10-62% (wet, night, all)
Modify Traffic Signals: Prohibit Right Turn on red								0.23	To reduce or prevent broadside collisions 23% (All Types)
Modify Traffic Signals: Provide All Red Phase, Broadside								0.25	To reduce or prevent broadside collisions 25% (All Types)
Modify Traffic Signals: Add left turn phase								0.36	To reduce or prevent broadside collisions36% (right angle all types)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Modify Traffic Signals: Provide Protected LT Signal Phase, Broadside								0.55	To reduce or prevent broadside collisions (All Types)
Modify Traffic Signals: Provide Protected LT Signal Phase, Broader or Head-On								0.1	To reduce or prevent broadside or head-on related collisions 10% (All Types)
Modify Traffic Signals: Yellow Retroreflective Border around signal head								0.35	To reduce or prevent broadside collisions at intersections 35% (rear-end)
Modify Traffic Signals: Provide Protected LT Signal Phase, Intersection Crashes								0.15	To reduce or prevent intersection related collisions 15% (All Types)
Modify Traffic Signals: Exclusive Pedestrian Phase								0.5	To improve pedestrian safety 50% (vehicle-pedestrian)
Modify Traffic Signals: Increase Yellow Time, Wet Surface								0.13	To reduce or prevent lane departure collisions 12-15% (wet-related departures)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Modify Traffic Signals: Modify Traffic Signal* (*calculate the appropriate CRF, not to exceed 20 percent)	0.2	0.2	0.2	0.2	0.2	0.2	15		
Modify Traffic Signals: New Traffic Signals	0.3	0.67	0.67	0.67	0.67	0.3	15		
Modify Traffic Signals: Provide All Red Phase, Broadside								0.15	To reduce or prevent broadside collisions 15% (All Types)
Pedestrian Enhancement: Overcrossing Pedestrian Fencing								0.3	To reduce or prevent all types of collisions 8-50%
Pedestrian Enhancement: School Zone Signals								0.25	To improve pedestrian safety 10-40% (vehicle-pedestrian)
Pedestrian Enhancement: Hybrid beacon, Sidewalks								0.01	To improve pedestrian safety Not Rated
Pedestrian Enhancement: Pedestrian countdown signal heads, F+SI								0.15	To improve pedestrian safety 15% reduction in serious injury and fatal collisions
Pedestrian Enhancement: Pedestrian signal								0.51	To improve pedestrian safety 51% (vehicle-pedestrian)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Pedestrian Enhancement: RRFB Midblock								0.6	To improve pedestrian safety 60% (ALL types of vehicle-pedestrian)
Pedestrian Enhancement: INSTALL pedestrian/bicycle over crossing								0.07	To improve pedestrian safety 7% (vehicle-pedestrian)
Pedestrian Enhancement: Pedestrian Countdown Signal Heads	0.25	0.25	0.25	0.25	0.25	0.25	15		
Shoulder/Roadside Safety Barrier: Guardrail, Intersection Broadsides								0.6	To reduce or prevent broadside collisions at intersections 60% (left-turn)
Shoulder/Roadside Safety Barrier: Increase shoulder width from 0 ft. to 8 ft.								0.95	To improve pedestrian safety 90-100% (vehicle-pedestrian/bicycle (fatal and injury)
Shoulder/Roadside Safety Barrier: Shoulder/Edgeline Rumble Strip** (**of run-off-road collisions)	0.15	0.15	0.15	0.15	0.15	0.15	10		
Shoulder/Roadside Safety Barrier: Shoulder/Roadside Safety Barrier** (**of run-off-road collisions)	0.25	0.3	0.3	0.25	0.25	0.25	20		

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Shoulder/Roadside Safety Barrier: Guardrail, Night Collisions								0.01	To prevent or reduce night collisions
Shoulder/Roadside Safety Barrier: CRZ - Out to 20 feet								0.42	To improve safety recovery 42% (F+I All Types)
Shoulder/Roadside Safety Barrier: CRZs - removing fixed objects								0.22	To reduce run-off-road collisions 22% (single vehicle run-off-road)
Shoulder/Roadside Safety Barrier: CRZ - Out to 30 feet								0.4	To reduce run-off-road collisions 17-100% (single vehicle run-off-road)
Shoulder/Roadside Safety Barrier: CRZ - Out to 20 feet								0.42	To improve safety recovery 42% (F+I All Types)
Shoulder/Roadside Safety Barrier: CRZ - removing fixed objects								0.22	To reduce run-off-road collisions 22% (single vehicle run-off-road)
Shoulder/Roadside Safety Barrier: CRZ - Out to 30 feet								0.4	To reduce run-off-road collisions 17-100% (single vehicle run-off-road)
Shoulder/Roadside Safety Barrier: Shoulder Widening								0.45	To improve sharp turn curve and reduce roadside departure 45%

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Shoulder/Roadside Safety Barrier: Increase shoulder width from 2 ft. to 4 ft.								0.01	To reduce or prevent lane departure collisions
Shoulder/Roadside Safety Barrier: Increase shoulder width from 0 ft. to 8 ft.								0.17	To improve roadside departure recovery and minimize roadside departure collisions 14-20% (Fixed Object, head-on, ROR, sideswipe)
Shoulder/Roadside Safety Barrier: Increase shoulder width to 5 ft. or greater								0.33	To improve roadside departure recovery and minimize roadside departure collisions 21-48%% (Fixed Object, head-on, ROR, sideswipe)
Shoulder/Roadside Safety Barrier: Beveled Shoulder edge								0.1	To prevent or reduce run off road collisions (ROR, Single-vehicle, fixed object, overturn F+I)
Shoulder/Roadside Safety Barrier: Apply shoulder treatments delineators								0.16	To improve roadway departure and recovery

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Shoulder/Roadside Safety Barrier: INSTALL 6 in. shoulder RS on section with narrow or no paved shoulders								0.3	To improve roadside departure and recovery 20-40% (ROR, Fixed Object, Over-turn)
Shoulder/Roadside Safety Barrier: INSTALL shoulder rumble strips								0.32	To prevent or reduce run off road collisions
Shoulder/Roadside Safety Barrier: 12 in. Shoulder Rumble Strip								0.32	To prevent or reduce run off road collisions
Shoulder/Roadside Safety Barrier: Increase shoulder width from 0 ft. to 4 ft., ROR								0.37	To prevent or reduce run off road collisions 33-40% (ROR - All Severities)
Shoulder/Roadside Safety Barrier: Widen and/or pave shoulders								0.43	To prevent or reduce run off road collisions 40-45% (Fixed object, head-on, ROR, Sideswipe)
Shoulder/Roadside Safety Barrier: Install New / Upgrade Guardrail Transitions and End Treatments								0.45	To reduce or prevent lane departure collisions 20-70% (F+I All Types)
Shoulder/Roadside Safety Barrier: Install New / Upgrade Guardrail to protect fixed object(s)								0.47	To improve roadside departure and recovery 25-70% (All Types)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Shoulder/Roadside Safety Barrier: Increase shoulder width from 0 ft. to 6 ft., Wet ROR								0.52	To prevent run-off-road in curves wet pavement 52%(All Types)
Shoulder/Roadside Safety Barrier: Increase shoulder width from 0 ft. to 10 ft.								0.55	Reduce ROR collisions 43-66% (ROR - All Severities)
Shoulder/Roadside Safety Barrier: Increase shoulder width from 0 ft. to 4 ft., Speed								0.15	To reduce or prevent speed related collisions 0-30% (All Types)
Shoulder/Roadside Safety Barrier: Increase shoulder width from 0 ft. to 6 ft., Speed								0.2	To reduce or prevent speed-related collisions 20% (sideswipe or head-on)
Shoulder/Roadside Safety Barrier: Delineate trees or utility poles with reflective tape or object markers								0.83	To reduce or prevent speed-related collisions 66-99% (Cross median All Types)
Striping and Signage: Install TRAVEL WAY RS | BARS								0.61	To reduce or prevent broadside related collisions 60.7% (All types)
Striping and Signage: Doubled up (left and right side), OVERSIZE WARN signs, All								0.23	To reduce or prevent collisions at intersections 13-60% fatal and injury when all combined

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Striping and Signage: ENHANCED pavement markings through lane edge line								0.23	To reduce or prevent collisions at intersections 13-60% fatal and injury when all combined
Striping and Signage: Doubled up (left and right side), OVERSIZE ADV "Stop Ahead" signs								0.33	To reduce or prevent collisions at intersections 13-60% nighttime (All types) when all combined
Striping and Signage: Doubled up (left and right side), OVERSIZE WARN signs, Nighttime								0.33	To reduce or prevent collisions at intersections 13-60% nighttime (All types) when all combined
Striping and Signage: ENHANCED pavement markings through lane edge line								0.33	To reduce or prevent collisions at intersections 13-60% nighttime (All types) when all combined
Striping and Signage: INSTALL LARGER ADV WARN and STOP signs								0.33	To reduce or prevent collisions at intersections 13-60% nighttime (All types) when all combined
Striping and Signage: RETROREFLECTIVE Sheeting on posts								0.33	To reduce or prevent collisions at intersections 13-60% nighttime (All types) when all combined

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Striping and Signage: Broadside or Head-On Collisions: Double arrow warning sign at T-intersection								0.3	To reduce or prevent broadside or head-on related collisions 30% (vehicle-pedestrian)
Striping and Signage: INSTALL Enhanced Lane lines								0.1	To prevent or reduce night collisions 7-15% (Night time and All Types)
Striping and Signage: Night Collisions: Enhanced pavement markings								0.15	To prevent or reduce night collisions 10-20% (Wet, Night, All Types)
Striping and Signage: INSTALL raised markers								0.36	To prevent or reduce night collisions 13-60% (All types)
Striping and Signage: Install raised retro reflective pavement markings								0.36	To prevent or reduce night collisions 13-60% (All types)
Striping and Signage: INSTALL LED Illuminated Signs								0.36	To prevent or reduce night collisions 13-60% (All types)
Striping and Signage: Centerlines, lane lines and pavement edge lines								0.42	To prevent or reduce night collisions 29-53% (Night time and All Types)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Striping and Signage: MODIFYING trailblazing freeway entrance packages								0.2	To prevent or reduce wrong way collisions
Striping and Signage: Reorienting, relocating, or adding wrong-way sign package								0.2	To prevent or reduce wrong way collisions
Striping and Signage: Repainting or adding wrong-way pavement arrow								0.2	To prevent or reduce wrong way collisions
Striping and Signage: UPGRADING signs with high intensity reflective sheeting								0.2	To prevent or reduce wrong way collisions
Striping and Signage: ADD Enhanced Red on back Side Markers to Lane lines and Edge lines								0.2	To prevent or reduce wrong way collisions
Striping and Signage: ADD Retroreflective Red on Backside Markers to Limit Line								0.46	To prevent or reduce wrong way collisions

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Striping and Signage: ADD Retroreflective Red on Backside Markers to Type V Arrows								0.46	To prevent or reduce wrong way collisions
Striping and Signage: Crosswalk Safety Enhancements								0.01	To improve pedestrian safety and minimize objects being dropped or thrown on traffic
Striping and Signage: Pavement markings								0.25	To improve pedestrian safety
Striping and Signage: INSTALL stop bar before crosswalk (bike box)								0.3	To improve pedestrian safety 30% (vehicle-pedestrian)
Striping and Signage: Install Bike Lane								0.35	To improve pedestrian safety 25%-50% (Rear-end, broadside)
Striping and Signage: INSTALL raised pedestrian crossing								0.35	To improve pedestrian and bicycle safety 35% (Pedestrian and Bicycle)
Striping and Signage: INSTALL high visibility crosswalk								0.35	To improve pedestrian safety 35% (vehicle-pedestrian fatal and injury)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Striping and Signage: Post-mounted delineation								0.1	To reduce or prevent lane departure collisions (Wet, night, All)
Striping and Signage: Dynamic advance curve warning signs and sequential curve signs, All Lane Departure								0.25	To reduce or prevent lane departure collisions (All)
Striping and Signage: Larger signs - chevrons								0.16	To reduce run-off-road collisions 16% (fatal and injury All types)
Striping and Signage: Larger signs - chevrons, F+SI								0.16	To reduce run-off-road collisions 16% (fatal and injury All types)
Striping and Signage: Post Mounted Curve Warning Sign								0.16	To reduce run-off-road collisions 16% (fatal and injury All types)
Striping and Signage: Larger signs - chevrons, Nighttime ROR								0.25	To reduce run-off-road collisions 25-30% nighttime (single vehicle run-off-road)
Striping and Signage: Combo - CHEV,CURVE signs and GROUND MOUNT delineation w.BEAC								0.48	To improve run off road collisions 10-78% ROR, rear-end, sideswipe, over-turn, hit object)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Striping and Signage: Optical Speed Bars (ramps and/or lanes)								0.18	To improve roadside departure recovery and minimize roadside departure collisions 8-23% (Fixed Object, head-on, ROR, sideswipe)
Striping and Signage: ENHANCED striping with high retro-reflectivity								0.51	To improve roadside departure recovery and minimize roadside departure collisions 51% (All Types)
Striping and Signage: RETROREFLECTIVE pavement markings-wet								0.01	To reduce or prevent lane departure collisions
Striping and Signage: Install truck climbing lanes								0.95	To reduce run-off-road collisions 95-100% (single vehicle run-off-road, overturn, hit object F+I)
Striping and Signage: INSTALL LARGER TYPE XI Signs								0.27	To reduce run-off-road collisions 27% (single vehicle run-off-road, overturn, hit object F+I)
Striping and Signage: Provide enhanced pavement markings, RWD								0.15	To Improve roadway departure 15% (ROR, Head-on, Sideswipe, Overturn, Hit Object)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Striping and Signage: Provide enhanced pavement markings, Wet Curve ROR								0.24	To prevent run-off-road in curves wet pavement 24% reduction in curve crashes (All Types)
Striping and Signage: INSTALL edge line "profile marking," edge line rumble strips								0.32	To prevent or reduce run off road collisions
Striping and Signage: Install centerline RS								0.54	To prevent or reduce run off road collisions 48-50% (Fixed object, head-on, ROR, Sideswipe)
Striping and Signage: 6 in. Edge line Stripe								0.55	To prevent or reduce run off road collisions
Striping and Signage: Install ADV WARN Signs and Markings, Broadsides								0.25	To reduce or prevent broadside related collisions 25% (All Types)
Striping and Signage: Install Warning sign Broadsides								0.25	To reduce or prevent broadside related collisions 25% (All Types)
Striping and Signage: Install/Improve ADV WARN signs Intersections								0.25	To reduce or prevent collisions at intersections 25% (All types)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Striping and Signage: Install/Improve signing and/or markings for pedestrians, Rear End								0.25	To reduce or prevent rear-end collisions at intersections 25% (All types)
Striping and Signage: Install/Improve signing and/or markings for pedestrians, Pedestrian Crashes								0.25	To reduce or prevent pedestrian related collisions 25% (Vehicle-pedestrian)
Striping and Signage: Install Slippery When Wet Sign(s)								0.38	To reduce or prevent broadside or head-on related collisions 28-48%
Striping and Signage: Install Yield Signs								0.41	To reduce or prevent broadside collisions at intersections 35% (rear-end)
Striping and Signage: Install ADV WARN Signs with LED Borders								0.41	To reduce or prevent broadside related collisions 11-55% (Broadside, angle, running intersection)
Striping and Signage: Install Warning sign with flashing beacon								0.46	To reduce or prevent broadside related collisions 37-56% (All Types)
Striping and Signage: ADD FLASHING BEAC or LED Bordered Signs								0.48	To reduce or prevent collisions at intersections 36-62% (Rear-end, angle type)

Countermeasures	CRF All	CRF-K	CRF-A	CRF-B	CRF-C	CRF-O	Project Life (Years)	Expected CRF	Notes
Striping and Signage: Double arrow warning sign at T-intersection.								0.21	To reduce or prevent rear-end collisions14-26% (All types)
Striping and Signage: Backplates with Retroreflective Borders	0.15	0.15	0.15	0.15	0.15	0.15	10		
Striping and Signage: Class II Bike Lane	0.35	0.35	0.35	0.35	0.35	0.35	10		
Striping and Signage: Striping and Signage	0.1	0.1	0.1	0.1	0.1	0.1	10		
Striping and Signage: INSTALL Type XI Sign								0.56	To reduce rear-end and broadside collisions related to turning 16-99% (Rear-end, sideswipe, broadside, 3- and 4-way stop-controlled)
Striping and Signage: Placing edge lines and pavement markers								0.52	To Improve Surface Friction for Wet Collisions 52% (Wet, All)
Striping and Signage: Install truck climbing lanes								0.43	To prevent rear-end, sideswipe, speed collisions between truck-vehicles 43% (All Types)