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U.S. 101 Central Coast California Freight Strategy

Appendix D. Performance Evaluation Framework

white paper

prepared for

AMBAG

prepared by

Cambridge Systematics, Inc.

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1.0 Introduction

A robust set of performance measures will be implemented as part of the U.S. Highway 101 Central Coast California Freight Study to evaluate the goods movement system. These measures will provide stakeholders with a method to gauge the condition and use of the current system, identify freight-related priorities, develop policy, and prioritize investment. The performance measures will provide a continuing method to monitor conditions and evaluate progress towards the Plan's Vision and Goals.

The recommended performance measures highlighted in this technical memorandum will become the basis for evaluating projects, programs, and policies identified in the Plan. A performance-based evaluation process will help stakeholders and decision makers understand the benefits of proposed goods movement actions through the analysis of objective qualitative and quantitative information.

This memorandum contains the following sections:

- **Section 2.0 – Overview of Performance Measures:**

  This section explains the purpose of performance measures and how they are selected. It also highlights freight-specific performance measures utilized in Federal and State studies and plans that were identified through the literature review and discusses "best practice" performance measures that appear in all of the listed documents.

- **Section 3.0 – Performance-Based Evaluation Process:**

  This section explains the process developed to arrive at a final set of recommended performance measures, explains their relevance to the Plan, identifies the source of information, and proposes methodology to complete the needs analysis.

2.0 Overview of Performance Measures

The use of performance measures in the public sector has matured and expanded significantly in recent years. However, the use of freight-specific performance measures remains limited nationally, and varies significantly between states and regions. This section explains: 1) the purpose of performance measures; 2) how performance measures are evaluated and chosen; 3) the state of the practice at both the Federal and state level, including a discussion of current efforts in California to develop freight-specific measures; and 4) commonly utilized "best practice" performance measures.

2.1 Purpose of Performance Measures

Performance measures are tools that provide a way to assess the condition of the transportation system, identify challenges and opportunities for system improvement, identify and evaluate strategies to meet goods movement goals, and monitor ongoing performance. They can also be used to help decision-makers allocate limited resources more effectively than would otherwise be possible. It is common for different performance measures to be applied to each of these unique purposes, situations and system needs. Performance measures can be applied as follows:

- **Linking Strategies to Vision and Goals.** Performance measures can be developed and applied to help link Plan strategies to the Vision and Goals of the Plan. Only when strategies address the goals of the plan are they truly effective in determining the progress being made to meet the goals, and in identifying gaps.

- **Needs Assessment and Strategy Development.** Performance measures can be used to assess condition, performance, and use of the transportation system through the establishment of performance measurement benchmarks. They also help identify system challenges where projects, programs or policies may be needed.

- **Project Evaluation and Prioritization.** Performance measures can provide information to guide when and where to invest in projects and programs that provide the greatest benefits. Projects can be identified and prioritized by understanding the potential impact a given project could have on system performance as measured by the developed performance measures.

- **Managing Performance.** Applying performance measures can improve the management and delivery of programs, projects and services by showing a link between project implementation and resulting changes in conditions. Performance measures for system performance can also be used to highlight the technical, administrative, and financial issues critical to managing any program or project.

- **Communicating Results.** Performance measures may help communicate the value of public investments in transportation, contributing to state and Federal reporting, and providing a way for stakeholders to see an agency's progress on improving the transportation system. This can help build support for future transportation investments.

- **Strengthening Accountability**. Performance measures promote accountability on the use of taxpayer resources and reveal whether transportation investments are providing the expected performance improvements.

Identifying performance measures is the first step in better understanding a transportation system. However, the ability to measure a system at a large scale does not, by itself, provide sufficient knowledge to fully understand that system. In practice, quantitative performance measures are used to represent a complicated set of activities, phenomena, and human behavior, using one number. While quantitative performance measures are generally considered the best way to measure transportation system performance, practitioners must assure that the measure accurately represents the phenomena of interest, and that the measure being used is not oversimplifying the subject of analysis. For example, while measures may show that freight congestion increases along with regular automobile traffic, they do not explain the complicated human behavior that could be the basis of these changes such as tourism cycles, commute behavior, business logistics practices, the impact of weather on travel choice, and other causal factors.

To effectively use performance measures, organizations must understand the complex relationship between measures and real-world phenomena, including what can and cannot be accurately measured. Practitioners must also understand how changes impact real-world conditions and the causal links between projects and performance measure change.

2.2 Choosing Performance Measures

Performance measures should be carefully selected to align with Plan goals and the available data and resources. When considering performance measures, questions related to how they will be applied and the availability of data should be considered. The most appropriate performance measures will also vary depending on regional and local characteristics and unique features.

While performance measures provide many benefits, a few pitfalls should be avoided when implementing performance measurement systems, including:

- **Selecting performance measures based solely on data availability.** High quality data may not be immediately available to measure performance relative to vision and goals. Although it is prudent to begin with measures for which data are available, performance measures which link to visions and goals should not be excluded solely due to a current lack of data. While the costs for collecting data on new performance measures may be high, if a measure is critical enough to monitoring progress towards a key goal, an agency should examine strategies for collecting data on an ongoing basis.

- **Selecting performance measures based on their quantitative nature and strength while discounting qualitative or low tech measures.** While high quality data is important to performance evaluation, qualitative information can also be applied and provide insight into system conditions and use. In addition, quantitative measures may not adequately address all political and community value considerations and/or project types. Likewise, while robust tools such as travel demand and economic models can provide detailed evaluation of discrete projects, other lower tech tools such as spreadsheets and sketch analyses can also be applied and provide useful results.

- **An inappropriate number of performance measures can undermine the agency's ability to utilize them effectively.** Too many performance measures may cause a lack of focus and foster wide-ranging data collection efforts that consume valuable resources. As states and regions progress in their efforts to incorporate performance measures they tend to reduce their number of measures to a "critical few." However, utilizing too few performance measures can leave agencies with gaps in critical areas, undermining the effectiveness of their performance measurement program.

2.3 State of the Practice

Prior to the most recent transportation legislation, freight performance measures were not widely used, in part due to the difficulty in obtaining freight-specific data. Unlike passenger transportation, freight transportation is essentially a private sector activity that involves businesses (shippers/receivers), carriers (logistics companies and shipping lines) and logistics service providers that help move goods. The public sector interacts with freight transportation through the provision of infrastructure, setting rules and regulations and establishing policies. Because most of the freight data is kept by private companies, data, projects, or plans that the public sector could use to further the movement of goods are sometimes difficult to obtain due to privacy concerns.

The signing of the Moving Ahead for Progress in the 21st Century (MAP-21)[1] transportation legislation in July 2012, brought performance measures into the spotlight. Under MAP-21, State Departments of Transportation

[1] MAP-21 §2002; 23 USC 601-609.

(DOT) and Metropolitan Planning Organizations (MPOs) will be required to establish and use a performance-based approach to transportation decision-making and the development of short and long-range transportation plans.

The U.S. DOT will establish performance measures to align with seven National Goals established as part of the legislation, including: 1) safety, 2) infrastructure condition, 3) congestion reduction, 4) system reliability, 5) freight movement and economic vitality, 6) environmental sustainability, and 7) reduced project delivery delays. Several of these core goal areas can be directly tied to the freight system. At this time, national performance measures in the "freight movement and economic vitality" area have not been formalized, however, dialog on the subject indicates the need to include system condition and system performance (e.g., travel time, delay and travel time reliability) as meaningful freight system measures. Other categories of measures may also be applied to the freight system. The U.S. DOT is required to establish performance measures for States and MPOs to use to assess the Interstate and National Highway Systems. Once performance measures are set, States and MPOs must establish performance targets in coordination with other State and local transportation agencies.

2.3.1 Current Status of U.S. DOT Mandated MAP-21 Performance Measure Development

In March 2014, the U.S. DOT published a Notice of Proposed Rulemaking (NPRM) for State DOT and MPO performance measure development as part of the requirements to implement MAP-21 performance provisions. The Safety Performance Measures NPRM proposes safety performance measures and specifies State DOT and MPO requirements for establishing and reporting specific annual targets for fatalities and serious injuries. A Pavement and Bridge Condition Performance Measure NPRM was released in January 2015 that established measures to carry out the National Highway Performance Program to assess pavement and bridges on the National Highway System, and pavement on the Interstate System. Future NPRMs will focus on congestion, emissions, system performance, freight, and public transportation.[2]

2.3.2 U.S. DOT Freight Condition and Performance Report

The U.S. DOT is developing a multimodal freight system condition and performance report to supplement required state reports on highway-focused performance measures. This report was due for release in the fall of 2014, but as of writing has not yet been published. FHWA staff now anticipates a release date of late spring/early summer 2015.

2.3.3 Performance Measures in California

A number of recent studies in California contain robust performance measures associated with goods movement. The plans and performance measures listed below are from studies on freight movement in California, studies specific to U.S. 101 in the Central Coast region, or from other transportation plans for the counties that are included in the U.S. Highway 101 Central Coast California Freight Plan.

[2] FHWA Publishes Performance Management NPRMs Required by MAP-21. Accessed 8 June 2015. Online at: http://www.fhwa.dot.gov/tpm/rule.cfm.

California Freight Mobility Plan

The California Freight Mobility Plan (CFMP) is a statewide planning document that examines freight movement across every mode of transportation. It serves as a high-level analysis of the transportation system and identifies initiatives and projects needed to strengthen California's position in the global market.

Performance measures are split between three modes and are aligned with the CFMP goals. The performance measures in the plan are identified in Table 1 below.

Table 1. California Freight Mobility Plan Performance Measures

Highway Metrics	Rail Metrics	Seaport Metrics
Pavement Condition	Train Height Clearances	Navigation Channel Depths
Bridge Condition	Track Weight Limits	Waterway Bridge Clearance
Truck Travel Speed	Posted Max. Train Speed	
Truck Hours of Delay	Rail Bottlenecks/Chokepoints	
Highway Bottlenecks/Chokepoints	Railroad Grade Crossing Fatalities and Injuries	
Corridor Reliability Buffer Index		
Roadway Truck Collisions, Fatalities, and Injuries		

Caltrans Transportation Concept Report: U.S. 101

This report is a multimodal look at the entire U.S. 101 corridor that identifies trends and deficiencies, providing a basis for long-term preservation strategies. A list of specific performance measures for the corridor related to freight movement was not developed in this report. However, for each of the segments of U.S. 101 in District 5, Caltrans measured the following during the PM Peak:

- Traffic volume,
- Vehicle miles traveled,
- Vehicle hours traveled,
- Volume/capacity ratio,
- Level of service,
- Average speed, and
- Capacity per lane.

Trucks utilize the same road network as other vehicles; therefore the above data has a direct bearing on freight movement. Segments of U.S. 101 with a high volume/capacity ratio or low average speed, for example, indicate congested sections which negatively impact the movement of freight. As these performance measures improve, freight movement will also improve.

San Luis Obispo Council of Governments U.S. 101 Mobility Master Plan

This study examined U.S. 101 in San Luis Obispo County. Twelve performance measures were used to select four segments of the route for detailed analysis. The initial screening criteria and the related scoring criteria, which were not specific to goods movement, are identified in Table 2 below. Other performance measures with limited applicability to the current study included park-and-ride coverage, transit coverage, bicycle connectivity, and pedestrian connectivity.

Table 2. San Luis Obispo Council of Governments U.S. 101 Mobility Master Plan

Group	Phase I Performance Measure	Score Criteria
Corridor Vehicle Operations	U.S. 101 Mainline Level of Service	LOS A-C=0, LOS D=2.5, LOS E=5, LOS F=10
	U.S. 101 Merge-Diverge Lever of Service	LOS A-C=0, LOS D=2.5, LOS E=5, LOS F=10
	U.S. 101 Weave Level of Service	LOS A-C=0, LOS D=2.5, LOS E=5, LOS F=10
	Parallel Roadway/Intersection Level of Service	LOS A-C=0, LOS D=2.5, LOS E=5, LOS F=10
Corridor Safety	U.S. 101 Safety (Collisions)	Crashes per MVMT < expected (using TASAS, as compared to facilities in California)=0 0.1675>expected=2.5 0.335>expected=5 0.5025>expected=7.5 0.67>expected=10
	Parallel Roadway Safety (Collisions)	Number of parallel network crashes(0)=0 Number of parallel network crashes(31)=2.5 Number of parallel network crashes(62)=5 Number of parallel network crashes(92)=7.5 Number of parallel network crashes(123)=10
Emissions	U.S. 101 Emissions	Tons of CO_2 with Pavley I+LCFS (0)=0 Tons of CO_2 with Pavley I+LCFS(0.755)=2.5 Tons of CO_2 with Pavley I+LCFS(1.51)=5 Tons of CO_2 with Pavley I+LCFS(2.265)=7.5 Tons of CO_2 with Pavley I+LCFS(3.02)=10
Vehicular Connectivity	Parallel Roadway Connectivity	Frontage roads or adjacent route=0 Alternate route that is slower or longer=5 No alternate routes=10

Santa Barbara County Association of Governments 101 in Motion

This 2006 study produced a consensus package of projects to improve mobility on the U.S. 101 Corridor in Santa Barbara County, from the Ventura County line north/west for approximately 27 miles to Winchester Canyon. Performance measures in this report were divided into three sections: Transportation Performance, Community/Environmental Considerations, and Cost/Implementation. The most relevant ones to freight movement are identified in Table 3 below.

Table 3. Santa Barbara County Association of Governments 101 in Motion

Transportation Performance Criteria	Objectives	Measures
Improve Mobility/Increase Capacity	Increase peak hour person trip capacity Reduce peak-hour corridor person trip demand Increase network capacity	Added person trip capacity (PPH) Reduced demand, PPH Reduce number of gaps and lane drops
Reduce Congestion	Improve LOS to "D" or better Reduce person hours of congestion	Number of "D" or better locations Total reduce hours of congestion
Improve Safety	Reduce corridor accident potential	Rating from 1-5 based on representative accident rates
Improve Goods Movement	Increased Goods movement capacity and reduce conflicts	Added Highway/Rail capacity usable for freight reduced conflicts/regulatory constraints
Economic Vitality	Minimized impacts	Congestion Relief Potential Pricing and Job Creation Impacts

Monterey Bay 2035 Metropolitan Transportation Plan/Sustainable Communities Strategy

The Metropolitan Transportation Plan/Sustainable Communities Strategy (MTP/SCS) is the long-range transportation plan for the AMBAG region and includes land use, housing, and environmental considerations in addition to transportation projects. Freight-related performance measures and goals included in the MTP/SCS include:

- **Daily truck delay goals (Economic Vitality).** 2,802 hours in 2010; 11,471 in 2035 No Build scenario; 10,667 in 2035 MTP/SCS scenario.
- **Greenhouse gas reduction goals (Environment).** Comply with Senate Bill 375, California Global Warming Solution Act, (Nunez, 2006) which requires the AMBAG region to reduce GHG by 5 percent per capita by 2035.
- **Maintenance of the transportation system goals (System Preservation and Safety).** 50 percent of total spending goes to rehabilitation and maintenance.
- **Fatalities and Injuries per capita goals (System Preservation and Safety).** 0.4 percent in 2010, and remaining 0.4 percent in both 2035 No Build and MTP/SCS scenarios.
- **Peak Period Congested Vehicle Miles of Travel (Healthy Communities).** 130,455 miles reduction in MTP/SCS scenarios versus 2035 No Build. Reducing congestion overall will aid the movement of goods.
- **Commute Travel Time (Access and Mobility).** Keep commute travel time at 2010 existing levels. Since trucks often use the roads at the same time as commuters, holding commute times at current levels will increase goods movement predictability.

Santa Barbara County Association of Governments Regional Transportation Plan and Sustainable Communities Strategy

This study is the Long-Range Transportation Plan for SBCAG and includes land use, housing, and environmental considerations in addition to transportation. Freight specific topics cluster around U.S. 101's importance to the region and the heavy reliance on truck trips to move goods. Performance measures for the Mobility and System Reliability goal include:

- Roadway Level-of-Service;
- Average travel distance (all trips and work trips);
- Average travel time;
- Average commute time (workers);
- Transit ridership;
- Transit accessibility (percent of population and jobs within one-half mile of bus stop with frequent and reliable service);
- Percent Mode share (all trips); and
- Percent Mode share (workers).

These performance measures are not specific to freight but may impact goods movement performance. Since trucks utilize the same road network as other users, decreases in average travel time or improved level of service will have positive impacts on truck movement.

2.4 "Best Practice" Performance Measures

There are a limited number of performance measures which are common throughout all of studies and related to freight movement. These represent widely used "best practice" performance measures for freight movement. Note that this list is not meant to be comprehensive. Additional performance measures are viable and critical to different geographies or modes depending on the specific circumstances present. All four categories of performance measures identified below are included in the U.S. 101 Central Coast California Freight Plan.

- **Pavement and Bridge Condition.** Measured through a pavement rating system and bridge inspections. Information is widely available, updated regularly and can be used to quantify safety, reliability and/or state of repair of the freight transportation system.

- **Truck-involved fatalities/injuries.** This measure is an important indicator of safety, and can be paired with/compared with overall fatalities/injuries. It is measured in total number, per capita, or per vehicle miles (truck) traveled. Measuring per vehicle miles travelled (truck) is the most accurate approach as a rise or fall in total count may be due to an increase or decrease in activity and not necessarily a change in safety conditions. However, this approach requires additional data that may not be readily available.

- **Emissions and Air Quality.** Measured through Greenhouse Gas levels, varying Particulate Matter (PM) size, or other available metrics. This is a common metric used to evaluate the environmental impacts of goods movement. However, freight specific data may be scarce as not all location collect information by type of vehicle.

- **Congestion.** Measured by Volume/Capacity Ratio, Level of Service, Hours of Delay, or a Reliability Index such as Buffer Time Index or Planning Time Index. Measures of reliability are particularly useful for freight movement as reliability is often cited as the most important consideration by those involved in logistics.[3] Buffer time index measures the amount of *additional* time that should be added to a trip to ensure on time arrival 95 percent of the time. Planning time index calculates the *total* travel time needed to arrive on time 95 percent of the time.

3.0 Performance-Based Evaluation Process

The intent of employing a performance-based evaluation process is to provide an objective means of evaluating projects, programs and policies (i.e., strategies) relative to the Goods Movement Plan vision and goals. The performance measures should inform strategy development and advance key needs and issues. This section details the process that is being used to develop a final portfolio of projects, programs, and policies using performance measures as part of this Plan. Figure 1 shows the overall performance-based evaluation framework, with steps corresponding to the discussion bullets below.

- **Develop Vision and Goals**. The Vision and Goals of the U.S. Highway 101 Central Coast California Freight Plan is the foundational element of the Plan. The development of strategies and the effectiveness of the plan will be guided and determined by the Vision and Goals.

- **Develop Performance Measures and Metrics**. Performance measures should evaluate progress towards the Plan Visions and Goals and align with existing (or potential) data and resources available. However, they should not be constrained by quantitative measures alone – stakeholder input, qualitative analysis, and policy considerations should also inform chosen measures. These performance measures and metrics will be used to evaluate needs and opportunities and assess projects, programs and policies.

- **Understand the Freight System**. Data from State, regional, and local plans and studies, and input from stakeholders will be collected and synthesized in order to provide a base level of information about current conditions in the corridor.

- **Identify Needs and Opportunities.** An “Issues and Opportunities” matrix will be created based on collected data. The matrix will detail both how the needs and opportunities relate to different parts of the goods movement system, and where they fit into the Plan’s Goals. This step will also drive and be shaped by the formulation of performance measures. After needs and opportunities are identified, they will be assessed to determine which should be considered priority concerns. Those that directly relate to a Plan goal, or that cut across multiple functions or facilities of the goods movement system may deserve more attention and a higher priority. Stakeholder input (discussed below) in addition to the developed list of performance measures can help focus attention on important topics or ensure that topics lacking a large quantitative presence are not missed.

- **Identify and Assess Projects, Programs and Policies**. A comprehensive list of potential projects, programs, and policies will be drawn from the above sources. These will address the developed matrix of needs, issues, and opportunities. After the initial compiling of potential projects, programs, and policies,

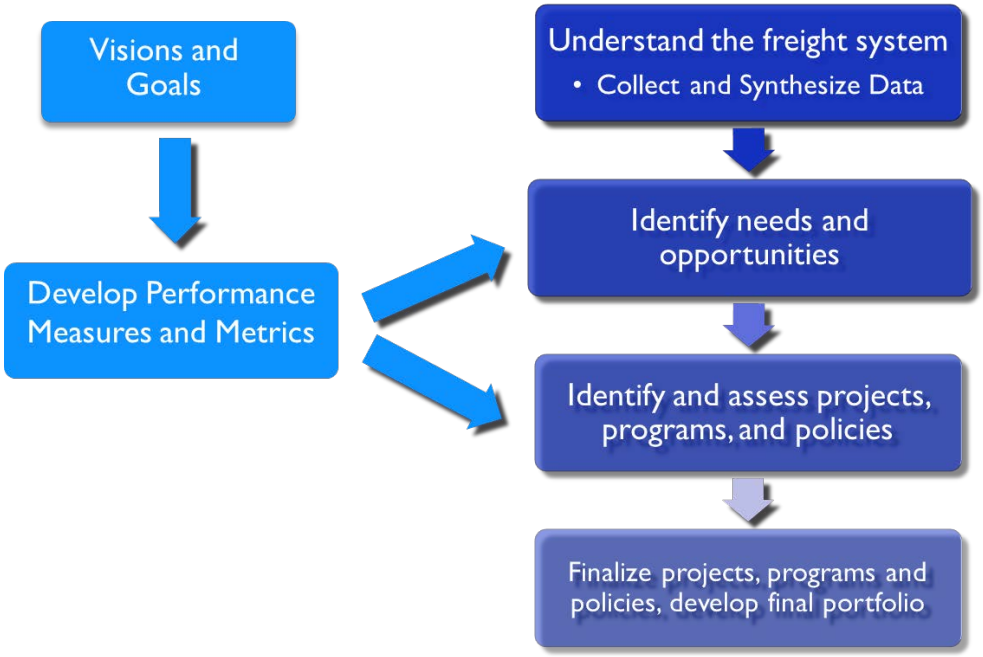
[3] Information from numerous interviews with industry.

an evaluation and assessment phase begins. Strategies will be screened to determine: 1) if they address each of the identified issues, needs, and opportunities, 2) if they have sufficient impact on goods movement along U.S. Highway 101, and 3) if there are potential synergies or tradeoffs between specific projects, programs, and policies that require further consideration and examination. Performance measures will be a key source of input in determining which strategies will best address issues, needs, and opportunities.

- **Finalize Projects, Programs, and Policies and Develop Final Recommendations.** Based on the assessment described above, a final recommended projects, programs, and policies that address the identified needs and opportunities will be developed. The recommendations can inform decision-makers on how best to achieve the Plan's Vision and Goals.

- **Stakeholder and Community Input (not included in Figure 1)**. Input and recommendations from the communities, businesses, and other stakeholders along U.S. 101 is critical to the Plan's success. While feedback will be sought throughout the process, comments are critical during the identification and evaluation process. Quantitative performance measures, while ideal, may not fully capture conditions that impact freight movement. Qualitative input from those who rely on U.S. 101 can aid in prioritizing the issues, needs, and opportunities and developing the best projects, programs, and policies to address them.

Figure 1. U.S. 101 Performance Measurement Framework



3.1 Proposed Performance Measures

Based on the review of best practices, visions and goals, and feedback from stakeholders regarding the unique needs and opportunities facing the region, a recommended set of performance measures and metrics is established and shown in Table 4. In addition, performance measures and metrics have been selected based on ability to be quantified, data availability and resource capability, and ease of understanding. The

current condition column indicates whether the measure will evaluate current conditions, and the future conditions column indicates whether the measure will evaluate future conditions with planned improvements.

Note that the terms *performance measures* and *performance metrics* are different as used in the memo. Performance measures are broad categories of measures that address specific goal areas. Within these categories, specific performance metrics can be developed that are essentially the evaluation criteria that can be used to determine needs and benefits. Metrics can be evaluated using models, quantitative data from prior studies, or can be evaluated qualitatively.

Table 4. Recommended Set of Performance Measures and Metrics, by Goal Area

Goals	Measure(s)	Metric(s)	Description and Relevance
Support economic development	Access and Multimodal Connectivity	Freight routes access from/to locations with significant freight activities; parallel roadway/rail connectivity	Freight or industrial land uses adjacent to U.S. 101 or intersecting routes generate truck traffic. Alternative route choice and rail choices are important to support economic competitiveness. Measurements include road and traffic conditions on connecting routes and distribution of freight producing industries.
Provide an efficient, reliable, well-maintained and safe goods movement facility	Travel time delay on truck routes – Recurrent and Seasonal	Truck delay	Measured in vehicle-hours of delay, this represents the amount of delay that trucks encounter on a recurrent basis.
	Travel Time Reliability	Planning time index (PTI)	This represents the additional time that a traveler must add to an average trip to ensure on-time arrival 95 percent of the time.
	Freight-Related Crashes	Truck-involved crashes and crash rates	Total crashes, crash types, and crash locations are key indicators of system safety and can highlight areas with safety concerns.
		Rail-Vehicle crashes at at-grade rail crossings	Rail-vehicle incidents are a safety concern and cause delays for both truck and rail freight movement.
	Freight Infrastructure Conditions	Bridge conditions ratings	Facilities with low ratings indicate potential rough travel, delays due to maintenance/repair work, and the need for investment.
		Pavement conditions ratings	
	Trucking Parking	Number of parking spaces along corridor	Lack of parking is cited as a major issue along the corridor, both short and long haul. Locating parking in areas where demand is high (origins and destinations) is also critical.
	Truck Routes	Extent and signage of truck route network	Availability of truck networks and the degree to which they are publicized are key measurements. An identified truck route network increases safety and transportation system conditions by directing trucks to approved and appropriate routes. This is especially important for “first and last mile” routes connecting U.S. 101 to origins and

Goals	Measure(s)	Metric(s)	Description and Relevance
			destinations.
	Adoption of Advanced technologies	Degree of Implementation and Coordination of ITS technologies	ITS systems can increase safety and efficiency of the U.S. 101 corridor. Measurements include the number of locations with ITS and the degree of coordination between municipalities.
Reduce and mitigate air quality impacts from goods movement operations	Emissions and Air Quality	Tons of $PM_{2.5}$, PM_{10}, and CO_2/N_2O emissions from trucks.	Air quality is a key indicator of environmental impacts of freight movement. $PM_{2.5}$ is the most telling indicator of freight pollution.
	Use of Clean Fuel Technology	Use of clean fuel technology	The number of alternative fueling locations and level of implementation by the truck fleet are potential measurements.