I-10 Corridor Coalition

Truck Parking Availability System

Concept of Operations

April 16, 2021

Revision History

The following revision table presents the changes made for each version of this document.

Revision	Date	State/Description
1.0	October 2020	Initial version
1.1	December 2020	Revised version
1.2	February 2021	Addressed final Coalition comments
1.3	April 2021	Addressed FHWA comments

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Tables

Figures

List of Acronyms

Acronym	Name
511	America's Traveler Information Telephone Number
ADOT	Arizona Department of Transportation
API	Application Programming Interface
ATA	American Trucking Associations
ATCMTD	Advanced Transportation and Congestion Management Technologies Deployment
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
ATRI	American Transportation Research Institute
CALTRANS	California Department of Transportation
CB	Citizen's Band (Radio)
CCTV	Closed Circuit Television
CDOT	Colorado Department of Transportation
CFIRE	National Center for Freight and Infrastructure Research and Education
CMS	Changeable Message Sign
ConOps	Concept of Operations
CVISN	Commercial Vehicle Information Systems and Networks
CWG	Communications Working Group
DBB	Design-Bid-Build
DBOM	Design-Build-Operate-Maintain
DMS	Dynamic Message Sign
DOT	Department of Transportation
DPAS	Dynamic Parking Availability Signs
FAST	Fixing America's Surface Transportation
FDOT	Florida Department of Transportation

Acronym	Name
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
GPS	Global Positioning System
HOS	Hours of Service
ITD	Innovative Technology Deployment
ITS	Intelligent Transportation Systems
IVR	Interactive Voice Recognition
JIT	Just-in-Time
JSON	JavaScript Object Notation
KYTC	Kentucky Transportation Cabinet
MAASTO	Mid America Association of State Transportation Officials
MAFC	Mid America Freight Coalition
MAP-21, PL 112-141	Moving Ahead for Progress in the 21st Century
MCMIS	Motor Carrier Management Information System
MDOT	Michigan Department of Transportation
MnDOT	Minnesota Department of Transportation
MPO	Metropolitan Planning Organization
MUTCD	Manual on Uniform Traffic Control Devices
MVDS	Microwave Vehicle Detection System
NAFTA	North American Free Trade Agreement
NATSO	National Association of Truck Stop Operators
NCHRP	National Cooperative Highway Research Program
NHFP	National Highway Freight Program
NHS	National Highway System

Acronym	Name
NHTSA	National Highway Transportation Safety Administration
NMDOT	New Mexico Department of Transportation
NOFO	Notice of Funding Opportunity
NPMRDS	National Performance Management Research Data Set
NTSB	National Transportation Safety Board
O&M	Operations and Maintenance
OOIDA	Owner-Operator Independent Drivers Association
PHFS	National Primary Highway Freight System
PTZ	Pan-Tilt-Zoom
RFID	Radio-Frequency Identification
ROW	Right of Way
SwRI	Southwest Research Institute
TEA-21	Transportation Equity Act for the 21st Century

Acronym	Name
TIGER	Transportation Investment Generating Economic Recovery
TMC	Traffic Management Center or Transportation Management Center
TOC	Traffic Operations Center
TPAS	Truck Parking Availability System
TPIMS	Truck Parking Information Management System
TSO	Truck Stop Operator
TSMO	Transportation Systems Management and Operations
TxDOT	Texas Department of Transportation
USDOT	United States Department of Transportation
USTA	United States Transportation Alliance
VDOT	Virginia Department of Transportation
VMS	Variable Message Signs
WisDOT	Wisconsin Department of Transportation

Introduction

This document details the Concept of Operations (ConOps) for a multi-state truck parking availability system (TPAS). The TPAS concept was developed to address the growing number of concerns associated with truck parking along the nation's busiest freight corridors, including the lack of available real-time information that allows commercial vehicle operators to make informed parking-related decisions.

Currently, commercial vehicle parking often overflows onto rest area ramp shoulders, freeway ramp shoulders, adjacent roads, and private parking lots. This creates an unsafe situation for commercial vehicle operators as well as other motorists. The problem is compounded by the lack of information provided to drivers to assist them in finding safer places to park their vehicles and rest. However, the expansion of rest area parking is costly. The provision of adequate parking may be addressed in part through better utilization of existing parking spaces. For this to be an effective solution, available parking spaces must be identified, counted, and communicated back to commercial vehicle operators in real-time. This ConOps documents what can be accomplished by the proposed I-10 TPAS to help address these truck parking challenges.

The I-10 Corridor Coalition is leading the development of a TPAS to address truck parking safety and efficiency needs. The I-10 Corridor Coalition consists of four southwestern state Departments of Transportation whose mission is to foster the development, operation, and maintenance of an integrated and balanced transportation system that adequately serves the transportation needs of those states. The four states are:

- California;
- Arizona;
- New Mexico; and
- Texas.

The TPAS project will be an expansion of each states Intelligent Transportation Systems (ITS) program, which will require steps to implement, operate, and maintain. To help plan for TPAS, the I-10 Corridor Coalition, as part of the systems engineering process and best practices required by the USDOT for developing ITS deployments, has developed this ConOps document to help define user needs, identify the architecture, and define the implementation plan.

1.0 Purpose and Overview

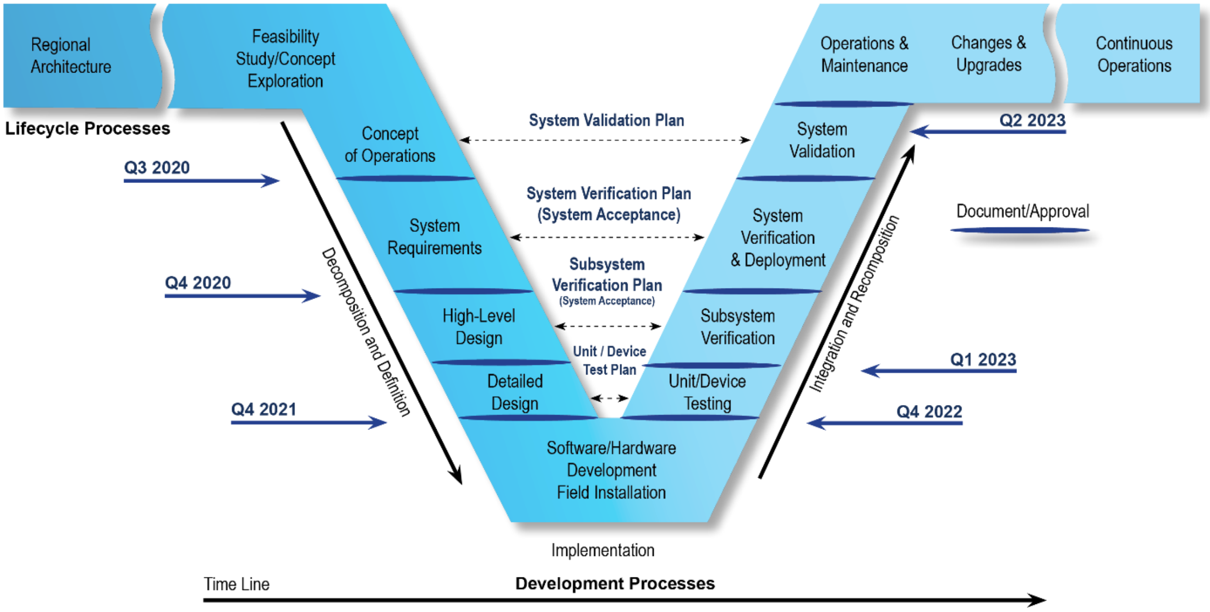
The I-10 TPAS ConOps provides a high-level understanding of a proposed system to collect and disseminate real-time truck parking availability information along I-10 within the I-10 Corridor Coalition states. The ConOps documents the shared understanding of project stakeholders' needs (see **Table 5** for a list of project stakeholders) for the I-10 TPAS and how it will be operated and maintained. The document, written from a stakeholder perspective, is organized as follows:

- **Scope** identifies the problems that need to be addressed by the project.
- **Reference Documents** provides a list of documents that were referenced in developing this document.
- **Background** provides an understanding of the actions taken so far to address needs and identifies needs that still need to be addressed.
- **User-Oriented Project Development** describes the stakeholder outreach process.
- **Operational Needs** defines the needs that the system must satisfy.
- **System Overview** provides information about the various components of the I-10 TPAS project and a summary of how each agency in the I-10 Corridor Coalition is meeting the core functions of the system.
- **Operation & Maintenance Elements** describes the system functions and agency responsibilities for system operations and maintenance.
- **Operational Scenarios** describe real-world situations that the TPAS program would be expected to encounter in a day-of-the-life storytelling format.
- **Summary of Impacts/Outcomes** describes the desired results of the I-10 TPAS project.

The main body of the ConOps document describes the core functions needed for a consistent and seamless I-10 TPAS project deployment by the I-10 Corridor Coalition. In addition to the main body of the document, state-specific appendices provide state-level details about decisions, organization, and processes relating to the I-10 TPAS project.

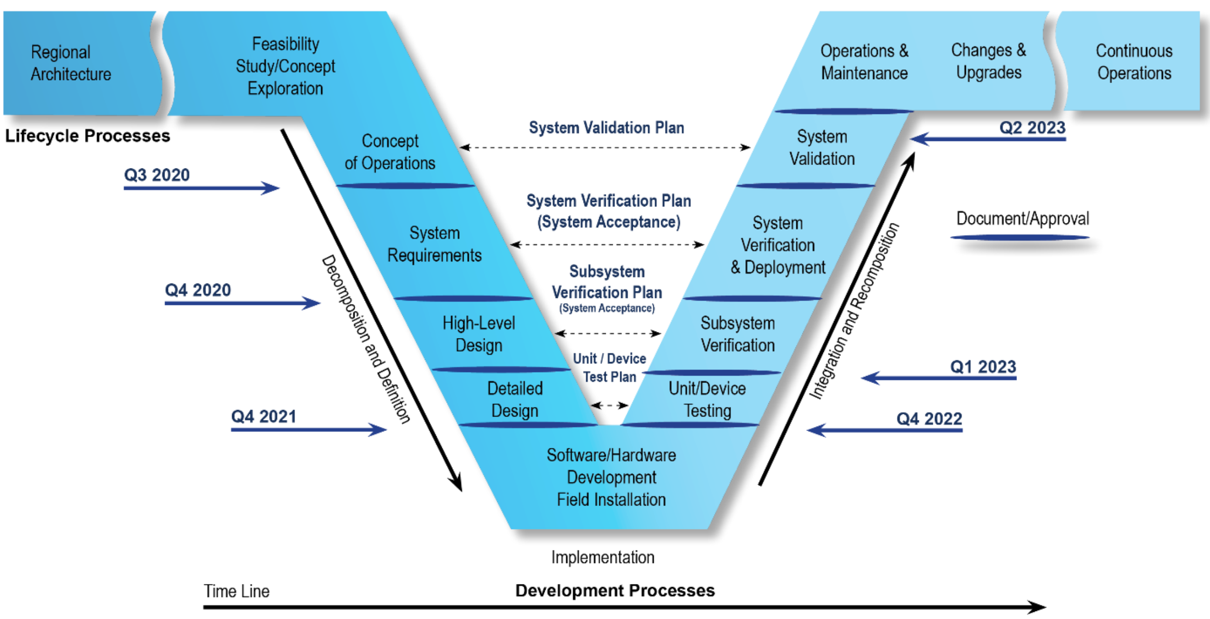
Systems Engineering

Systems engineering is a multi-step verification process that takes place throughout the design development, implementation, and operation stages of ITS projects. The requirements, testing procedures, and system validation steps outlined in the "V" diagram shown in **Figure 1**



are intended to ensure that the initial needs and concept of the system carry forward into the design, and eventually, operation and maintenance of the system. Once the system begins the operations and maintenance part of its lifecycle other systems engineering models maybe more appropriate.

It is good practice and a federal requirement to apply the systems engineering process for any ITS project that uses federal funding. Included in **Figure 1**



is a proposed timeline for the I-10 TPAS project overlaid on the “V” diagram. The overall I-10 TPAS project schedule for deployment is shown in **Figure 2**. A ConOps is one step in the overall systems engineering process and focuses on “what” should be done before defining “how” it will be done. It defines the technology alternatives to be considered and assesses the best alternatives based on the identified user needs. The ConOps is not intended to prescribe a specific technology.

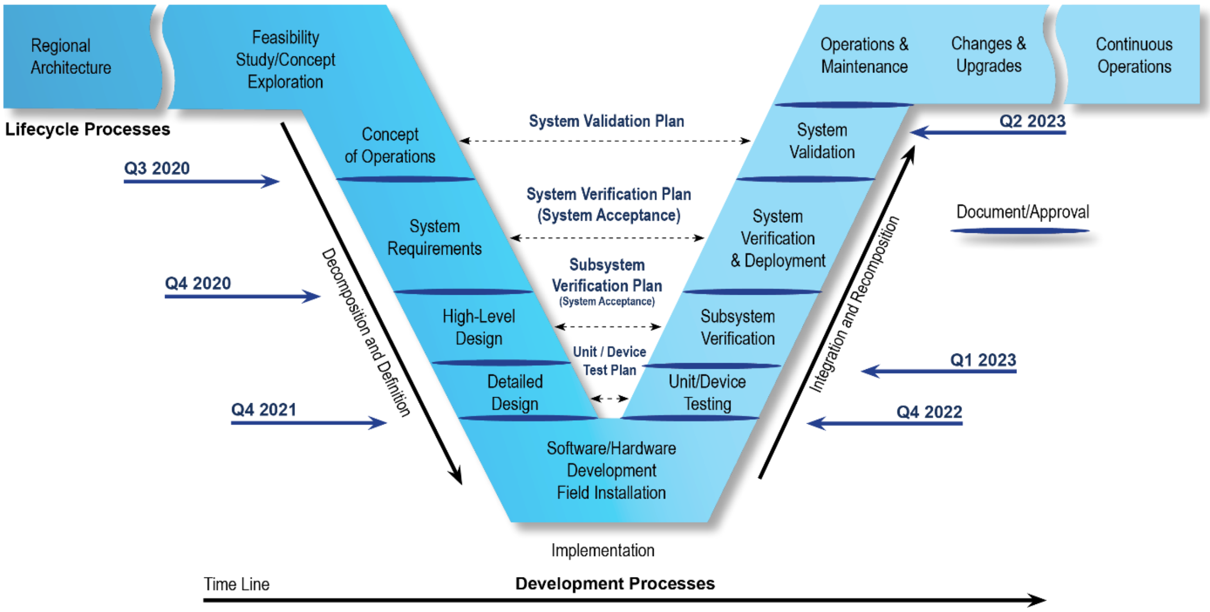


Figure 1: Systems Engineering "V" Diagram

Source: Systems Engineering for Intelligent Transportation Systems, FHWA, 2007

Figure 2 is located on the next page

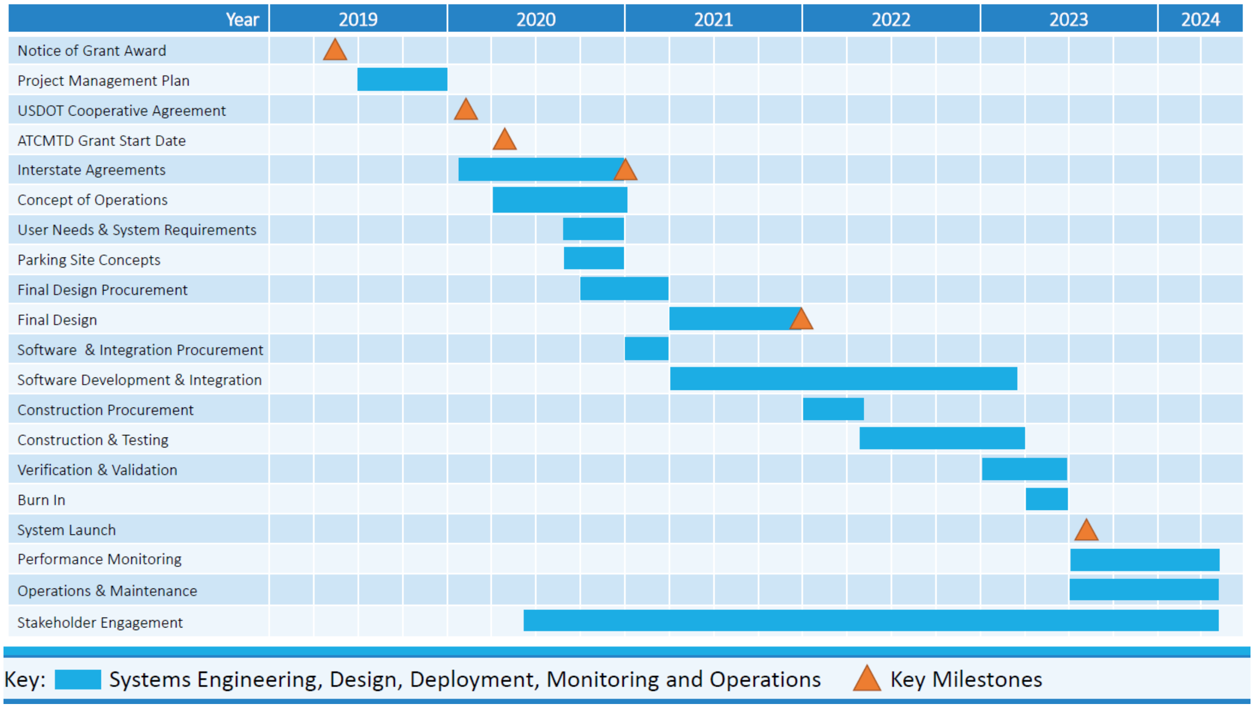


Figure 2: I-10 TPAS Project Schedule

2.0 Scope

The I-10 Corridor Coalition, whose members comprise the Departments of Transportation (DOT) of California, Arizona, New Mexico, and Texas, have received a Fixing America's Surface Transportation (FAST) Act-established Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) grant for deployment of a TPAS on the I-10 Corridor. The Texas Department of Transportation (TxDOT) is the lead agency for the project.

Finding safe truck parking is a challenge given Hours of Service (HOS) regulations and limited parking spaces. The I-10 TPAS will monitor truck parking availability at 37 public truck parking locations along the I-10 Corridor from California to Texas and will disseminate the availability information to truck operators. The objective of this system is to make truck parking information available to truck drivers and dispatchers in real-time to assist them in making informed and timely parking decisions. **Figure 3** shows the project corridor and truck parking sites.

Figure 3 is located on the next page

Figure 3: I-10 TPAS System Map

I-10 is part of the National Primary Highway Freight System (PHFS). The I-10 corridor is a critical national trade corridor and the segment from California to Texas connects four of the ten largest U.S seaports by tonnage (Los Angeles, Long Beach, Houston, and Beaumont). Truck drivers hauling freight along the corridor must find parking to meet mandated breaks and off duty requirements mandated by federal HOS regulations. There is also a limited amount of safe and convenient parking. Under current conditions, drivers frequently spend significant amounts of time looking for a place to park and rest for a required break or at the end of their workday. Drivers who have not found parking before exceeding their HOS are often forced to park in unauthorized, unsafe locations including highway shoulders, on and off ramps, or on local streets.

The inclusion of truck parking technology as a funding area in the United States Department of Transportation's (USDOT) 2018 Notice of Funding Opportunity (NOFO) for the ATCMTD grant program provided an opportunity to address parking needs along the I-10 corridor through the deployment of an I-10 Corridor Coalition TPAS. This system will improve mobility and transportation safety along this critical freight corridor, reduce infrastructure damage, diesel emissions, and save commercial truck drivers thousands of dollars a year in lost earnings.

2.1 Project Purpose

Providing truck parking availability information increases public safety by reducing fatigue-related crashes, congestion delay, time spent searching for parking, emissions and fuel use, and limits damage to public highway infrastructure. This is done by gathering accurate, reliable and timely information about public truck parking availability and providing real-time access to such information via Dynamic Parking Availability Signs (DPAS), state traveler information websites/applications, and other third-party applications.

2.2 Project Benefits

Through discussions with the four I-10 Corridor Coalition states and other stakeholders, general benefits the project will produce were identified. The project will:

- Reduce fatigue-related truck-involved crashes in the I-10 corridor
- Reduce emissions associated with excess driving while searching for parking
- Reduce public infrastructure degradation and associated costs for repairs
- Create a technology platform that can be expanded in future deployments to serve other corridors within the four states, other states along I-10, and/or other ITS needs in the I-10 corridor
- Explore the technical and operational feasibility of a multijurisdictional I-10 corridor
- Develop a model for regional cooperation and interoperability that can be expanded to other states in the southwest U.S. and across the remainder of the I-10 corridor (Louisiana, Mississippi, Alabama, and Florida)
- Support development of technology standards to improve mobility of people and freight along the I-10 corridor
- Enhance the use of and better manage existing truck parking capacity
- Improve operational performance
- Collect, disseminate, and use real-time transportation-related information
- Monitor transportation assets to improve and prioritize investment decisions
- Deliver economic benefits
- Integrate technologies into Transportation Systems Management and Operations (TSMO)
- Evaluate the impacts of project technologies
- Provide reproduceable technology deployment
- Implement rural technology deployments

2.3 Project Sites

Each of the four states in the I-10 Corridor Coalition have rest area locations where the TPAS will be deployed. The information in the ConOps covers each rest area included in the ATCMTD Grant Agreement. The information in **Table 1** through **Table 4** provide some basic information about each rest area. The information covers name, direction served, mile marker, number of marked truck parking spaces, number of informal truck parking spaces, the configuration of the formal truck parking spaces, and whether truck parking is separate from automobile parking.

California has six rest area locations that will be evaluated. The marked parking configurations at these rest areas are all diagonal pull through truck parking spaces. A few of the locations have adjacent informal gravel or dirt parking lots that are used by truckers for parking. **Table 1** provides details about each rest area location.

Table 1: California Rest Area Truck Parking Sites

Site Name	Direction	Mile Marker	Formal Truck Parking Spaces	Informal Truck Parking Spaces	Formal Configuration	Separated from Vehicular Traffic
Wildwood	EB	86	20	8	Diagonal	Yes
Whitewater	WB	113	11	3	Diagonal	Yes
Whitewater	EB	113	18	5	Diagonal	Yes
Cactus City	WB	159	5	10	Diagonal	No
Cactus City	EB	159	4	20	Diagonal	No
Wiley's Well	EB & WB	222	8	15	Diagonal	No

There are eight rest area locations being evaluated in Arizona. All of the locations have marked diagonal parking spaces. Some of the locations have separate driveways providing access to truck and automobile parking. This is a key consideration when assessing deployment of entrance/exit counting technology. Table 2 provides details about each rest area location.

Table 2: Arizona Rest Area Truck Parking Sites

Site Name	Direction	Mile Marker	Formal Truck Parking Spaces	Informal Truck Parking Spaces	Formal Configuration	Separated from Vehicular Traffic
Ehrenberg	EB	5	14	1	Diagonal	No
Ehrenberg	WB	5	15	2	Diagonal	No
Bouse Wash	EB	53	12	2	Diagonal	Yes
Bouse Wash	WB	53	13	2	Diagonal	Yes
Texas Canyon	EB	320	23	5	Diagonal	Yes
Texas Canyon	WB	320	23	0	Diagonal	Yes
San Simon	EB	388	16	0	Diagonal	No
San Simon	WB	388	17	0	Diagonal	No

New Mexico has five rest area locations that will be evaluated. The parking configurations are a mix of diagonal, parallel, and one location that contains both (parallel and diagonal) marked parking spaces. For the majority of rest areas, parking is shared in the same location for truck and automobile parking. Table 3 provides details about each rest area location.

Table 3: New Mexico Rest Area Truck Parking Sites

Site Name	Direction	Mile Marker	Formal Truck Parking Spaces	Informal Truck Parking Spaces	Formal Configuration	Separated from Vehicular Traffic
Lordsburg Welcome Center	EB & WB	20 (EB), 21 (WB)	10	2	Diagonal	No
Yucca Rest Area	EB	53	13	4	Parallel	No
Gage Rest Area	WB	61	10	11	Parallel	No
Las Cruces Rest Area	EB	135	0	11	Both	No
Anthony Welcome Center	WB	164	17	8	Diagonal	No

There are 16 rest area (safety rest areas) and two Information Center locations in Texas that are being evaluated. The parking layout for trucks at these sites are either diagonal parking or parallel. Most of the diagonal parking area locations have separated truck and automobile parking. This could allow for vehicle detection technology to be deployed that would only count truck traffic.

Table 4 provides details about each rest area location.

Table 4 is located on the next page

Table 4: Texas Rest Area Truck Parking Sites

Site Name	Direction	Mile Marker	Formal Truck Parking Spaces	Informal Truck Parking Spaces	Formal Configuration	Separated from Vehicular Traffic
Anthony Information Center	EB	1	34	5	Diagonal	Yes
El Paso Co.	EB	51	5	11	Diagonal/ Parallel	No
El Paso	WB	51	7	8	Diagonal	No
Culberson Co.	EB	150	15	19	Parallel	No
Culberson Co.	WB	150	19	19	Parallel	No
Pecos Co. West	EB	233	30	20	Diagonal	Yes
Pecos Co. West	WB	233	30	20	Diagonal	Yes
Sutton Co.	EB	393	6	11	Parallel	Yes
Sutton Co.	WB	393	12	1	Parallel	No
Kerr Co.	EB	513	8	9	Diagonal	Yes
Kerr Co.	WB	513	6	3	Parallel	No
Guadalupe Co.	EB	618	28	5	Diagonal	Yes
Guadalupe Co.	WB	618	28	3	Diagonal	Yes
Colorado Co.	EB	691	23	10	Diagonal	Yes
Colorado Co.	WB	691	23	10	Diagonal	Yes
Chambers Co.	EB	814	26	12	Diagonal	Yes
Chambers Co.	WB	814	26	12	Diagonal	Yes
Orange Information Center	WB	880	32	5	Diagonal	Yes

3.0 Referenced Documents

Several related documents were referenced as part of the I-10 TPAS ConOps development. The following documents provide additional details on the need for truck parking information and activities conducted by other entities to address truck parking needs.

I-10 ATCMTD Grant Application (2018)

TxDOT was awarded a $6.8 million ATCMTD grant from the USDOT's Federal Highway Administration (FHWA) for the I-10 Corridor Coalition TPAS project. The grant application provides an overview of the project. The I-10 TPAS project will implement a truck parking availability detection and information dissemination system at 37 public truck parking locations along the I-10 corridor in California, Arizona, New Mexico, and Texas. The objective of this system is to make truck parking information available to truck drivers and dispatchers in real time to assist them in making informed parking decisions. The four states have committed to match the grant funding with other available non-Federal funds or in-kind match to maximize safety, mobility, operational, environmental, and state-of-good-repair elements along the corridor.

California Freight Mobility Plan 2020 (2019)

https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/freight-cfmp-2019-draft/00-cfmpdraftchapter17final.pdf

The California Freight Mobility Plan 2020, published in December 2019, provides an update to the state's original freight mobility plan adopted in 2014. The goals of the plan include investing in multimodal mobility solutions; growing the economic competitiveness of the state's freight sector through increased efficiency, productivity, and workforce preparation; supporting strategies that avoid, reduce, or mitigate environmental impacts; enhancing community health and wellbeing; improving safety and system resilience; maintaining and preserving infrastructure assets; and providing transportation choices and improving system connectivity. The plan also emphasizes the need to address shortages in safe truck parking spaces to improve the competitiveness of California's freight system through increased capacity, reliability, and efficiency. The plan also includes a number of strategies for implementation of the plan's goals. Some of the strategies mentioned to address this issue include expanding the system of truck parking facilities or integrating ITS into rest areas to provide real-time traffic information and information on availability of truck parking.

Eastern Sierra Corridor Freight Study (2019)

https://dot.ca.gov/-/media/dot-media/district-9/documents/f0003780escfsfinalreport20190228revv2a11y.pdf

The California Department of Transportation (Caltrans) prepared a corridor freight study looking primarily at the Eastern Sierra Corridor. According to the study, projected growth and future traffic in the Eastern Sierra Corridor study area is not expected to worsen congestion or overwhelm the capacity of the system. The study, however, identified future truck parking gaps along the corridor, particularly in the Bishop zone centered on the City of Bishop and the Ridgecrest zone. This gap between parking demand and supply leads to safety issues and trucks parking at undesignated locations. The study highlighted several recommendations to address three main areas of concern: (1) Trucks Climbing Lanes, (2) Truck Parking, (3) Trucks on Main Street. The five solutions outlined for truck parking included building low-cost lots using existing public right-of-way (ROW); expanding existing public truck parking locations; enticing private sector investment; implementing ITS technology solutions; and better utilizing existing local, state, and federal public facilities.

Truck Parking Facility Feasibility and Location Study (2008)

https://www.alamedactc.org/wp-content/uploads/2018/11/Truck_Parking_Facility_Feasibility_and_Location_Study-1.pdf

In December 2008, the Alameda County Congestion Management Agency in California prepared a study to better understand the cause of trucks stopping or parking and to identify ways in which such activities could be accommodated that would lessen traffic congestion in the county. The study found that there are two important reasons why drivers park: the first is to stop temporarily for personal needs and/or to await instructions as to what to do next; and the second is when the driver must take their mandated rest period. According to the study, there is a shortage of truck parking facilities in the area, partially because no one provides them, which results in drivers parking in unauthorized locations. In addition, drivers that do not live locally prefer to leave the Bay Area because there are limited parking facilities in the immediate area, and none are satisfactory. Further, public agencies do not often plan for truck parking as a community requirement, and commercial truck stop operators face several significant obstacles when they attempt to operate such locations.

Arizona Truck Parking Plan (2019)

https://azdot.gov/sites/default/files/2019/08/final-report-arizona-truck-parking-study.pdf

The Arizona Truck Parking Plan, published in 2019, was created as a result of the Arizona State Freight Plan. The study provides an in-depth analysis of truck parking issues in the state and a framework for the Arizona Department of Transportation (ADOT) to advance projects and policies to improve truck parking. The study highlighted the importance of investing in information solutions. In addition, the Arizona Truck Parking Advisory Group was asked to rank a number of capacity and information projects as part of a survey, and the group identified development of a Truck Parking Information Management System (TPIMS) pilot as one of their top three priority projects. Using input from the Truck Parking Advisory Group, project readiness, and the prioritization process, an implementation plan was developed as part of the Arizona Truck Parking Plan. Phase I (Exploration of Initial Steps) of the plan highlighted the development of a TPIMS proof of concept, which would compare and assess the pros and cons of various technologies used to implement a TPIMS. Phase II (Full Implementation) would continue the projects initiated under Phase I. Regarding the TPIMS, findings of the TPIMS proof of concepts would be used to identify additional sources of funding to implement the project on a corridor or statewide basis. Phase III (Future Actions) would explore opportunities for ADOT to expand the TPIMS to additional locations if necessary.

Arizona State Freight Plan (2017)

https://azdot.gov/sites/default/files/2019/08/arizona-state-freight-plan-110917.pdf

The Arizona State Freight Plan, approved on November 15, 2017, established immediate and long-range plans for freight related transportation investment priorities and policies that would generate the greatest return for America's economy. More specifically, it identifies freight transportation facilities that are critical to the state's economic growth and gives appropriate priority to investments in such facilities. The freight plan also fulfills federal requirements introduced in the FAST Act, which requires that states develop a freight plan in order to receive National Highway Freight Program (NHFP) funding for freight projects. A number of system needs and issues were identified for consideration in the freight plan, including inadequate truck parking facilities in Arizona. Based on several factors, the Statewide Truck Parking & Freight Operations project was chosen as one of six top priority freight improvement projects that were to be advanced to development and completion using Arizona's apportionment of dedicated

FAST Act freight funds under the NHFP Program. This project would address the shortage of safe truck parking in the state.

Arizona Truck Parking Supply, Demand, Needs Analysis (2017)
https://azdot.gov/sites/default/files/2019/08/WP1-Truck-Parking-Literature-Review-and-Best-Practices.pdf

The Arizona State Freight Plan identified inadequate truck parking facilities as an issue affecting the safety and efficiency of freight movement in Arizona, particularly on I-17 between Phoenix and Flagstaff, and on I-10 between Tucson and the California border. In addition, trucking companies in Arizona have reported shortages throughout the state, particularly on interstate corridors, and they also suggest that the state's shortages are expected to more than double in 15 years. As a result, ADOT commissioned a study of truck parking in Arizona in 2017. The Arizona Truck Parking, Supply, Demand, and Needs Analysis provides a literature review of previous studies conducted to assess issues that truck drivers encounter while trying to find parking and provides solutions outlined in these studies. The solutions identified are divided into two categories: information and capacity. Information solutions are focused on providing knowledge of parking availability and nearby facilities to truck drivers, while capacity solutions are focused on increasing parking supply. Stand-alone solutions identified in the study include creating printed and online parking maps and fixed parking signs, and ITS solutions include websites. applications, or variable signs that provide real-time information on parking availability. Capacity solutions include private-public partnerships or public-public partnerships to defray the cost of increasing capacity, adapting existing facilities, re-opening closed rest areas, and constructing new rest areas.

Freight-Related Economic Development Opportunity Study (2016)
https://dot.state.nm.us/content/dam/nmdot/planning/NM-HM96-2016-FreightStudy.pdf

In November 2016, the New Mexico Department of Transportation (NMDOT) completed a study to analyze emerging opportunities for statewide truck driver accommodations. The study team developed and distributed a survey to assess the preferences of drivers for parking facilities and service-related amenities. The study found that there are certain amenities that many drivers seek out. Some of these amenities include safety features, such as lighting and surveillance cameras; diesel fuel availability; food and dining options; opportunities for recreation and exercise, such as informal green space; proximity to both the interstate and urban area; and personal care and leisure needs, such as showers or clinics and the provision of Internet and Wi-Fi.

Further, truck-related economic development potential in New Mexico was also evaluated in the study through three screening phases. The first phase of the study indicated that, based on current and forecasted truck volumes, I-10 and I-40 are the state's two key freight corridors for long-distance truck traffic. The second phase identified the major freight-producing metropolitan areas and the corresponding interstate segments that are within the maximum drive time of eleven hours from New Mexico. The third phase assessed existing truck parking, driver-preferred amenities, and land use/ ownership in the focus areas to identify specific sites with the most potential for investment in truck-specific facilities. Using the results from the survey, the study includes a list of opportunities and challenges for each location identified in the second phase of the study and provides insight into features which should be considered as decision-makers consider location options to pursue future trucking centers.

New Mexico Freight Plan (2015)

https://www.dot.state.nm.us/content/dam/nmdot/planning/NM_2040_Plan-Freight_Plan.pdf

The New Mexico Freight Plan, published in August 2015, examines the current state of freight in New Mexico, and looks ahead to 25 years of growth and progress, out to 2040. The goals of the plan are: (1) Operate with transparency and accountability; (2) Improve safety and public health for all system users; (3) Preserve and maintain existing transportation assets for the long term; (4) Provide multimodal access and connectivity; and (5) Address impacts on communities related to air quality, noise, and quality of life issues. The plan mentions the need to address truck parking availability as a component of improving safety for system users. According to the report, not all rest areas located along Interstates can accommodate commercial trucks, and, in many cases, the number of available spaces is not sufficient to meet demand. This will be exacerbated by truck growth in these primary freight corridors and changes to federal HOS regulations. One of the strategies mentioned in the plan include improving truck parking facilities to address this issue.

Texas Freight Mobility Plan (2018)

http://ftp.dot.state.tx.us/pub/txdot/move-texas-freight/studies/freight-mobility/2018/plan.pdf

The Texas Freight Mobility Plan 2018, approved on March 7, 2018, builds upon the 2016 Freight Plan. The goals of the plan are: (1) Implement effective planning and forecasting processes that deliver the right projects on-time and on-budget; (2) Focus on the customer; (3) Ensure efficient use of state resources; (4) Optimize system performance; (5) Preserve existing assets; (6) Promote safety; and (7) Respect and care for employees. The plan mentions the need to address the issue of adequate truck parking as a component of improving safety. The plan reports that Texas has one of the lowest ratios of number of spaces to National Highway System (NHS) miles and is one of many states that have a shortage of private truck parking spaces. Therefore, as part of the Texas Freight Transportation Implementation Plan, TxDOT is conducting a truck parking study – the Texas Statewide Truck Parking Study – to identify truck parking needs and strategies to address them.

Texas Statewide Truck Parking Study (2020)

http://ftp.dot.state.tx.us/pub/txdot/move-texas-freight/studies/truck-parking/final-report.pdf

The purpose of the Texas Statewide Truck Parking Study, completed in April 2020, was to analyze and address truck parking needs in Texas with practical, innovative, and cost-effective strategies. The goals of the study include improving safety, reducing congestion, and enhancing economic competitiveness of the Texas Multimodal Freight Network; and developing actionable parking strategies to meet truck parking needs across the state by partnering with the private sector. The study aims to improve the safety of roadways and mitigate impacts associated with truck parking; identify specific needs for truck parking in the state; identify strategies to address these needs; and develop an action plan for truck parking recommendations. A number of key analytical steps were used, including data collection and best practice review; truck parking inventory and utilization survey(s); needs assessment and future parking demand and conditions analysis; and recommendations, solutions, and implementation development. The study involved a variety of public and private sector stakeholders impacted by truck parking, and outreach components consisted of the Texas Freight Advisory Committee; TxDOT Internal Working Group; stakeholder interviews and surveys; and workshops and focus groups.

Truck Parking Availability Detection and Information Dissemination (2018)

https://ops.fhwa.dot.gov/freight/infrastructure/truck_parking/workinggroups/technology_data/product/best_practices.pdf

According to this document, several states are implementing TPIMS to convey real-time data to truck drivers about parking availability in upcoming rest stops. This document includes examples of the technology being deployed in the various states and highlights a few of the best practices. The Mid America Association of State Transportation Officials (MAASTO), which consists of Iowa, Indiana, Kansas, Kentucky, Michigan, Minnesota, Ohio, and Wisconsin, developed a regional TPIMS. The detection and notification technologies vary by state. This real-time information is displayed via DMSs, smartphone apps, in-cab displays, and websites. A review of the system found that the truck drivers surveyed for the study preferred DMSs as their preferred method of communication for parking availability. In Minnesota, video cameras with stereoscopic video analytics are used to gather data, which is disseminated in three ways: roadside DMS, an internet/website information portal, and an onboard geolocation application that informs drivers of parking availability downstream from their current direction of travel. A study was conducted to test the effectiveness of the deployment by getting feedback from drivers and operators. The study found that the system provided accurate 24/7 information about truck parking availability to drivers.

The document also outlines other initiatives that states outside of the MAASTO TPIMS project have implemented. In California, video detection and in-ground sensors (including induction, magnetic, infrared, radio-frequency identification (RFID), and optical) are currently being tested at truck parking facilities in the cities of Sacramento and Stockton. Further information about other initiatives can be found in the document linked above.

MAASTO TPIMS Project Concept of Operations (2016)

https://trucksparkhere.com/wp-content/uploads/2017/07/MAASTO-TPIMS-ConOps.pdf

In 2016, the MAASTO TPIMS Partnership created their ConOps to provide a high-level understanding of a proposed system to collect and disseminate real-time truck parking availability information within the MAASTO multistate region. The document summarizes the decisions each state and the regional partnership made to create a consistent and seamless eight-state truck parking availability deployment. Each state in the MAASTO TPIMS Partnership was able to format the project to best fit their state's needs and requirements. The document includes a table showing each state's initial decisions regarding procurement process, data collection method, data collection technology, data analytics and sharing, and information dissemination. This table was created to illustrate the commonalities and differences between state decisions early in the project for the sake of guiding final decisions.

Evaluation of MDOT Truck Parking Information and Management System (2016)

http://www.michigan.gov/documents/mdot/MDOT_Truck_Parking_Project_Report_528340_7.pdf

In May 2016, the Michigan Department of Transportation (MDOT) evaluated its TPIMS along I-94 from the Indiana border to east of the I-94/I-69 interchange. The results of the evaluation confirm that the parking system was successfully implemented using modified off-the-shelf equipment, and output data was successfully integrated with existing traffic management systems. Further, the evaluation found that directing more resources to detector and system optimization can improve parking count accuracy. Drivers agreed that parking information systems were personally valuable to the driver and could save them time while driving. The study found that drivers selected dynamic truck parking signs as their preferred source of parking information as compared to other sources such as website-based applications or smartphone applications. Drivers found the signs to be both clear and useful, suggesting that acceptance of this source to be quite high. However, the results of the safety evaluation conducted as part of this study showed that the safety effects from the TPIMS were not detectible in the study. This is likely due to the limited area of implementation of the pilot parking information system. Nevertheless, prior research on the effect of rest areas showed that they provide a real protective effect, reducing crashes along the roads where they are located. Thus, there is good evidence to believe that providing information about the availability of truck parking would have a protective effect as well. Analysis of data also indicated that there was good consistency in the parking space occupancy during the duration of the pilot. The calibration corrections were significant for both the private and public rest areas but showed improvements over time. Similarly, the number of malfunctions per month showed improvement towards the end of the pilot period.

I-94 Truck Parking Information and Management System Concept of Operations (2012)

Source: Michigan Department of Transportation

In 2012, the MDOT developed its own TPIMS ConOps for a project to deploy TPIMS along I-94 from the Indiana border to east of the I-94/I-69 interchange. The initial deployment is still in operation today and is relevant to the MAASTO TPIMS Partnership project, as it is a comparable system and located within project corridors.

A Comprehensive System for Assessing Truck Parking Availability (2015)

https://www.dot.state.mn.us/ofrw/PDF/assessing-truck-parking.pdf

The University of Minnesota conducted a study to design and evaluate a space occupancy video detection system with accompanying dissemination technologies in the form of roadside changeable message signs (CMS), a website, and an onboard geolocation application that informs the driver of parking availability of one or more parking facilities further down from their current direction of travel. The three notification systems were evaluated during a field test, and surveys were conducted to provide feedback from truck drivers to better understand their views on parking shortages and the utility of the parking information dissemination systems. The tests showed that drivers who used the system could better comply with regulations for long-haul trips and felt that the system had positive impacts on their productivity. In addition, the evaluations quantified preferable locations of roadside CMS and their perceived importance when compared to other information delivery mechanisms. Further, the study found that the detection system detected parking space occupancy with a 95 percent accuracy rate and could provide 24/7 parking status with no need for manual interventions to correct detection errors.

Truck Parking Technologies Analysis Concept of Operations and High-Level Requirements (2016)

Source: Wisconsin Department of Transportation (WisDOT)

The WisDOT built a similar system along I-94 as Minnesota DOT using a $1 million grant from the FHWA. This system provides interstate truck parking continuity between Wisconsin and Minnesota. In Wisconsin, the system provides DMSs, integration with Wisconsin's traveler information telephone number (WI 511), and third-party mobile applications to indicate availability of truck parking at four key rest areas.

Jason's Law Truck Parking Survey Results and Comparative Analysis (2015)

http://www.ops.fhwa.dot.gov/freight/infrastructure/truck_parking/jasons_law/truckparkingsurvey/index.htm

The USDOT conducted the Jason's Law Truck Parking Survey in order to meet the requirements of the Moving Ahead for Progress in the 21st Century (MAP-21; P.L. 112-141) law that became effective on October 1, 2012. This analysis, completed in 2015, documents the findings of the Jason's Law Truck Parking Survey that is designed to: (1) Evaluate the capability of States to provide adequate parking and rest facilities for commercial motor vehicles engaged in interstate transportation; (2) Assess the volume of commercial motor vehicle traffic in each State; (3) Develop a system of metrics to measure the adequacy of commercial motor vehicle parking facilities in each State. Approximately 72 percent of state DOTs that were surveyed responded affirmatively to the questions: "Do you have a problem with commercial vehicle truck parking in your State?" States reported parking shortages in official parking locations as well as observing evidence of truck parking overcrowding manifested by trucks parking in unofficial parking locations. Respondents observed trucks parked at a variety of unofficial locations, including freeway ramps, freeway shoulders, roadsides, and local streets. Drivers and dispatchers reported difficulty in finding safe parking locations to obtain required driver rest. These problems are observed in regions with high populations and population densities, along major freight corridors carrying interregional commerce, and in locations associated with ports and manufacturing centers.

ATRI Research Synthesis (2016)

https://truckingresearch.org/wp-content/uploads/2016/12/ATRI-Truck-Parking-Case-Study-Insights-12-2016.pdf

The American Transportation Research Institute (ATRI) conducted literature research and analyzed driver survey data in order to gain an understanding of truck parking issues from the perspective of the drivers. There were three components and reports produced as part of the study: (1) Understanding Truck Driver

Perspectives on Parking Reservation Systems; (2) Case Study: Real World Insights from Truck Parking Diaries; (3) Utilizing Truck Global Positioning System (GPS) Data to Assess Parking Supply and Demand. An overall "Managing Critical Truck Parking" synthesis was produced after completion of the study. The study reinforced some of the results from the survey results in the Jason's Law Truck Parking Survey Results and Comparative Analysis report described above. The ATRI study found that weekends had lower demand for parking than weekdays, and on weekends, unauthorized/undesignated parking occurred less often, and drivers spent less nonproductive search time finding parking. Parking demand fluctuated significantly depending on the time-of-day, with peak demand occurring in the evening and early morning hours. Regional truck parking diary data did not align perfectly with the truck driver survey results from the Jason's Law Report, however. Regions identified as problematic in the truck parking diaries frequently included the South Atlantic, Southwest, and Pacific regions. The study also found that respondents would give up an average of 56 minutes of drive time per day to park early rather than risk not being able to find parking down the road, which impacted their productivity. In addition, according to the study, factors related to where drivers choose to stop for 10-hour required breaks are largely practical – with proximity to route ranked first, followed by restroom/shower access, expected parking availability, and width of space/ease of access. The study also listed several recommendations to improve truck parking issues and public safety. One of these recommendations includes creating information systems that provide real-time parking availability.

Colorado Truck Parking Information Management System (2016)

https://www.codot.gov/programs/planning/documents/plans-projects-reports/projects/fastlane-applications/truck-parking-information.pdf

This document, published in April 2016, discusses the proposed Colorado TPIMS. According to the document, data will be collected at both public and private sites, and the detection technology that will be deployed will be existing technology that has been used in MAASTO and other TPIMS efforts, such as static cameras and sensors. The technical solutions for detecting parking availability will be selected for their cost-efficiency, accuracy, and ruggedness for locations of extreme weather conditions. Data will be disseminated through DMSs, websites and mobile applications (i.e. the COtrip website), and the Colorado Department of Transportation (CDOT) 511 smartphone application. CDOT will utilize public-private partnerships to install ITS data collection infrastructure and will consult with a variety of stakeholders to advise on policy and planning-level activities and strategies. Further, CDOT will engage with neighboring states to ensure Colorado TPIMS has interoperability with other systems and will adopt common software and communication interfaces. CDOT will leverage existing working relationships to build toward a regional TPIMS. CDOT will use a technical approach and schedule that will follow six tasks. The first is stakeholder participation; the second is to develop specific elements of the parking detection ITS strategy; the third is to develop the dissemination strategy; the fourth is to design and construct the ITS infrastructure; the fifth is to monitor and refine the strategy; and the sixth is project evaluation.

Using FMCSA's ITD (CVISN) Grants for Truck Parking (2016)

http://its.dot.gov/presentations/its_america2015/SmartPark_TR01.pdf

In 2007, the Federal Motor Carrier Safety Administration (FMCSA) began research and development of an experimental truck parking information system as part of an Innovative Technology Deployment (ITD), formally Commercial Vehicle Information Systems and Networks (CVISN), grant. Starting in 2011, two rest areas in Tennessee approximately 20 miles apart on I-75 north were equipped with truck parking information infrastructure. The system included the use of a combination Doppler radar/laser scanner for data collection. Dissemination methods included dynamic truck parking signs, Interactive Voice Recognition (IVR), smartphone applications, and a SmartPark Research Project Website. The intent of the project was to demonstrate whether or not truck drivers could be diverted from a full rest area to one with vacancies, as well as to test out a truck parking reservation system.

Florida Department of Transportation Truck Parking Availability System Concept of Operations (2016)

http://www.floridatruckinginfo.com/Documents/Concept%20plans/System%20Engineering/Concept%20of%20Operations.pdf

The Florida Department of Transportation (FDOT) developed a ConOps for a project to deploy TPAS along the four primary Interstate corridors in Florida. The TPAS will measure parking availability electronically and disseminate information collected through various methods, including dynamic truck parking signs, the Florida 511 Traveler Information System, and mobile applications. The ConOps also provides information on stakeholders, their associate roles, and functions of the TPAS.

Mid America Freight Coalition Truck Parking Management Systems (2015)

https://midamericafreight.org/wp-content/uploads/2015/07/MAFC_TPMS_Synthesis_07012015.pdf

The Mid America Freight Coalition (MAFC) developed a report to study the need and provide an assessment for truck parking management systems in the United States. According to the report, video and in-pavement detection techniques are the forerunners in adopted approaches, and variable message signs (VMS) and smartphone applications are the leading dissemination methods. The report emphasized that a multistate approach to parking information systems on major freight corridors would present a substantial opportunity to increase safety of truck operators and the general public while providing safe and convenient parking. Further, these systems should include and leverage private sector efforts, and performance measures should be established to support and validate these multistate truck parking efforts.

Commercial Motor Vehicle Parking Shortage (2012)

https://ops.fhwa.dot.gov/freight/documents/cmvrptcgr/index.htm

The Conference Report accompanying the Consolidated and Further Continuing Appropriations Act of 2012, Pub. L. No. 112-55, 125 Stat. 552 requested that the FHWA research the shortage of parking available to commercial motor vehicles and how this impacted operators' compliance with federal safety requirements. The report indicated that truck parking shortages remained widespread and, at least in some geographic areas, acute. Further, anticipated growth in truck movements will exacerbate the shortages unless the public and private sectors respond with improved utilization of existing parking capacity and investment in additional capacity. The study suggests creating public-private partnerships to provide additional capacity where needed.

FHWA Systems Engineering Guidebook for Intelligent Transportation Systems (2009)
http://www.fhwa.dot.gov/cadiv/segb/files/segbversion3.pdf

The FHWA Systems Engineering Guidebook for Intelligent Transportation Systems was written as a resource to help improve development of ITS, to guide agencies through a uniform process for developing multi-agency ITS systems, and to guide consultants in meeting an agency's expectations for the development process of ITS systems. The document provides guidance for the following: life cycle phases for ITS systems; activities needed to carry out each development task; tailoring development activities to fit large and small projects; roles and responsibilities in project development; important activities that the system's owner needs to be involved with; activities to ensure that all bases are covered for each activity; tips, cautions, and other essential information needed for a task; applicable industry standards; templates for the development of key project documents and example case studies to assist the practitioner in tailoring the processes for their project.

NCHRP Synthesis 317 – Dealing with Truck Parking Demands (2003)
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_317.pdf

In 2003, the National Cooperative Highway Research Program (NCHRP) compiled a synthesis of research surrounding the truck parking issue. The synthesis draws data from a survey distributed to highway maintenance engineers all over the United States, and this data is supplemented with a literature review. The purpose of the synthesis is to identify practices that have been used to manage the increasing demand for commercial motor vehicle parking. The emphasis is on identifying successful and innovative strategies that have been implemented by transportation agencies as well as potential strategies that have yet to be deployed. These strategies include expanding or improving public rest areas; educating or informing drivers about available spaces, such as using ITS; or making better use of the private sector and private truck spaces. The data also showed that there is a greater amount of available truck parking in the private sector than in public sector and that most truck drivers prefer to use commercial parking facilities than public rest areas. In addition, overcrowding tends to concentrate in public rest areas. The study also emphasized the need for a multifaceted approach to meet demand for truck parking.

4.0 Background

4.1 National Truck Parking Issues

There is general agreement among transportation agencies and advocates that safe and convenient truck parking is insufficient along the NHS and other freight corridors. This is especially true for I-10, which is part of the PHFS, a network of highways identified as the most critical highway portions of the U.S. freight transportation system determined by measurable and objective national data. Given the high volume of trucks that travel on I-10, congestion at many traditional truck parking sites has translated into truck drivers using unauthorized locations like rest area ramp shoulders, freeway ramp shoulders and freeway shoulders, and adjacent roads for overflow parking, creating an unsafe situation for all motorists.

Truck drivers are faced with a number of operational and regulatory challenges, including HOS limitations, limited availability of parking at public and privately operated rest facilities, pressure resulting from just-in-time delivery schedules, and stress and delay resulting from traffic congestion in many urban areas and/or major truck corridors. These issues also impact the safety, operations, and economies of the general motoring public, agencies that maintain and operate the transportation infrastructure, and private business.

Access to safe and convenient parking areas for trucks is essential for safe travel of both commercial vehicle operators and the motorists with whom they share the road. FMCSA regulates HOS and mandates rest periods for drivers of at least 10 hours per day after every 14-hour shift. Additionally, drivers must take periodic 30-minute breaks as defined by the FMCSA. Violators risk fines and disciplinary action. The enactment of the electronic logging device rules has eliminated any flexibility in HOS monitoring. However, drivers frequently report challenges to complying with these regulations, including:

- Difficulty finding safe and convenient parking options where needed, and
- Inadequate information regarding parking availability and wayfinding.

Safety Concerns

One common truck parking concern is driver fatigue. Drivers who are unable to find a safe place to rest are at higher risk for being involved in fatigue-related crashes. In 2015, the National Center for Freight & Infrastructure Research & Education (CFIRE) published a synthesis titled “Truck Parking Management Systems”. This synthesis concluded that driver fatigue may account for up to 11 percent of truck crashes. The synthesis also noted that a disproportionate number of truck crashes occur between 10:00 p.m. and 6:00 a.m., or in areas where parking is unavailable for more than 30 miles.

Drivers who have not located parking before reaching their HOS limits are often forced to park in unauthorized areas and/or unsafely in order to avoid fines or discipline from their employer. Without reliable, real-time information about parking availability, some drivers often choose to end their shift early and travel from lot to lot looking for available parking. Figure 4: shows results from the 2013 Safe Truck Parking Survey by Desiree Wood, Hope Rivenburg, and Andrew Warcaba Associates for locations where truck drivers generally park. A significant number of surveyed truck drivers park in areas that could be considered unsafe; including ramps, abandoned lots, and isolated locations like shopping center delivery areas.

Figure 4 is located on the next page

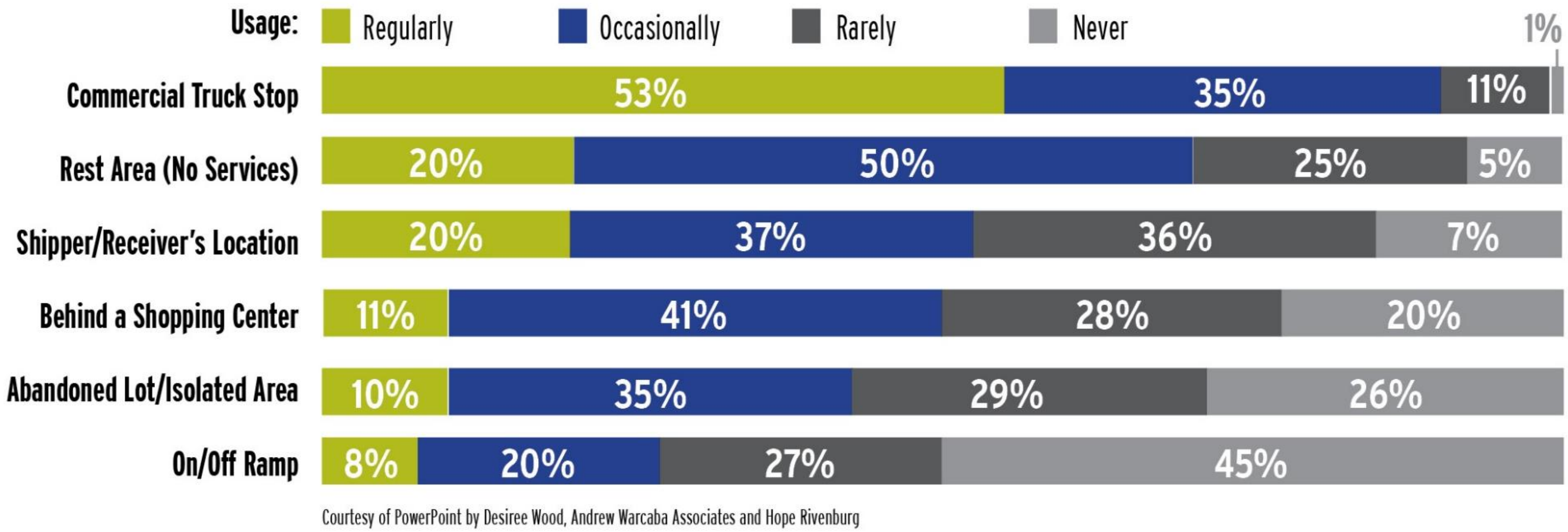


Figure 4: 2013 Safe Truck Parking Survey Results by Generalized Parking Locations

In the most serious of cases, the result of parking in unsafe areas is personal injury or death. This outcome was addressed in Section 1401 of MAP-21; a section called “Jason’s Law”. In 2009, Jason Rivenburg, a commercial truck driver, sought a safe spot to rest before delivering a load of milk early the next morning. Jason’s unfamiliarity with parking options nearby led him to park at an abandoned gas station, where he was later robbed and murdered. As a result of this incident, “Jason’s Law” was passed, bringing the need for safe truck parking into the national spotlight and expanding eligibility for states to use federal highway funds for truck parking projects.

Economic Concerns

Truck parking improvements provide a number of strong economic benefits within the project corridors and help strengthen the overall economic productivity and competitiveness of the I-10 Corridor Coalition states.

According to a 2013 Safe Truck Parking Survey presentation by Desiree Wood, Hope Rivenburg, and Andrew Warcaba Associates, a survey of nearly 4,000 truck drivers revealed that 83 percent of the respondents routinely took longer than 30 minutes to find parking; 39 percent took longer than one hour.

According to Traffic Technology International, a national smart truck parking system is estimated to save the US economy billions of dollars each year. It is estimated that the yearly cost of wasted fuel and lost working hours is $7 billion with an average yearly cost of $35 billion in damaged or stolen goods in transit in the US. At least some of this might be attributed to truck drivers searching for safe areas to rest or being forced to sleep in unsafe or congested locations. The TPAS project seeks to greatly decrease the time spent searching for parking and, in turn, decrease the amount of fuel used and increase the time traveling towards a destination.

A large-scale smart truck parking system is expected to enhance the ability of the U.S. to compete globally. The I-10 corridor is a critical national trade corridor and the segment from California to Texas connects four of the ten largest U.S. seaports by tonnage (Los Angeles, Long Beach, Houston, and Beaumont). On its western end, the Ports of Los Angeles, also known as America’s Port and the largest port in the US, and Long Beach (San Pedro Bay Ports), the second largest port in the US, via Interstate-710 and Interstate-110 are the busiest container ports in the nation, transferring goods between ships and trucks bound to destinations throughout the country. In Texas, the Port of Houston is the sixth busiest container port in the nation and the busiest U.S. port by foreign waterborne tonnage, and the Port of Beaumont is the fifth largest in the U.S. in terms of annual tonnage and is the largest military cargo port in the country. Between them, the I-10 corridor serves several major metropolitan areas, major international airports, critical military bases, large rail-truck intermodal facilities in each state, and the El Paso International Border Crossing, which processed nearly 780,000 inbound trucks in 2017. By proactively providing drivers with real-time parking information, the region will allow drivers to competitively move goods more efficiently and safely.

To improve safety and efficiency within the nation's truck transport network, drivers require real-time information regarding locations of available parking. Recommendations in the first National Freight Advisory Committee report identify ITS as a solution for truck parking issues, while also citing fatigue prevention as a mean to stem crashes in the transportation sector. Both recommendations can be accomplished by launching a TPAS.

In the long term TPAS is envisioned to be an ITS-enabled nationwide network of safe, convenient parking areas with the ability to collect and broadcast real-time parking availability to drivers through a variety of media outlets. This will enable drivers to proactively plan their routes and make safer, smarter parking decisions. It will also enable public and private parking facility owners to understand the magnitude and timing of the demand on their facilities, thereby allowing for smart partnerships and investments to increase parking capacity in areas where demand exceeds supply.

4.2 National Research Programs

There is an extensive body of research on truck parking utilization and safety. In 2003, FMCSA determined that fatigue accounts for over eight percent of all fatal truck crashes (NCHRP, 2003). Research conducted by the National Highway Transportation Safety Administration (NHTSA) in 2000 suggests that driver fatigue may be a contributing factor in 30 to 40 percent of all heavy truck crashes.

Congress, recognizing this problem, has on more than one occasion directed the National Transportation Safety Board (NTSB) and USDOT to review the causes of heavy truck crashes and the adequacy of the nation's commercial vehicle parking supply. In 1998, Congress directed the NTSB to review the causes of truck-related crashes. Section 4027 of the Transportation Equity Act for the 21st Century (TEA-21) specifically required USDOT to conduct a study to examine the adequacy of the nation's parking facilities on the NHS. In a special investigative report, NTSB recommended that FMCSA create a guide to inform truck drivers about locations and availability of parking.

On October 1, 2012, the Moving Ahead for Progress in the 21st Century (MAP-21, PL 112-141) went into effect. Section 1401 of MAP-21, also known as Jason's Law, directed the USDOT to conduct a survey and assessment to:

- Evaluate the capability of each state to provide adequate parking and rest facilities for commercial motor vehicles engaged in interstate transportation;
- Assess the volume of commercial motor vehicle traffic in each state; and
- Develop a system of metrics to measure the adequacy of commercial motor vehicle parking facilities in each State.

From the Jason's Law survey, some national trends in truck parking were identified. For truck drivers, finding available and safe parking at night was a significant problem. States lacked resources to fund parking projects and enforcement. The survey also identified communication with truck drivers on parking issues and availability as being necessary and important for helping drivers find parking and to broadcast safe options in emergencies or adverse weather conditions.

4.3 Existing Systems

Since the enactment of MAP-21 and Jason's Law going into effect, various truck parking projects were carried out across the nation in various states using different technologies and different implementation approaches to information dissemination. The subsections below provide examples and short synopsis of regional and individual state truck parking systems that are active in the United States today.

MAASTO TPIMS

Eight states in the MAASTO region secured $31 million in federal funds to build a seamless truck parking system known as TPIMS. The federal funds were provided through a Transportation Investment Generating Economic Recovery grant. The states of Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Ohio, and Wisconsin created the first ever regional system that monitors available truck parking at authorized public and private truck facilities in real time, and then relays the information to drivers and dispatchers through roadside dynamic truck parking signs, mobile applications, and traveler information sites (511). In total, 137 public and private parking availability monitoring sites were installed across all eight states. The system has been operational since January 2019. Each state has agreed to collect three years of data for calculating performance measures that evaluate elements such as system accuracy, downtime, and truck driver perceptions of the system. Below are descriptions of each state's system.

Indiana

Nineteen public truck parking facilities are monitored for parking availability as part of the TPIMS deployment on I-65, I-69, and I-70 in Indiana. An entrance and exit counting system that uses in-pavement magnetometers monitors parking availability. Cameras were also installed at each public site to allow for assessment of how well the system is working and to allow for manual counts of available spaces for manual resetting of the system. Operations, maintenance, and testing of the system is conducted in-house. Dynamic message signs are placed approximately 10 to 15 miles upstream from truck parking sites.

Iowa

The TPIMS was deployed at a total of 45 public and private truck parking sites in Iowa. The Iowa DOT was the only state transportation agency that opted to forego dynamic truck parking signs on I-29, I-35, I-80, and I-380 in favor of using grant funds to construct more sites. This decision was mainly influenced by the Iowa DOT Director who had placed a moratorium on new dynamic message signs along interstates. Information dissemination is being done through mobile applications, in-cab systems, and the state 511 website. In-pavement magnetometers are used for space occupancy detection at most public sites while most private sites use video detection to do entrance and exit counting due to the large number of spaces. A private contractor was selected to design, build, operate, and maintain (DBOM) the system.

Kansas

Eighteen public rest areas had TPIMS deployments constructed along I-70 as part of the Transportation Investment Generating Economic Recovery grant. Four additional public rest areas on I-135 were integrated into the system, although those sites were not a part of the federal grant agreement. Kansas chose a camera vision system to monitor space occupancy by creating a three-dimensional rendering with multiple cameras of the truck parking area. The technology has been demonstrated to be highly accurate. Dynamic message signs are typically spaced about five miles in advance of the nearest rest area.

Kentucky

The Kentucky Transportation Cabinet (KYTC) deployed TPIMS at twelve public truck parking facilities and one private facility. These facilities are located on I-65, I-71, and I-75. Side-fire radar was installed at the entrance and exit driveways of all sites. The KYTC uses side-fire radar on the interstate, so modifications to the system for use in TPIMS was able to be done in-house with assistance from the traffic operations center contractor. Design, installation, operations, and maintenance of the system is done in-house. Dynamic message signs are placed anywhere between one and 30 miles upstream from a designated TPIMS facility.

Michigan

Seven public truck parking sites were included in the Michigan TPIMS deployment on I-75, I-94, and I-275. MDOT chose to use open source camera analytics software to do entrance and exit counting, which is less expensive than the space occupancy detection approach and provides the DOT with an actual count of the trucks utilizing the site. This type of system requires up to two manual resets per day to maintain system accuracy. Dynamic truck parking signs are typically placed 15 minutes upstream of a truck parking facility.

This was not the first TPIMS deployment in the state. A TPIMS was deployed by MDOT in southwest Michigan, where it has been continuously operating since mid-2014. This made for seamless integration of the MAASTO TPIMS system. The I-94 international trade corridor was selected for implementation due to frequent overcrowding of rest areas, which was forcing drivers unfamiliar with the area to park along ramp shoulders and freeway shoulders at adjacent interchanges. There are seven private and five public sites along a 130-mile stretch of I-94 from the Indiana state line to Parma, Michigan. Data is disseminated via dynamic truck parking signs, Michigan's traveler information website, a third-party website, and mobile applications.

Minnesota

TPIMS was deployed at seven public rest areas on I-94 and I-35 in Minnesota. The Minnesota Department of Transportation (MnDOT) chose in-pavement magnetometers for their space occupancy detection because it helps to limit the number of manual resets that must be done at each site and were the most cost-effective technology at that time for monitoring space occupancy. Cameras at each site are used for system checks and data validation. Equipment was procured by the MnDOT and in-house staff was used to design, build, operate, and maintain the system. Typical spacing from a dynamic message sign to the truck parking site is five miles. The MnDOT deployment used full matrix color dynamic message signs instead of hybrid static/dynamic signs used by other MAASTO states.

TPIMS was not the first deployment for the state. Prior to TPIMS, three rest areas on I-94 eastbound were equipped with a stereoscopic camera pattern recognition system developed by the University of Minnesota. The camera system is able to identify the occupancy of each space within the rest area. Multiple dissemination methods have been developed, including in-cab communications via People Net, changeable message signs (CMS), the MN 511 website, and the University of Minnesota website. This pilot deployment was replaced by the TPIMS deployment.

Ohio

TPIMS was deployed at eighteen public sites on I-70, I-75, and US-33 in Ohio. Like Iowa, a DBOM contractor was selected for their portion of the project. In-pavement magnetometers were used for space occupancy detection at eight sites while the other ten sites use in-pavement sensors to monitor trucks entering and exiting the truck parking facility at the ingress and egress driveways. Placing the technology at entrance and exit points is the preferred method because of the cost-savings. However, the layout of some sites prevented ODOT from building all their sites this way. Typical spacing of a dynamic message sign to the site is five miles depending on the location of available power.

Wisconsin

TPIMS was deployed at ten public truck parking sites on I-39, I-90, and I-94 in Wisconsin. The Wisconsin Department of Transportation (WisDOT) uses in-pavement magnetometers at the entrance and exit of all sites to count trucks. This method of counting trucks aligned with WisDOT's desire to know how many trucks access each site no matter if they are parking in a formal spot or informal spot. Space occupancy monitoring would not have been able to determine that number of trucks. Dynamic message signs are placed anywhere between one and ten miles upstream of a designated TPIMS facility. Design, construction, operations, and maintenance are all being done in-house.

This is not the first truck parking system for the state. A previous $1 million grant from FHWA allowed Wisconsin to add sites at four key rest areas on I-94 between the Minnesota state line and I-39. The system provides the same information dissemination methods as TPIMS: dynamic message signs, integration with WI 511, and third-party mobile applications.

Other States

Florida

The Florida Department of Transportation (FDOT) launched their TPAS at 74 rest areas and weigh stations along the four primary interstate corridors in Florida. Weigh station sites count the number of trucks entering and exiting the facility with a microwave vehicle detection system (MVDS), whereas the rest areas are outfitted with in-ground sensors. Part of their deployment was testing different sensor types. The TPAS measures parking availability electronically and disseminates information collected through various methods, including dynamic truck parking signs, the Florida 511 Traveler Information System, and mobile applications.

Virginia

The Virginia Department of Transportation (VDOT) has gone through various stages of developing a statewide truck parking solution. In 2015, they completed a study to address parking challenges as well as complement the ongoing efforts to promote safety and truck parking capacity. VDOT implemented a pilot site for monitoring truck parking availability at one rest area along I-95. They are currently considering a larger deployment of a TPAS. VDOT also implemented a multiphase project across the state to add more truck parking and availability.

Colorado

The Colorado TPAS collects and distributes parking availability data for two rest areas and two private truck stops on two dynamic message sign locations along I-70. They use in-pavement magnetic sensing and video analytics-based technology to perform counting of trucks entering and exiting these sites. The TPAS components are fully automated with a remote network monitoring system that provides operational, health, and accuracy alerts. Truck parking availability information is transmitted through a wireless network to reach the dynamic message signs, existing in-cab routing systems, and a hands-free, FMCSA-compliant mobile app.

5.0 User-Oriented Project Development

User-oriented project development is important to make sure the system provides what the system stakeholders really need. **Table 5** lists all of the stakeholders related to the TPAS project, along with their corresponding roles and responsibilities. The inputs from these stakeholders form the basis of the ConOps for the I-10 TPAS project and are fundamental for the effective design of the system. Having a sophisticated plan for gathering stakeholder input is required.

Table 5 is located on the next page.

Table 5: Stakeholder Roles and Responsibilities

Stakeholder Group	Roles and Responsibilities
FHWA	Awarded ATCMTD grant to the I-10 Corridor Coalition. Ensures that grant-related activities meet federal standards.
I-10 Corridor Coalition/ Individual States	Comprised of the four I-10 Corridor Coalition states. Responsible for designing, deploying, and providing ongoing operations and maintenance of the TPAS, and are the ultimate owners of the system. The I-10 Corridor Coalition states include Texas, Arizona, California and New Mexico.
TxDOT	Serving as Lead Agency administering the ATCMTD grant for the TPAS project. Point of contact between FHWA and grant participants.
State Traffic Operations Centers (TOCs)/ Traffic Management Centers (TMCs)	Responsible for day-to-day operations and maintenance of the system. Operations and maintenance may be coordinated through a contractor in some states.
State Highway Patrol/State Police	Responsible for safety and security at rest areas along I-10. Can also help disseminate information about the TPAS to truck drivers parking in unauthorized locations to make them aware of the TPAS project and help inform their future parking decisions along I-10.
MPOs	The I-10 corridor passes through several Metropolitan Planning Organizations (MPO) boundaries and these agencies will also be a part of the project coordination process.
Contractors	Contracted by the state DOTs to perform operations and maintenance duties on state-owned truck parking monitoring equipment. They may also be contracted to own, operate, and maintain their own truck parking monitoring equipment. The contracted company may be required to collect, aggregate, and provide truck parking data to the respective state DOT for the state's dissemination.
Third-party Website/App Developers	Access truck parking availability data collected by the I-10 Corridor Coalition, and disseminate the information on websites, smartphone applications, and in-cab systems.
State Trucking Associations	Provide key reviews of marketing and outreach materials and will assist the team by recruiting motor carrier participants for stakeholder outreach activities.
Fleet Dispatchers/Driver Managers	Receive the truck parking information from the state 511 sites or from the third-party website/application developers and can disseminate it to truck drivers as desired.
Truck Drivers (Independent, Contracted, and Company Truck Drivers)	Receive truck parking information from multiple platforms including roadside signs, websites, smartphone applications, dispatchers, and in-cab systems. With the information, they are able to make better decisions regarding their stopping points.
Truck Stop Operators (TSOs)	Own and operate truck stops along freight corridors. If the I-10 TPAS is expanded to include private truck stops in the future, the TSOs will collaborate through a public-private partnership to aid in deployment of infrastructure within the truck stops.
Industry Freight Organizations (NATSO, OOIDA, ATA, USTA, etc.)	Help to publicize the system, provide feedback from users, and collaborate on integrated solutions.
FMCSA	Promote activities to prevent commercial motor vehicle-related fatalities and injuries.
DOT Travel Information Providers	Receive truck parking availability information from the TPAS and provide the information to truck drivers and dispatchers through existing travel information dissemination systems.

5.1 I-10 Corridor Coalition Engagement

For full details about the I-10 Corridor Coalition engagement process, please see the I-10 Corridor Coalition Truck Parking Availability System (TPAS) Stakeholder Engagement and Communication Plan. Various I-10 Corridor Coalition workshops and meetings are being held at regular intervals over the life of the TPAS project.

A project Core Team is holding regular conference calls/meetings to coordinate on project progress, upcoming tasks/action items, and deliverables throughout the four-year deployment and operations of the project. The project Core Team includes state project managers from each state DOT. These project managers are responsible for managing and coordinating all necessary planning and deployment activities within their states, rest area access, coordination with state enforcement agencies, and coordination with operations staff. In addition to the state project managers, project Core Team members have been identified from each state that will serve as active participants on the project Core Team throughout the duration of the project.

The project Core Team is holding bi-weekly teleconference workshops to collaborate on project progress and group decision-making during key project milestones. Due to the COVID-19 pandemic, the Core Team has maintained flexibility with moving all meetings to a virtual environment. Workshops to date have been conducted virtually to ensure the health and safety of participants.

The following topics were discussed over the course of the workshops:

- Goal setting
- Risk assessment
- Requirements
- Stakeholder engagement
- Concept of Operations
- System requirements
- Conceptual design
- Final design plans
- Final deployment and testing (validation/verification plan)
- Performance measures

The project Core Team has also established a Communications Working Group (CWG) which is comprised of state DOT staff to coordinate on various aspects of the project and the ATCMTD grant requirements. At the direction of the TxDOT Project Manager and in coordination with the project Core Team, the working groups are being convened at designated times throughout the project to communicate and coordinate on various technical aspects of the project. The working groups also serve as a conduit for project communications to various internal departments within the state DOTs with a specific interest or role in the I-10 TPAS project.

The CWG is being engaged at key project milestones to help with the state-level and regional stakeholder marketing and communications for the project. This group is a part of developing consistent messaging and branding of the I-10 TPAS project for use in both internal and external stakeholder communications and engagement. The group is also assisting with project updates and background materials for dissemination by the states through their own communication channels. Materials will be customizable for each state to highlight its role in and benefits achieved through the TPAS effort.

In addition to the workshops and working group meetings, the TxDOT Project Manager, in coordination with the project Core Team, is preparing and holding DOT leadership and communicator briefings through the project. At a minimum, these briefings will take place at key project milestones. Further, WebEx conference call meetings with key internal stakeholders are being scheduled as needed or at key milestones, and one-on-one and group emails are being used for internal and/or external communication as needed. SharePoint is being used as an internal website for the project Core Team to post latest updates, documents, PowerPoint presentations, FAQS, etc.

5.2 Industry Stakeholder Engagement

The I-10 Corridor Coalition is collaborating with key trucking industry stakeholders and representatives from the law enforcement/public safety agencies in each state at key project milestones to better understand system user requirements, expectations, and implementation challenges/successes for the regional TPAS. A broad range of communication tools and strategies are being used to provide information to and solicit input from trucking industry stakeholders on the TPAS project. The strategies used in each state will vary.

The American Trucking Associations (ATA), its research arm ATRI, Owner-Operator Independent Drivers Association (OOIDA), United States Transportation Alliance (USTA), and public safety agencies will, through periodic team consultation, provide insights into system user needs and preferences. The organizations will also provide information about potential media events, and other opportunities to communicate and market the TPAS project to potential users and stakeholders.

The strategies for providing information and collecting input include:

I-10 Connects Website

The CWG is maintaining and updating the I-10 Connects website (**www.i10connects.com)** to expand TPAS awareness and use among drivers, dispatchers, and other truck routing decision makers from project initiation to the end of its operations and maintenance period. The website is being used to help member states consistently and effectively communicate internally and externally about the project. Content will be updated as needed and at significant project milestones.

Other marketing and communication items produced for the project are posted to the website. The CWG will identify a key contact to monitor the website and field stakeholder questions and comments to be directed to the appropriate project member for follow-up. The website will also be utilized to provide links to the TPAS smart phone application developed for the project, state DOT 511, or other traveler information websites, as well as the public data feed for the TPAS to interested third-party application developers.

Driver/Truck Industry Surveys

The I-10 Corridor Coalition is developing and distributing up to three electronic surveys at specific milestones throughout the project to capture user needs and expectations about TPAS to help guide ConOps development and understand how the rest area parking sites are operating pre- and post-deployment. Questions include topics such as parking spot utilization and demand, corridor safety, and system reliability.

Newsletters/Fact Sheets

The CWG is developing outreach material to support key messages and communicate at project milestones about project goals and specific project issues. All newsletters and fact sheets are being distributed electronically and formatted for posting on the project webpage. A small number will be printed for use at events and meetings.

Media Releases

The CWG is developing media releases and coordinate with each of the four DOTs to announce and promote major events, milestones, and/or traffic impacts.

Targeted Media Outreach

The CWG is working with individual DOT technical representatives to coordinate tours and interviews with key media outlets to provide a project overview. Periodic updates will be offered during the project to keep them informed about upcoming activities and events.

Trade Publications

The CWG is developing and distributing project-related articles and press releases for truck industry publications and trucking association websites. Printed articles are available for review on www.i10connects.com.

PowerPoint Presentation and Script

A presentation slide deck for the project is being developed and maintained for the project. The slide deck includes "standard" slides providing general project overview information, as well as detailed technical slides that can be selected and used to create tailored presentations for specific internal and external audiences. Each slide includes "scripted" notes covering key talking points.

Social Media

The CWG is using Twitter, Facebook, YouTube, and other social media avenues to disseminate information to a larger audience and keep the public informed about project progress and status. The CWG is also coordinating with each DOT to help disseminate information through their existing state social media sites.

In order to develop performance metrics for the system, a baseline stakeholder survey was developed in partnership with ATRI and submitted to trucking industry stakeholders. In addition, stakeholder workshops were held to give the I-10 Corridor Coalition an understanding of the concerns and needs of the industry stakeholders for the TPAS project deployment.

Small Group Meetings/Conference Calls/Briefings

The CWG is helping plan, prepare materials for, and host small group meetings, conference calls, and/or briefings with industry organizations at key project milestones to provide information about the project and solicit input as appropriate. Meetings may include presentations created from the available project slide deck and will be tailored to the specific audience.

External/Industry Workshops

The CWG is helping plan, prepare materials for, and host industry workshops to raise awareness with their members about the project and gather input as appropriate. Workshops may include presentations created from the available project slide deck and will be tailored to the specific audience.

Project Marketing Materials

Prior to deployment of the TPAS system, the CWG will lead the development of rack cards, brochures, posters, etc. for placement at rest areas and distribution to industry stakeholders to help publicize the upcoming system to drivers.

Static Project Information Kiosks

The I-10 Corridor Coalition will coordinate with each of the four DOTs to add information kiosks at high volume public rest areas to help create awareness for truck drivers and dispatchers. Project marketing materials will be displayed at these kiosks and replenished as needed.

TPAS Video Clips

The CWG will lead the development of videos that highlight how TPAS will work and the benefits of the system, for posting on the I-10 Connects website and social media sites.

Electronic Project Information Kiosks

The CWG will utilize electronic boards or computers, as available, in high volume public parking sites to disseminate TPAS information and updates, including surveys, TPAS video clips, and electronic messages.

Online Driver/Dispatcher Briefings

The I-10 Corridor Coalition will coordinate the development of materials geared toward drivers and dispatchers to raise awareness of TPAS and help them understand how find truck parking availability.

Stakeholder Comment Opportunities

The CWG will develop and post a contact link on the I-10 Corridor Coalition website for stakeholders to submit questions or comments about the project. A contact will be identified to field the questions and coordinate the development of appropriate responses.

Application Developer Stakeholder Coordination

The I-10 Corridor Coalition states will develop state-level 511 or traveler information websites for the I-10 TPAS. Internal and external stakeholder engagement and FHWA requirements will provide guidance on the development of applications. Supplementing these dissemination methods for TPAS with private third-party applications will help expand the reach of truck driver and dispatcher usage of the system.

Making sure that truck drivers and dispatchers are aware of and using the TPAS is a critical part of the project's deployment and ongoing operations. At key milestones throughout the project, the I-10 Corridor Coalition will provide project information updates to interested third-party smartphone, in-cab, and website application developers through online meetings or forums to make them aware of the benefits and process for using TPAS data in their applications. The I-10 Corridor Coalition will develop and share a TPAS public data feed that third-party application developers can use to provide parking availability data to their users. The I-10 Corridor Coalition will be able to leverage the database of interested third-party application developers from the MAASTO TPIMS projects to increase awareness and usage quickly for the TPAS project.

Industry Stakeholder Input

A WebEx meeting was held on August 26, 2020 for State Trucking Association leadership and other key stakeholders from all four states. The meeting was held to provide an overview of TPAS as well as gather input about the needs of stakeholders for the how the system will be operated and maintained.

A survey directed towards drivers and dispatchers was rolled out at the meeting. Understanding that drivers have survey fatigue from other freight related planning initiatives, key questions were posed at the meeting to understand issues drivers face as well as how the system would support them. Below are the key topics discussed and preferences identified during the meeting.

- It takes 30 to 60 minutes for drivers to find parking, or the exact time was unknown.
- Drivers have difficulty finding all types of parking (30-minute HOS breaks, overnight and parking while off duty) and often park in unauthorized locations.
- The team wanted to understand the typical process drivers use to determine where they will stop. The following comments were provided:
    - Trip planning is one aspect of how drivers will determine where they park; but where they park can change depending on traffic
    - Driver dispatcher may help drivers look for parking spots
    - Some drivers that drive semi-regular routes have their favorite spots identified
    - Parking can depend on timeclock and drivers may need to find something quick so they park at the first spot available
    - Drivers have knowledge of locations and areas where they can find availability
    - Weather conditions can attribute to where drivers select to park
    - Some oversize/overweight drivers also have escort cars so must find parking for all vehicles
- Accuracy is an important aspect of the TPAS system.

- A system that could integrate private rest areas would be useful as well.
- Roadside signs and in-cab systems are the most preferred methods to received real-time parking availability information.
- Five minutes is reasonable to be considered “real-time”; it is beneficial in urban areas to be updated as frequently as possible.
- Drivers would prefer signs five to ten (5-10) miles in advance of the truck parking site for planning purposes.
- In regard to how many sites should be posted on DPAS signs, having more data is helpful as more locations helps drivers make more informed decisions.
- When approaching a state line, it is important to provide the next state’s information.
- Preferences on how information appears on the signs varied but the option that only shows availability received the most votes.

- Drivers would like for low capacity to be displayed on the signs as “Full” versus “Low”.
- States are committed to keeping signs up and working in a reasonable amount of time if signs were to be struck by a truck.
- System will provide alerts to inform drivers and dispatchers when the system is down.
- The grant is for the technology, but the system will provide data to the states about how frequently sites are full that can indicate if they need to expand sites and create more parking.
- Drivers use 511/Traveler Information sites.
- Stakeholders agreed that a separate application for the I-10 Corridor Coalition would not be necessary.
- In general, the group agreed that the main concern is that there is not enough parking in general for trucks.

The on-line survey went live in early September 2020 and was available until early November 2020. Questions are designed to solicit input similar to the information provided by the State Trucking Association leaders and other key stakeholders. Below is a summary of key findings and the full results are provided in Appendix E.

6.0 Operational Needs

6.1 Vision

Truck drivers, dispatchers, private and public officials in the I-10 corridor will have access to accurate and reliable real-time information about public truck parking availability through an advanced, coordinated, seamless, and intelligent transportation information system.

A successful deployment of the I-10 Corridor Coalition TPAS project will identify vacant truck parking spaces at public rest areas and communicate that information in real-time to drivers, dispatchers, public officials, and other stakeholders using a variety of information dissemination systems. The information systems developed during this project, such as data formatting for multi-state collaboration and possibly a smartphone application, could be expanded to other corridors in the region and other states along I-10 (e.g., Louisiana, Mississippi, Alabama and Florida).

6.2 User Needs

After the first TPAS I-10 Corridor Coalition workshops in 2020, an itemized list of user needs was developed. The purpose of this list is to track and verify that the project is meeting the user needs throughout the systems engineering process. Table 6 provides the itemized list of user needs and indicates to which stakeholder the user need applies.

Table 6 is located on the next page.

Table 6: User Needs

	User Need	I-10 Corridor Coalition	Individual States	FHWA	Truck Drivers	Fleet Dispatchers/ Driver Managers	Traffic Management/ Operation Centers (TOC/TMC)	DOT Travel Information Providers	Contractors (O&M)	Third-Party Website/App Developers	State Highway Patrol/State Police	FMCSA	Industry Freight Organizations
A	Receive timely, reliable, and accurate parking availability information to efficiently locate parking.	X	X		X	X	X	X					X
B	Access consistent information about truck parking availability along the I-10 Corridor.		X		X	X	X	X		X	X	X	
C	Receive consistent information between states.		X		X	X				X			
D	Receive truck parking information through multiple dissemination methods (e.g. Dynamic Parking Availability Signs (DPAS), websites, smartphone applications, etc.).				X	X	X						X
E	Receive information on amenities including lighting, HAZMAT parking and oversize/overweight parking accommodations.				X	X		X					
F	More efficiently utilize existing truck parking to maximize usage of safe, formal truck parking.	X	X	X	X	X					X	X	X
G	Develop a cost-effective, sustainable solution with minimal operation/maintenance requirements.	X	X				X	X	X				
H	Receive information in a way that meets federal safety guidelines for commercial drivers.				X								X
I	Reduce fatigue-related truck crashes in deployed corridors.	X	X	X	X	X	X				X	X	X
J	Reduce unauthorized parking, especially on ramps.	X		X			X				X	X	
K	Protect parking user privacy and proprietary data.	X	X		X			X	X	X			
L	Account for unique parking situations (e.g. HAZMAT, oversize/overweight, drop loads, etc.)	X	X		X	X	X		X		X	X	
M	Maximize understanding and acceptance of the TPAS.	X	X	X	X	X		X					X
N	Comply with the Federal ATCMTD Grant by operating and maintaining a TPAS system for a minimum of 3 years.	X	X	X									
O	Comply with the Federal ATCMTD Grant by providing an operational TPAS system by Q3 2023.	X	X	X									
P	Collect data for performance measurement, operations analysis, and evaluation for future truck parking expansion.	X	X	X			X		X	X			X

6.3 Goals and Objectives

The I-10 Corridor Coalition agreed upon goals and objectives for the I-10 TPAS project during Core Team meetings. The goals and objectives for the project are discussed below.

- **Reduce fatigue-related truck-involved crashes in the I-10 corridor.**
  The I-10 Corridor Coalition TPAS will enable commercial vehicle drivers to readily identify parking spaces and reduce the chances of operating while fatigued.
- **Reduce emissions associated with excess driving while searching for parking.**
  The I-10 Corridor Coalition TPAS will enable commercial vehicle drivers to readily identify parking spaces and reduce travel searching for parking.
- **Reduce public infrastructure degradation and improve safety by decreasing trucks parked in unauthorized locations.**
  The I-10 Corridor Coalition TPAS will enable commercial vehicle drivers to readily identify parking spaces and reduce parking along highway shoulders, ramps, or other unauthorized locations.
- **Increase driver efficiency by reducing time spent looking for parking.**
  The I-10 Corridor Coalition TPAS will reduce the amount of time spent looking for parking, which will increase the available time used for traveling to a destination.
- **Create a standardized information technology system that can be expanded in future deployments to serve other corridors within the four states, other states along I-10, and/or other ITS needs in the I-10 corridor.**
  The I-10 Corridor Coalition TPAS will create a system that can be expanded elsewhere in the member states, possibly expanded to adjacent states, and could be leveraged to deliver other truck-related information such as forecasted truck availability or weather advisories.

6.4 Performance Measures

The I-10 Corridor Coalition will collect information and report on the project's observed performance with respect to the relevant long-term outcomes that are expected to be achieved through the construction of the project. The performance measures identified in the MAASTO TPIMS Transportation Investment Generating Economic Recovery grant project will be used as a baseline for the I-10 TPAS project for national consistency and benchmarking. However, the I-10 Corridor Coalition will refine these measures based on the systems engineering process.

The I-10 project metrics will include observed measures comparing baseline (pre-deployment) as well as post-implementation for a minimum of three years. Findings from these assessments will be used to evaluate and compare projects and monitor the results that grant funds achieve.

The I-10 Corridor Coalition will track and report on the following performance metrics for the project on a quarterly basis:

1. **Parking Spot Utilization and Demand Cycles** – The change in usage of existing parking assets across the I-10 corridor over time.
2. **Corridor Safety and Security –** Reduced HOS violations, reduced unauthorized parking on corridor ramp shoulders and freeway shoulders, improvements in the safety and security of truck drivers;
3. **Air Quality –** Reduce emissions related to searching for available parking;
4. **Parking Utilization Efficiency –** A measure of use of HOS for travel compared to looking for parking, and compared to use of unauthorized parking spaces (e.g. highway shoulders and ramps); and
5. **System Reliability** – A measure of the reliability and accuracy of the truck parking availability information.

The following section provides a general overview of how the performance metrics will be assessed. The details on how the performance metrics will be assessed and who will be responsible for the assessment and reporting will be detailed in the project's Project Evaluation Plan.

Methodology and Tracking Criteria

The performance metrics process will begin with the collection of baseline truck parking data prior to implementation of the I-10 TPAS, during the 60-day "burn-in" period prior to system Go-Live, and post deployment for a minimum of three years to assess the system over time. Data sources will include, but are not limited to, end-user survey data, HOS violation data, and site-specific data at deployed truck parking sites. During the 60-day "burn-in" period the detection systems will be cable of collecting parking usage data.

The project metrics reporting will be the responsibility of each of the four states. The four states will develop common metrics for tracking and reporting based on the systems requirements. Each state will track and report on the metrics for their portion of the corridor on a quarterly basis and provide the results to TxDOT who will review and compile the information for submission to FHWA. The I-10 Corridor Coalition agreed that the methodology and tracking procedures should meet the following criteria:

- Relevance to the goals of the project;
- Ability to improve the operation of the system over time;
- Ability to efficiently collect the data over three years; and
- Ability to be applied consistently across the corridor.

Parking Utilization and Demand Cycles

Measurement Period: Baseline Pre-Deployment and Post-Deployment, Annual Surveys, Quarterly Parking Inventory

Several tools will be used to measure how parking utilization and demand cycles are impacted by implementation of the I-10 TPAS project:

- Baseline and post-deployment truck parking surveys; and
- Available truck parking studies and inventory data.

Surveys

A truck parking utilization survey will be jointly developed by the states and deployed through email distribution lists provided by trucking industry stakeholders such as the ATA, OOIDA, USTA, and the National Association of Truck Stop Operators (NATSO) and to truck drivers and trucking companies within the four states. The survey will be administered by the I-10 Corridor Coalition and the results will be provided to TxDOT for coordination with FHWA. The pre-deployment survey will be administered prior to completion of construction and system Go-Live in July 2023 and will provide a baseline for the trucker's perception of parking utilization. After completion of the system, each state will administer one post-deployment survey. The survey questions will assess parking behaviors before and after implementation of the TPAS to determine what changes have occurred. The pre-deployment survey for I-10 TPAS is included in Appendix E. The pre-deployment parking utilization survey will be compared with subsequent post-deployment survey data to assess if truck driver's perception of parking utilization is changing.

Parking Studies and Inventory Data

The I-10 Corridor Coalition will collect existing truck parking data for the deployed sites along the corridor. Upon collection of the data, a database and baseline of truck parking trends for the deployed sites will be created. After the construction phase during the burn-in period, the states will collect parking spot utilization data prior to activation of the system components that disseminate parking availability information. Each state will collect the parking utilization data and will provide the data to TxDOT who will compile the information for the I-10 corridor in the Project Metrics Report. The baseline manual observation must be completed by each state during the system burn-in period when the surveillance cameras will be working, but information from the system is not being shared with truck drivers. These manual observations will provide a limited sample size that can be used to adjust the analytical results provided by the surveys. This allows for a pre-implementation snapshot of parking usage and patterns that can standalone as the baseline data or be combined with other existing parking availability data. After system activation, the parking lot utilization will be tracked on a quarterly rolling basis with an annual analysis of the data. This approach will provide for an assessment of the system's ability to influence the overall utilization and demand cycle of the parking facilities. Each site will be aggregated by state and for the total project. The average percentage utilization for the project will be reported. When aggregating by state and for the total project, the utilization will be weighted by the number of parking stalls.

Corridor Safety and Security

Measurement: Baseline and Post-Deployment, Annual Average

Deployment of TPAS is intended to improve safety and will help truck drivers meet FMCSA's HOS requirements. For the qualitative safety measure, the truck driver surveys will be administered by the I-10 Corridor Coalition and the results will be provided to TxDOT before and after the project's deployment to assess truck driver and trucking company perception of how safety has been improved with the implementation of TPAS.

For the quantitative measure, a risk factor database will be developed based on HOS violations extracted from the FMCSA's Motor Carrier Management Information System (MCMIS). Consistent safety data collection is difficult with thousands of officers across the state with numerous duties to perform each day. Furthermore, accidents caused by driver fatigue is documented; however, drivers will often fail to admit that they were drowsy or fell asleep. Therefore, the reliability of fatigue-related truck crashes is in question. The risk factor of accidents can be assessed based on HOS violations which are systematically documented in an electronic driver log.

Vehicle Operating Costs

Measurement Period: Pre-Deployment and Post-Deployment, Annual Basis

How TPAS impacts vehicle operating costs along the I-10 corridor is based upon two metrics:

- Fuel consumption
- Other operating costs

Change in vehicle operating costs will be the quantitative measure of the performance of this portion of the project evaluation. These costs will be associated with the change in distance traveled based upon the survey results which show the reduction in travel time spent searching for parking. The survey results will be utilized to determine the reduction in time spent searching for parking which will be converted to distance travelled based upon the assumptions in the Benefit-Cost Analysis performed as part of the ACTMTD Grant application.

Air Quality

Measurement Period: Pre-Deployment and Post-Deployment, Annual Basis

The air quality measure will evaluate how the TPAS impacts air quality along the corridor. The I-10 Corridor Coalition has identified two air quality project metrics:

- Change in user-reported time spent looking for parking; and
- Modeling of travel based on reported time spent looking for parking, as well as travel time information from the National Performance Management Research Data Set (NPMRDS).

For the quantitative measure, air quality impacts will be modeled by each state for their portion of the corridor, factoring in self-reported time spent and distance driven looking for parking, along with truck travel speeds from the NPMRDS. The states will provide the results to TxDOT who will compile and summarize the information in the Project Metrics Report.

Parking Utilization Efficiency

Measurement Period: Pre-Deployment and Post-Deployment, Annual Basis

The parking utilization efficiency measure will evaluate how the TPAS impacts time spent looking for parking. The I-10 Corridor Coalition has identified two metrics:

- Self-reported time spent looking for parking (collected through a survey – see Appendix E); and
- Budget for maintenance of typical unofficial parking locations (e.g. highway shoulders and ramps) and funds spent to maintain or repair such facilities.

For the quantitative measure, each state DOT will develop, track, maintain, and report their estimated needs and budget for maintaining specific unofficial parking locations along the I-10 corridor before TPAS deployment as a pre-project baseline, and annually compare the change in maintenance needs and budget. The states will provide the results to TxDOT who will compile and summarize the information in the Project Metrics Report.

System Reliability

Measurement Period: Post-Deployment, Quarterly Basis

The system reliability measure will evaluate how well the system operates and meets the defined I-10 TPAS System Requirements, developed during the project's systems engineering phase. Each state will collect the system reliability data on a quarterly basis and provide to TxDOT who will compile the information for the corridor in the Project Metrics Report. The I-10 Corridor Coalition has identified three system reliability project metrics:

- System Downtime
- User Complaints
- System Accuracy

System Downtime

The system downtime measure will evaluate the percentage of time the system is not functioning as intended. To calculate system downtime, each state will archive their project data and provide to TxDOT, who will compile the information for the Project Metrics Report. The states may consider developing a central data clearinghouse which could also archive data collectively for this task. This will be determined during the Systems Engineering process. The data for each site in each state will be queried to determine if there are data records for each time period. If there are missing records, the amount of time the site is considered down will be determined by subtracting the time stamp field of the last record before the gap from the first record after the gap.

The downtime for each monitored site will be calculated quarterly and rolled up to a state and system total downtime number. The performance measure of downtime has one limitation. While it assesses whether the site equipment is collecting field data, the field data is being processed and the data is being made available to the public data feed, it does not take into account dynamic parking sign functionality or other public data displays or feeds. Assessing whether or not signs are working consistently between states would be difficult because the systems used to control signs or other public systems will vary state to state. Therefore, dynamic sign functionality will not be collectively monitored and documented as part of the performance metrics. The states will provide the system downtime results to TxDOT who will compile and summarize the information in the Project Metrics Report.

User Complaints

User complaints define how truckers and trucking companies perceive the reliability of the system. This is an important metric identified by the project stakeholders, including both the major trucking companies as well as independent owner-operators, articulated through prior truck parking-related surveys performed nationally. It was noted by the ATRI that truckers would forgive one instance of inaccurate information; however, they would begin to question validity and usefulness of the system if they received inaccurate information a second time. To provide a consistent measure of user complaints, the surveys will be used to assess users' perceived accuracy of the system. The survey will filter truckers and trucking companies who have used the system and will gauge their perception of the reliability of the system. The survey questions will include:

- How and when did they obtain the information (signs, State DOT traveler information websites, State DOT traveler information applications, third-party applications, etc.)?
- Was the system functioning properly—were the signs, websites and applications functioning?
- Was the information accurate—providing the correct availability?

Survey data will be collected and administered by the I-10 Corridor Coalition through all dissemination outlets; however, the reporting will focus on the functionality of the state DOT signs, websites, and applications.

In addition, project stakeholder interviews will be held by each state pre- and post-deployment annually to assess perceptions of the system and its accuracy and reliability. Project stakeholders within each state such as Goods Movement Committees and Trucking Associations including ATA, OOIDA and USTA will be involved in the stakeholder interviews. Each state will collect the interview results. These results will be provided to TxDOT who will compile the information for the corridor in the Project Metrics Report.

System Accuracy

The goal of the System Accuracy measure is to assess if the system is providing the correct number of available spaces. The TPAS data structure is designed to archive data that can be used to assess accuracy. Manual parking availability checks on accuracy will be input to provide a baseline for assessing accuracy. Each state will collect and log the data as part of the manual reset or verification process and assessment of accuracy. When a manual reset or verification occurs, the amplitude of the required change to match the manually observed parking availability is recorded. Even if the number of spaces is correct, a manual record must be input to document accuracy of that system.

The accuracy measure compares the system calculated number of available spaces to the actual number of available spaces. This assesses how well the system is estimating the number of available spaces. The accuracy is calculated as a percentage of actual available spaces at the reset point in time. To calculate a percent accuracy that can be averaged for multiple points in time, the absolute value of the difference divided by the actual number of available spaces is subtracted from one.

Example:

Site X with 30 spaces is reporting 27 spaces available and is manually reset to 25 spaces available. The accuracy at that time of reset is 93 percent.

1-Absolute Value ((27-25)/30) = 93.3 percent

Each quarter, the individual site accuracies will be averaged to generate a state accuracy and a system wide accuracy. The individual site accuracies need to be averaged to get the systemwide accuracy instead of averaging the total state accuracies, so states with fewer sites do not bias the systemwide accuracy. The states will provide the system accuracy results to TxDOT who will compile and summarize the information in the Project Metrics Report.

7.0 System Overview

The TPAS project concept involves four primary components:

1. Selection of a procurement method;
2. Collection of truck parking data;
3. Aggregation and processing of data; and
4. Dissemination of truck parking availability information.

In order to accomplish the project objectives, equipment will be deployed at public rest area sites within each of the I-10 Corridor Coalition partner states.

7.1 Procurement Methods

There are several ways in which the public-private combinations of the TPAS can be implemented. The following methods were considered:

- **Traditional public deployment with public O&M:** I-10 Corridor Coalition states design, deploy, and own the infrastructure, with operations handled by TOCs/TMCs and maintenance through normal DOT ITS maintenance practices.
- **Traditional public deployment with private O&M:** I-10 Corridor Coalition states design, deploy, and own the infrastructure, with operations and maintenance wholly or partially contracted to a third-party contractor.
- **Private turn-key deployment with Private O&M:** A contractor is hired to provide data based upon the system requirements. I-10 Corridor Coalition states receive a truck parking availability data feed, with maintenance obligations and outage requirements specified in a contract. A private vendor owns the entire infrastructure.

Variations on the aforementioned methods are also acceptable. Each member of the I-10 Corridor Coalition TPAS team must determine whether they want to collect and disseminate data as a state agency or contract with a third-party to perform this function. The decision to privatize some or all of the system requires consideration of budget, capacity of the current operations staff, and conformance with current DOT priorities. All approaches would support performance metrics and system management, provide data to truck drivers to improve safety, economy, and the environment, and provide data to I-10 Corridor Coalition states for infrastructure/asset management.

In a fully public system, the state DOT could maintain control over information within the system (i.e., data integrity) and costs would remain transparent. If private sites are ever added to the TPAS in the future, an agreement between the state and any private property owners would be required to allow installation of state-owned equipment on their private truck stop property.

A fully privatized system for all four states would simplify the future integration of data into a larger regional/national network across state lines, leading to a more consistent system and uniform consumer product. A private system could also potentially create a business model that would shift O&M costs to the private sector. Privatizing O&M puts operational activities under the control of organizations that are experienced in managing parking.

Disadvantages of a fully private system are the reverse of the advantages of a public system: data would not be controlled by states and be as readily available. Additionally, if a private operator were to have difficulty during an economic downturn, a state's entire TPAS could fail.

7.2 Data Collection

Truck parking information must be collected efficiently, accurately, and in a timely manner. To allow monitoring of the collected data accuracy a camera is also required to provide remote surveillance of the parking areas. There are many ways to collect data from truck parking areas to accurately reflect their occupancy. There are various types of technology that can be used to collect data. However, they all must be adaptable to the constraints each individual site provides. An inventory of all proposed TPAS sites revealed the following detection types are needed:

- Truck Only Entrance and Exit Driveway Counts
- Combined Traffic Driveway Entrance and Exit Driveway Classification
    - Truck Counts
    - Vehicle Length Counts
- Space Occupancy Detection
    - Diagonal Spaces
    - Curb Parallel Truck Only Parking
    - Curb Parallel Mixed Parking

In the I-10 Corridor Coalition TPAS project, seven data collection technologies are being considered. Four of the technologies will count trucks entering and exiting the parking area. This process is referred to as entrance and exit counting. The other three technologies will focus on providing counts by detecting the presence of a truck at each parking space. This process is referred to as space occupancy detection. The six data collection technologies investigated are:

Entrance and Exit Counting Technologies

- Magnetometer
- Video Detection
- Microwave Radar
- Lidar/Laser

Space Occupancy Detection Technologies

- Magnetometer
- Magnetometer and Microwave Radar
- Video Detection

The selection of technology will be determined based on individual site characteristics at each truck parking area. Agency preferences for equipment they have experience with will also be an important consideration. The Detection Technology Evaluation Technical Memorandum prepared for the I-10 Corridor Coalition in June 2020 provides technical details and evaluations of many different data collection methods considered for the project.

To allow system operators to monitor system accuracy, a surveillance camera or cameras are needed. They must be installed so views of the entire truck parking area are provided to allow the number of available parking spaces to be remotely counted. A pan-tilt-zoom (PTZ) camera is the most likely option. The manual count by an operator is compared to the system reported number of availability parking spaces. If the system availability if not correct, the availability number must be reset to match the manual observation. The required magnitude of change is used to assess how often the system needs to be checked and reset. It will also be used in the performance measures.

7.3 Data Aggregation and Processing

The method used for aggregating and processing parking availability data depends on whether or not a state wants to keep this function within the agency or privatize it. A state may choose to pay a contractor for this function, integrate this process into their Advanced Traffic Management System (ATMS), or use a hybrid approach that has a standalone application processing availability data.

Assigning the processing and aggregation of the truck parking data to a contractor may be the best solution for some states. In this case, a third-party is contracted to aggregate the collected data and provide resulting truck parking availability information. The data could then either be disseminated by the third-party, sent to the state ATMS for dissemination, or a combination of the two.

It is important that the agreement with the contractor specifies the required accuracy and timeliness of the data provided. The drawback to using a third-party data processor is that the state would not directly control the data or its accuracy. To address this consideration, periodic audits are required to ensure that accurate and timely data is being provided that meet contractual requirements. States should retain the ability to view, download, and display the data as part of their ATMS software with very minor changes.

A state may choose to process and aggregate the calculated truck parking availability data using their current ATMS software. Updating and expanding the functions of ATMS software may be a complex and costly process. However, with this option the state would own the data and be able to ensure its reliability.

A hybrid approach would implement a standalone application to process the sensor data from parking areas to estimate the number of available parking spaces. This application would then pass the parking availability information to the state ATMS for display on the roadside signs and distribution through a webservice. The state ATMS would also be used to control and view the parking site camera video for resetting or monitoring the system operation.

7.4 Information Dissemination

There are several ways to present the aggregated truck parking availability data to the public, and any or all options may work in tandem. One report concluded that truck drivers preferred to receive truck parking information around 20 miles before the exits for which the information is given (University of Minnesota, 2015). Based on stakeholder input, the preferred location to begin receiving availability information for commercial drivers is between 30 minutes and one hour in advance of the parking location. This translates to approximately 35 to 70 miles in advance of the parking facility assuming speed limits are 70 mph along the I-10 corridor. Drivers also expressed an interest in receiving availability information five miles from a site in order to have time to weigh their options and make a final decision on where to stop. The farther upstream the last sign, the more time there is for the parking availability to change before the driver arrives.

Roadside Signs

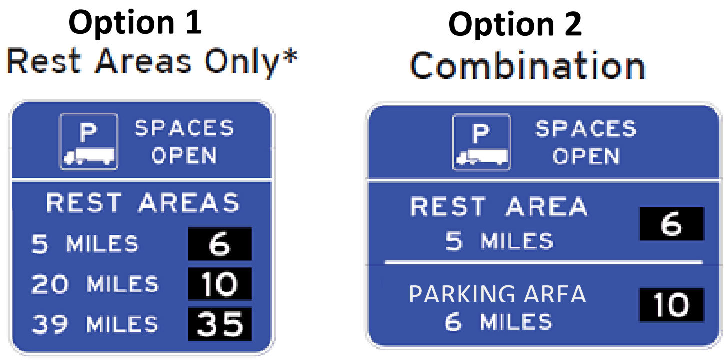
Roadside signage can disseminate truck parking availability information on two platforms: 1) DPAS, and 2) existing or new full matrix dynamic message signs (DMS).

Dynamic Parking Availability Signs

A DPAS, such as the ones shown in **Figure 5**, displays both static and dynamic text. The static message component indicates the upcoming rest areas and how many miles downstream they are along the corridor. Guidance provided by FHWA's Manual on Uniform Traffic Control Devices (MUTCD) group during the MAASTO TPIMS project in 2016 allows for up to three truck parking rest areas to be shown on one DPAS as long as all sites listed are rest areas. This helps provide parking availability information for the closest available lot, as well as lots 60 to 120 miles in advance. The dynamic message component provides the near real-time number of available parking spaces at each location. Note, MUTCD published a notice of proposed amendments in December 2020. Section 2I.15 of the proposed amendments addresses signing for TPAS. The proposed amendment was published after the I-10 Coalition states developed the I-10 DPAS concepts based on the MAASTO standard and stakeholder input in August 2020. The DPAS figures shown on the following pages are not consistent with all of the proposed MUTCD amendments. The Coalition states have developed and will submit responses to the proposed amendments based on the recommendations outlined in following section.

Currently, all TPAS facilities on the I-10 corridor are signed as rest areas and therefore signage will reflect what is shown in Sign Option 1 (See **Figure 5**). If a truck parking area that is not signed as a rest area is added to the TPAS project, a decision must be made on how to label the site on a DPAS. The first option would be to keep the name of the site and use Sign Option 2 (See **Figure 5**). This would limit the amount of data that could be displayed compared to Sign Option 1. It would also be inconsistent with other signs on the TPAS system. The second option would be to modify the advanced static signing for a specific site to primarily describe the facility as a rest area and secondarily describe it as a welcome center or travel info center. The TPAS Sign Memo that was written for the I-10 Corridor Coalition in September 2020 provides detailed information about signing considerations for the corridor.

Figure 5 is located on the next page.



* If all the parking areas are the same type (e.g., Rest Area), three parking destinations can be shown.

Figure 5: Dynamic Parking Availability Signs

Because of the time lag between viewing a sign and reaching a facility, as well as limits to the count accuracy, when the count of available spaces falls below an established boundary, the word "LOW" can be displayed instead of a precise number.

Multiple surveys and studies have concluded that DPAS are the most preferred method of truck parking information dissemination for truck drivers. As the MUTCD illustrates, creating a uniform sign type for use throughout the I-10 region is a form of branding and can increase visibility and awareness of TPAS, making it familiar to drivers throughout the region.

Infrastructure requirements for dynamic panel signs include a source of power and communications. The sign can be incorporated into existing ATMS system to allow for integrated operations with other ITS assets.

Existing/New Dynamic Message Signs

The Coalition states discussed an option of using existing or new full matrix dynamic message signs instead of hybrid static and dynamic signs discussed above. The potential benefit of this approach would be the ability to use the signs for other messaging. The Coalition states decided this potential benefit was actually a negative from the TPAS standpoint. The signs deployed as part of the TPAS must remain fully dedicated to providing truck parking availability messages at all times. All four states are planning on using hybrid static and dynamic signs throughout the initial launch of TPAS.

Web-Based Platforms

Web-based platforms, such as traveler information websites or smartphone applications, enable drivers and dispatchers to make informed route planning decisions at the beginning of their trip as well as en route.

Traveler information websites, such as those funded by the 511 programs and smartphone applications, are relatively low-cost ways to disseminate truck parking information. The cost to create and maintain a website and/or application is marginal compared to that of roadside signs, as is the cost to expand the website or application with the addition of new truck parking areas.

Web-based platforms can provide extensive detail about the amenities available at each parking area, such as restrooms, vending machines, Wi-Fi, etc. Websites have the additional ability to display the real-time truck parking cameras' images.

A pitfall to web-based applications is that this information can only be accessed by dispatchers, drivers with Wi-Fi or data plans and cellular service along the corridor, and vehicles with integrated in-cab systems. In order to ensure safe operations, mobile applications will need to be FMCSA "one-touch" compliant by relying on hands-free voice interactive commands. A smartphone application may sense a vehicle's roadway heading and GPS location to present parking availability information to drivers for facilities in proximity to the vehicle's position and travel path, whereas a website shows all of the available truck parking locations in its database.

An on-site survey conducted for the MDOT parking project in 2015 revealed that, even though a smartphone truck parking application had been available since December 2014, few drivers were aware of the application. Some drivers also confused the truck parking smartphone application with commercial truck stop applications. The commercial truck stop applications provided amenity information, but rarely provided truck parking availability information. Figure 6 shows a screenshot of a Traveler Information Website, and Figure 7 shows an example of a truck parking information smartphone application.

Figure 6 is located on the next page

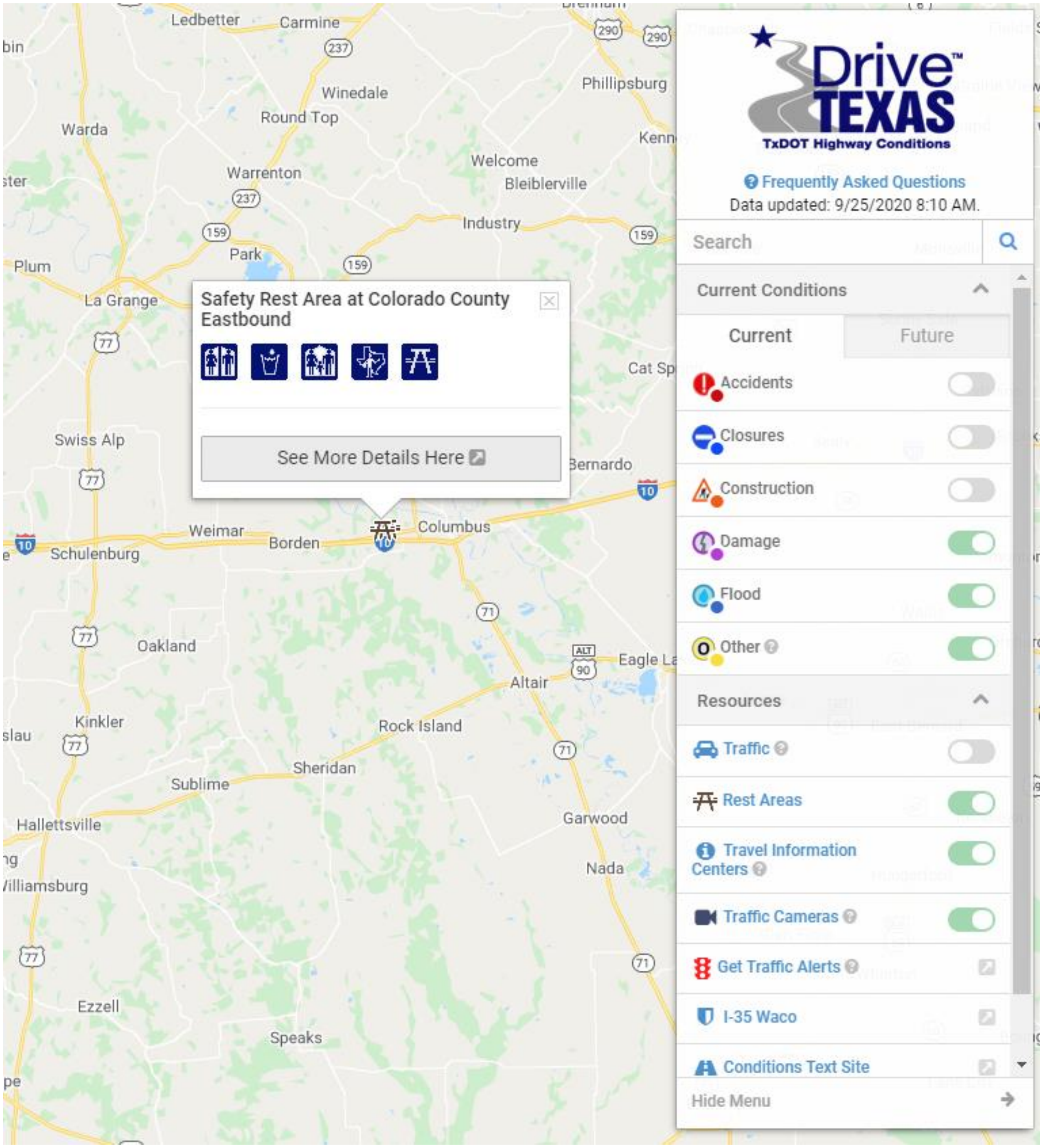


Figure 6: Texas's Traveler Information Website

Source: [DriveTexas™]()

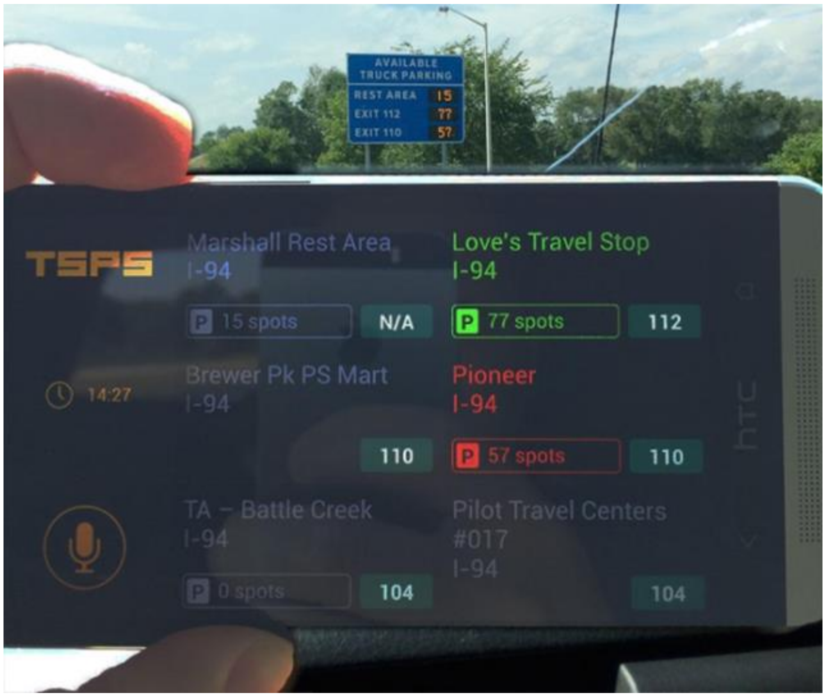


Figure 7: Smartphone Application

Source: Truck Smart Parking Services

Two options were explored for the I-10 Corridor Coalition TPAS team to choose from regarding web-based truck parking availability information dissemination.

Public

Under the public option, truck parking availability data is disseminated via an I-10 Corridor Coalition-funded website and/or Smartphone application. A public data feed is also provided, which will allow private third-parties to provide truck parking availability information on their websites, smartphone applications, and imbedded in-cab systems. With this method, the I-10 Corridor Coalition controls how information is displayed on the official site and application, including the look and the refresh rate. Maintaining, operating, and upgrading an I-10 Corridor Coalition-operated website and/or Smartphone application will require the states to develop a multi-agency funding mechanism to continue operation once grant funding is expended.

Private

With the private option, private third-parties would obtain truck parking availability data from the I-10 Corridor Coalition and provide truck parking availability information on websites, smartphone applications, and embedded in-cab systems. With this option, there is no I-10 Corridor Coalition-developed website or smartphone application. This results in lower development, operational, and upgrade costs than the public option, but it also relies on third-party vendors to disseminate the data. Since private industry is already showing interest in the truck parking availability data, this is considered a growing market sector that can disseminate the information successfully. As a result of a third-party service provider's focus on providing real-time traveler information and the competitive environment they operate in, they can more efficiently and proactively upgrade and enhance the web-based dissemination tools. This is also a simpler option for the I-10 Corridor Coalition and would make it easier to expand the system to other states in the future. With this method, each private developer could be required to enter into a data agreement with each DOT.

Within the private option, two approaches to sharing the truck parking availability data with private third-parties were considered. One approach included development of a central clearinghouse where data from all states is consolidated for distribution to private third parties. This approach provides one location to access the data for all states and the clearinghouse can also act as a data archive. The second approach has private third parties obtain data from individual states using a consistent data feed format. Based on discussions with potential private third-parties, it was determined that accessing the data from each state was not a concern as long as a consistent data feed is provided by each state.

If the central clearinghouse is not operational, data feeds from all states are lost. Operating and maintaining the central clearinghouse is an operational cost that must be funded by each state with non-grant money. The clearinghouse must remain operational for the system to operate, so any reduction in funding can jeopardize the systems operation. A state archive database that stores TPAS data can use grant funds because its primary purpose is archiving data for grant required performance measures.

The I-10 Corridor Coalition decided that each state will house their own individual data for distribution to third-parties. Each state will also be responsible for collecting and storing TPAS information required for performance measures in their own state archive database. An I-10 Corridor Coalition-funded website and/or Smartphone application will not be developed.

Additional Dissemination Methods

There are many ways in which truck parking data may be disseminated. While some of these methods have been researched and documented in detail, other methods include, but are not limited to:

In-Cab Systems

Many trucking companies equip their fleet vehicles with in-cab systems. These systems may provide applications for navigation, tracking HOS, providing fuel optimization and low-bridge information, etc. Manufacturers of in-cab systems may elect to use data from an online data feed to disseminate data via the in-cab systems.

GPS Systems

In a manner similar to in-cab systems, GPS manufacturers may elect to use data from an online data feed to disseminate data via on-board or aftermarket GPS systems.

Highway Advisory Radio

Highway Advisory Radio, also known as Travelers' Information Stations, exist for the purpose of disseminating highway information to travelers via radio. A governmental entity may elect to operate a Highway Advisory Radio Station for the purpose of providing truck parking information. Restrictions on

Highway Advisory Radio Stations may prohibit the dissemination of truck parking information at private truck stops.

Citizen's Band Radio

Individual truck drivers may communicate the availability of truck parking via Citizen's Band (CB) radio. This method would bypass the data collection infrastructure, as a driver who is currently parked at a rest area or truck stop may provide parking availability information at their location to drivers looking for parking.

Other Radio Options

Satellite radio services and some local radio stations may incorporate truck parking data into their existing traveler information segments.

Call-in Phone Systems

Using Interactive Voice Recognition (IVR) technology, call-in phone systems may be developed in order to help a commercial truck driver find parking along their route. A driver who is looking for information would verbally call the IVR system and follow the voice prompts to get the desired truck parking information in a hands-free environment.

Traveler Information Kiosks

Existing traveler information kiosks at truck stops and rest areas may be adapted to display truck parking information provided by the TPAS.

7.5 Cybersecurity

To address cybersecurity for the I-10 TPAS, each state will comply with their standard network security protocols and practices used for their existing ITS implementations. The intent of these existing protocols is to ensure the proactive protection of digital information, the network, and system equipment. The cybersecurity risk profile of the I-10 TPAS is comparable to other existing ITS components, so special protocols and practices beyond the existing standard should not be necessary.

7.6 Architecture

National ITS Architecture

The TPAS system needs and functions are mapped to the following national ITS architecture service packages:

- CVO05 – Commercial Vehicle Parking
- DM01 – ITS Data Warehouse
- DM02 – Performance Monitoring
- MC05 – Roadway Maintenance and Construction

More details on the national ITS architecture service packages are documented in the I-10 TPAS Project ITS Architecture document.

System Architecture

The proposed architecture for TPAS includes the flexibility to allow each state to run their own system while common standards provide interoperability across state lines. This will allow for seamless integration while setting standards for future truck parking efforts nationwide. The technology deployed at parking facilities and roadside signs will integrate with each state's existing ITS network and software platform. Each I-10 Corridor Coalition state is responsible for archiving their own state data for use in developing performance measures for their system. For state-specific details, see the state appendices. As shown in Figure 8, each state will host a webservice to share availability data with other states and third-party application developers. The webservice will use a common JSON based format. I-10 Corridor Coalition states will be required to share their data feed with each other for seamless dissemination of truck parking data on DPASs that display parking availability for out of state sites.

Figure 8 is located on the next page.

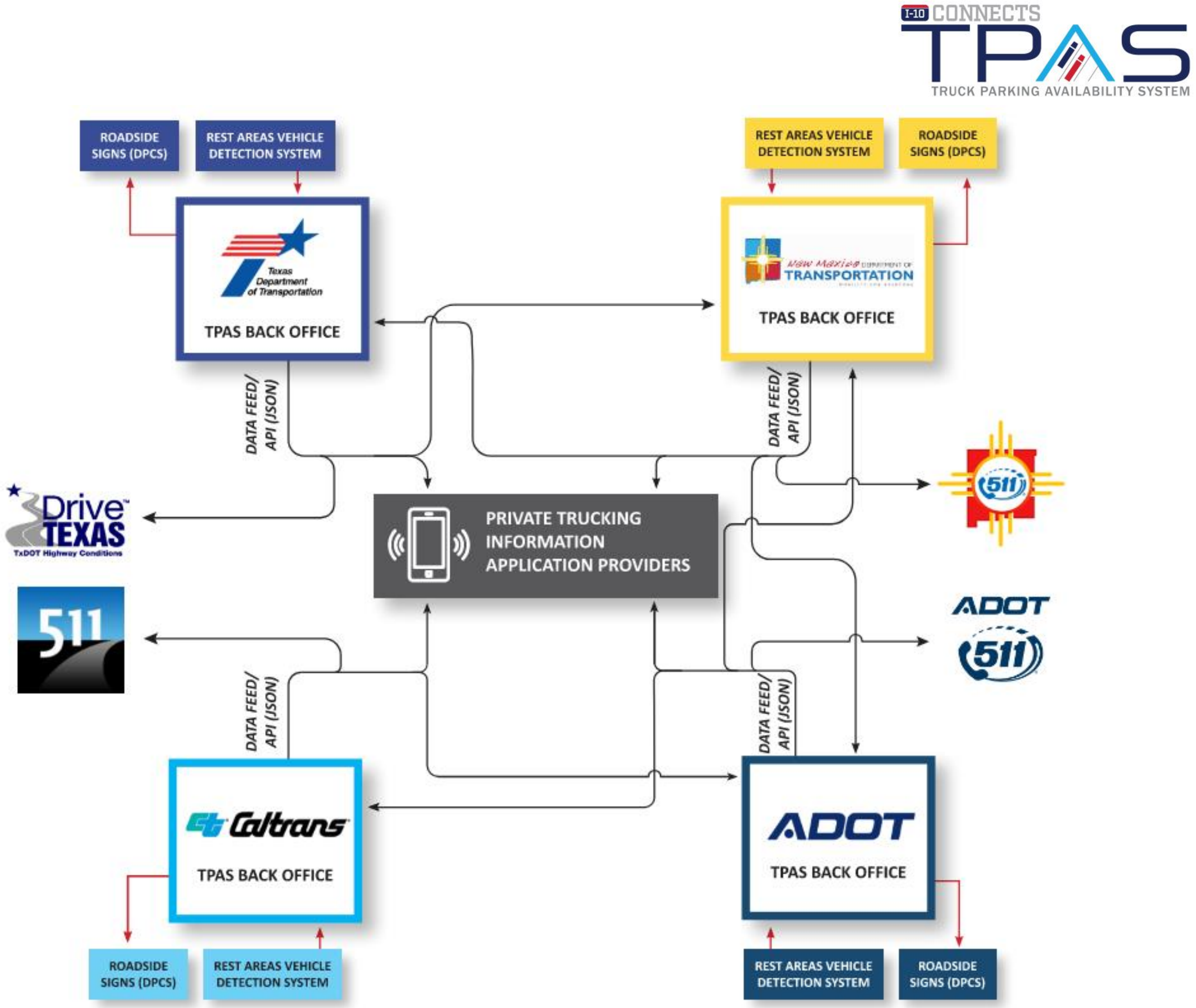


Figure 8: Regional TPAS Architecture

7.7 Core Functions Matrix

Each state in the I-10 Corridor Coalition TPAS was able to format the project to best fit their state's needs and requirements. **Table 7** shows each state's initial decisions regarding procurement process, data collection method, data collection technology, data analytics and sharing, and information dissemination. This table was created to illustrate the commonalities and differences between state decisions early on in the project for the sake of guiding final decisions. State decisions are subject to change.

Table 7 is located on the next page.

Table 7: Core Functions Matrix

Functions	Type	Arizona	California	New Mexico	Texas
Procurement	Public Sites	DBB	DBB	DBB	DBB
Data Collection Method	Public	Space Occupancy	Entry/Exit Count	Space Occupancy	Entry/Exit Classification and Space Occupancy
Data Collection Technology	Public	TBD	TBD	TBD	TBD
Operations & Maintenance	Public	Internal	Internal	TBD	Internal
	Sign Operations	Internal	Internal	Internal	Internal
Data Processing & Sharing	Processing	Internal	Internal	Internal	Internal
	Software	Standalone TPAS	Standalone TPAS or ActiveITS ATMS Upgrade	Standalone TPAS	Modified ATMS
Information Dissemination	Signs	DPAS	DPAS	DPAS	DPAS
	Website	State and Third Party	State and Third Party	State and Third Party	State and Third Party
	Mobile Website/ Mobile App	State and Third Party	State and Third Party	State and Third Party	State and Third Party
	Performance Management	State	State	State	State

Procurement

Each state was able to choose their preferred procurement type. California, Arizona, New Mexico and Texas are all doing a traditional Design-Bid-Build (DBB) process for system deployment.

Data Collection Method

States were able to choose between entrance and exit driveway counts and space occupancy detection as their primary data collection method. This method may change at specific rest areas in the event of special circumstances, as selected sites are investigated for monitoring equipment placement and configuration. California and Texas are planning to count trucks entering and existing the truck parking areas to help understand total site demand and reduce maintenance costs. Arizona and New Mexico are planning to deploy a space occupancy detection approach to save on operations costs.

Data Collection Technology

Each state provided feedback regarding their preferred data collection technology, which may be different at specific sites, depending on truck parking lot configuration and functional requirements. While this ConOps discussed seven different data collection technologies, states are able to choose any data collection technology which suits their needs and budget. All states are still in the process of determining the technology they will use.

Operations and Maintenance

Each state determined who would operate and maintain infrastructure at public sites and sign locations. All states will be operating and maintaining their signs using existing ATMS. California, Arizona, New Mexico and Texas will all operate and maintain the technology at the sites internally. See **Section 8** for more operation and maintenance details.

Data Processing and Sharing

Processing

California, Arizona, New Mexico, and Texas will handle the processing of all sensor data collected by the TPAS in-house. Data will be shared between states using the webservice data feed.

Software

Arizona and New Mexico will handle the processing of all data collected by the TPAS using a standalone TPAS software. Texas will process sensor data using a new TPAS module within their ATMS software. California will use standalone TPAS software unless the Caltrans District 8 ATMS is upgraded to ActiveITS. If the ActiveITS ATMS is implemented, the ActiveITS TPAS module developed for the SunGuide system in Florida will be used. It is still to be determined how Caltrans will process the data.

Data Dissemination

Signs

Each state plans to use the hybrid static/dynamic DPASs. Per the grant application, roadside signs have been identified as a primary method of truck parking availability dissemination. Sign locations and legends will be coordinated with the federal and state-specific MUTCD committees during the final design phase within each state. If the sign legend is different from what was used on the MAASTO TPIMS project, the states may need to seek approval from their FHWA division offices.

Website and Applications

Third parties will disseminate the truck parking availability information to the public. As a result of third-party service provider's focus on providing real-time traveler information and the competitive environment they operate in, they can more efficiently and proactively upgrade and enhance the web-based dissemination tools. The I-10 Corridor Coalition has agreed to provide a data feed using consistent data fields and formatting for each state. Each state will also integrate the truck parking availability information into their travel information websites.

7.8 Locations

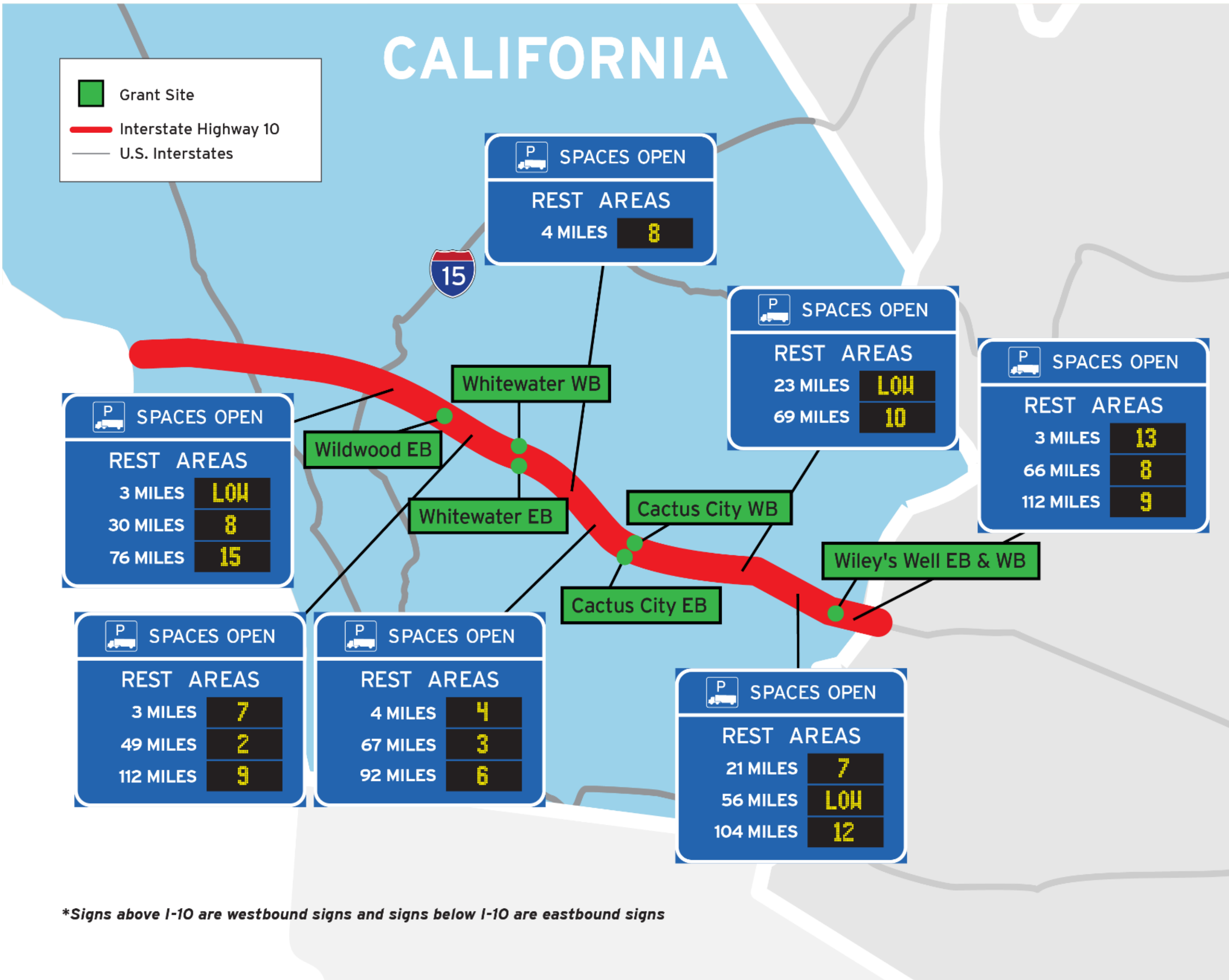


Figure 9 through Figure 13 show the site and sign locations on I-10 for the TPAS project. Note that the potential site list is not finalized. Sites may be added or removed depending on budget and other considerations. These sites were chosen by each state to meet their needs. All states will operate TPAS at public rest areas on their corridors. These facilities were selected for the following reasons:

- They carry high volumes of commercial vehicles, many of which are destined for large cities such as Los Angeles, Phoenix, Tucson, El Paso, San Antonio, and Houston, among others. Commercial traffic uses the truck parking facilities along these corridors as staging and resting areas prior to delivering their loads to their destinations.
- State law enforcement agencies report that public rest areas and private truck parking facilities along these segments experience overcrowding that spills over onto rest area and interchange

ramp shoulders, creating safety and operational concerns. Enforcement of unauthorized parking is a growing challenge as a result of increasing demand for truck parking.

Figure 9 is located on the next page.

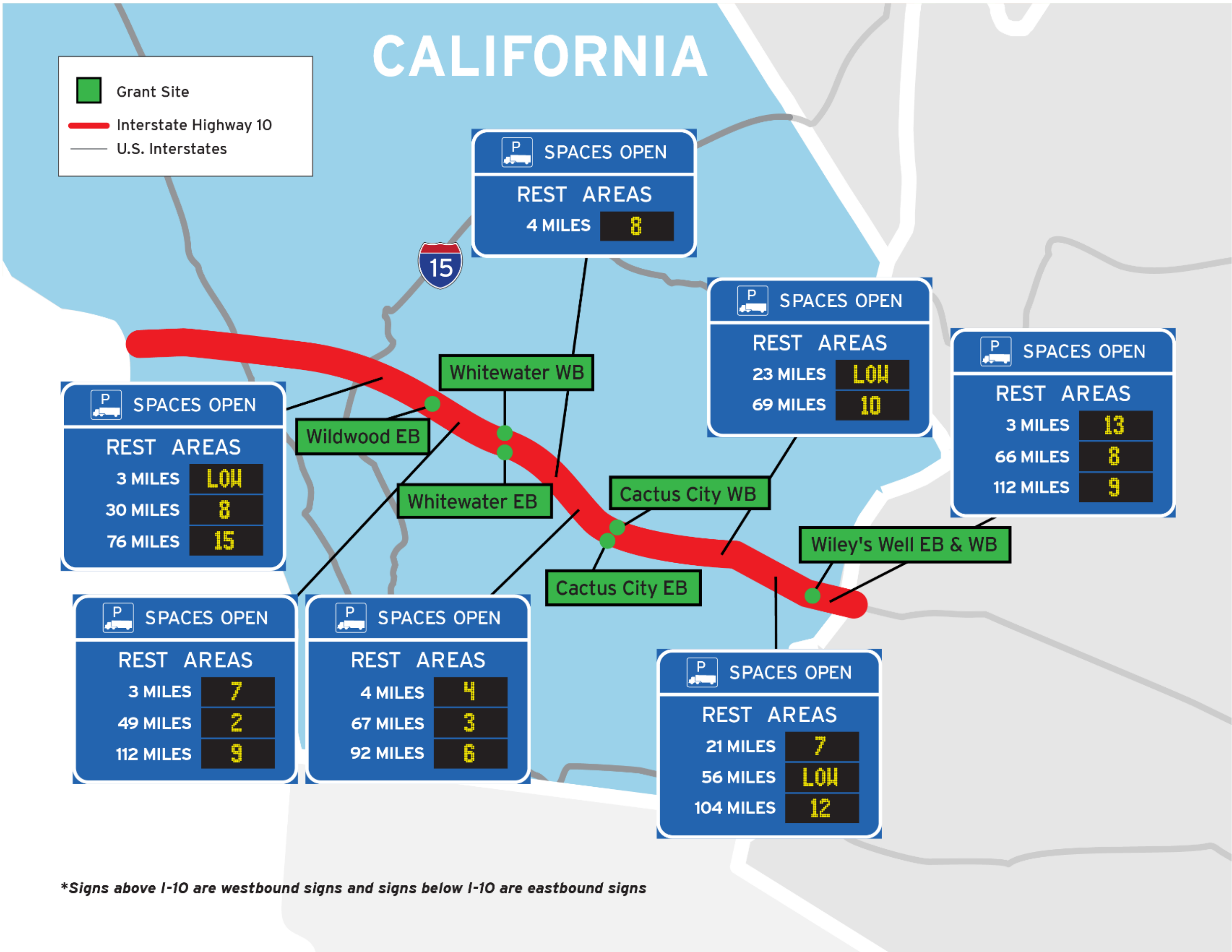


Figure 9: TPAS Proposed Sites and Sign Locations – California

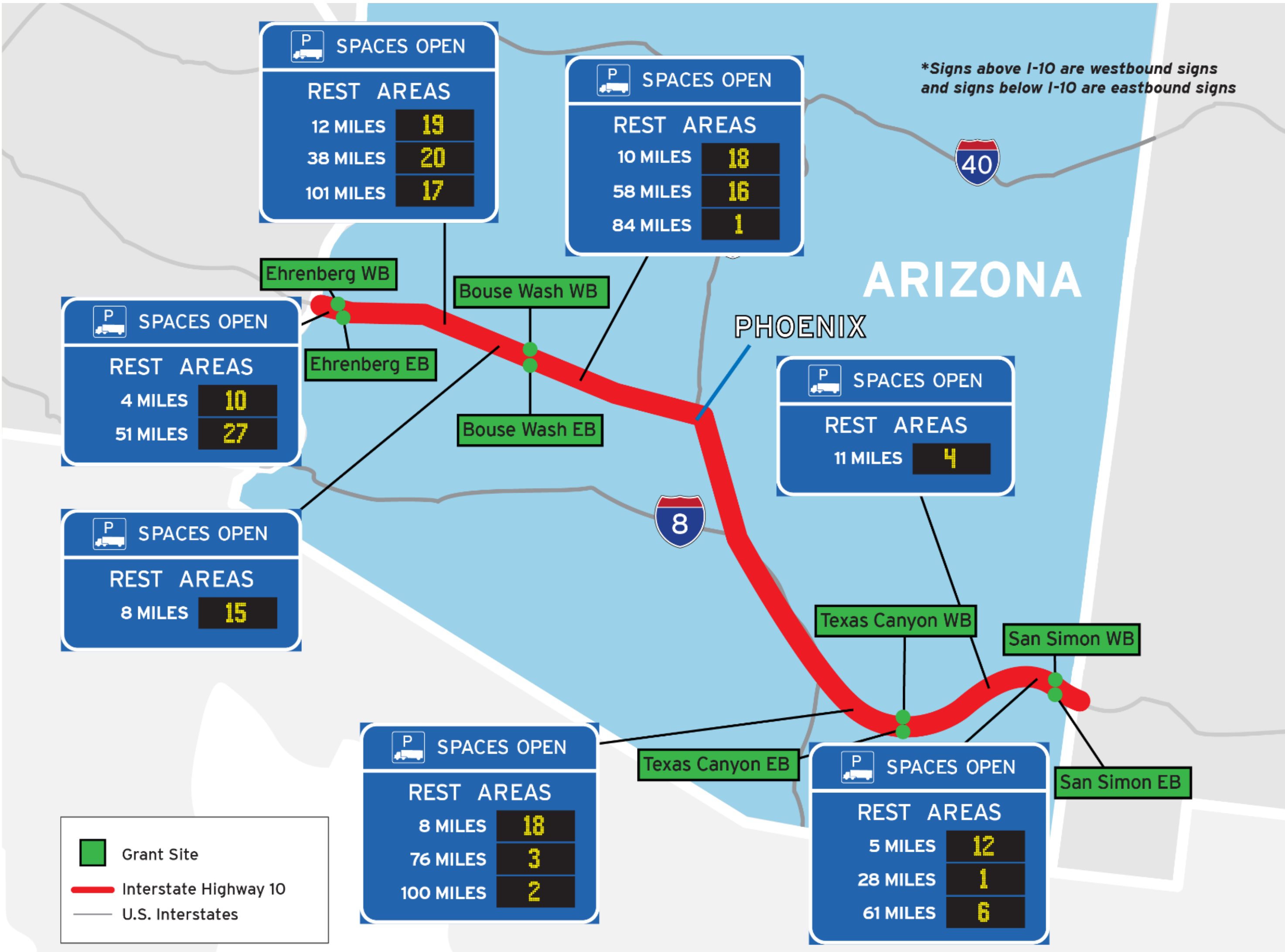


Figure 10: TPAS Proposed Sites and Sign Locations - Arizona

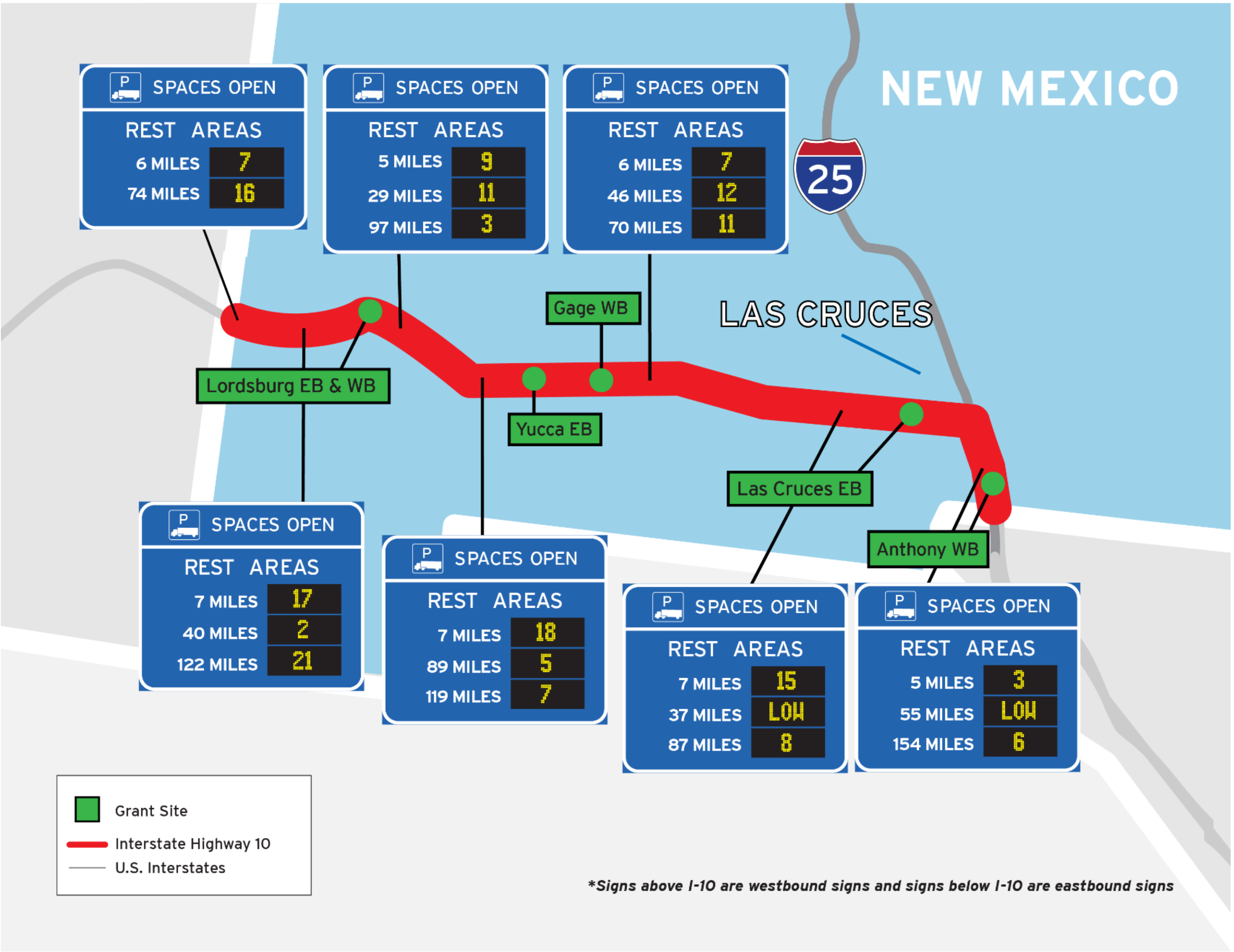


Figure 11: TPAS Proposed Sites and Sign Locations - New Mexico

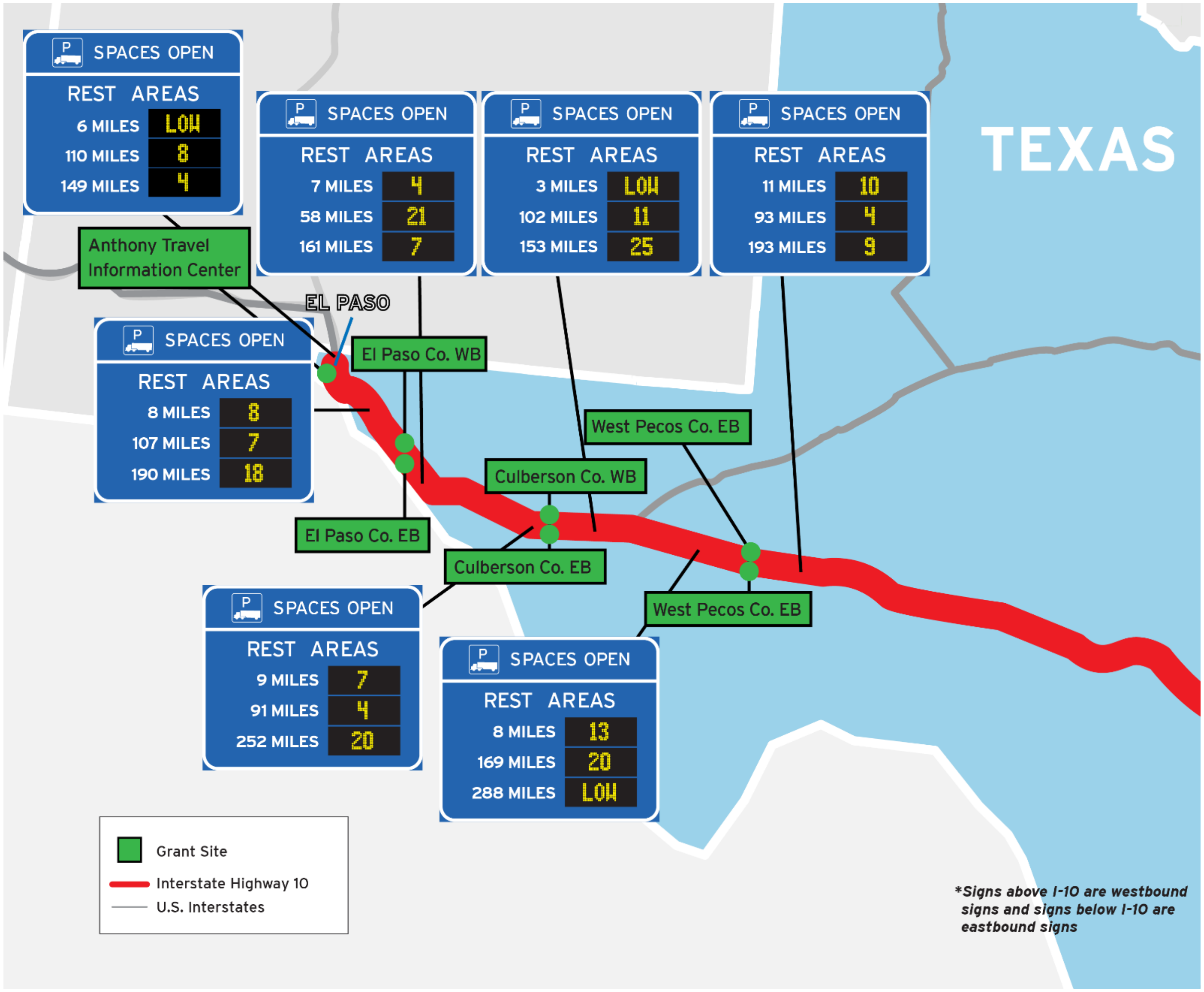


Figure 12: TPAS Proposed Sites and Sign Locations - Texas (West)

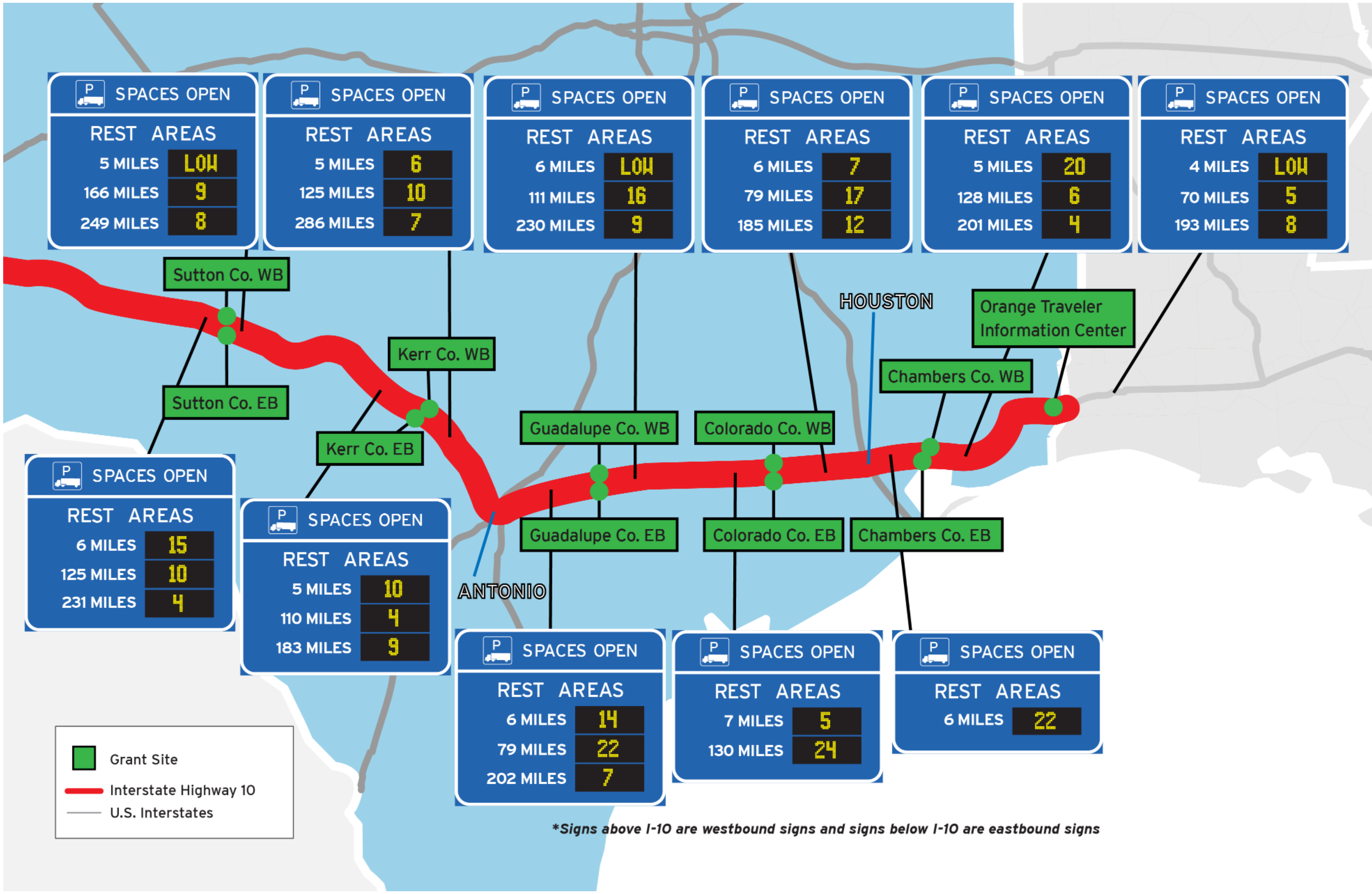


Figure 13: TPAS Proposed Sites and Sign Locations - Texas (East)

8.0 Operation & Maintenance Elements

This section of the ConOps documents the operation and maintenance commitments which will be necessary to maintain the system. TxDOT will lead the coordination and collaboration between the states during the operations and maintenance of the I-10 TPAS for the grant period. In relation to this longer-term deployment strategy, there are two key operations and maintenance factors:

1. This project will result in the development of a long-term deployment and systems maintenance approach by the state DOT stakeholders; and
2. The anticipated lifespan of the I-10 Corridor Coalition TPAS technology (hardware and software) elements is estimated to be between 5 and 10 years, depending on the equipment.

Each state's appendix includes a table titled "Deployment, Operations and Maintenance Responsibilities" which identifies the different system elements along with which entity will be responsible for their operation and maintenance. **Table 8** lists the project operation and maintenance elements that are discussed in each state's appendix.

Table 8: Project Operation and Maintenance Elements

Project Element	
ATMS Server	DPAS
ATMS Software	Traveler Information Web Site
Rest Area Communication Equipment	Truck Parking Availability Processing Server
Head-End/Management Center Communication Equipment	Truck Parking Availability Processing Software
Rest Area Parking Availability Monitoring System	CCTV Cameras at Rest Areas
Rest Area Parking Availability and Services Data	

8.1 Site Operational Requirements

Once the system goes live, each state will operate the TPAS system. TxDOT will lead the coordination and collaboration between the states to discuss and agree on site operational requirements for the I-10 TPAS in conformance with the System Requirements. The following processes will be followed to ensure the system is operating as intended:

- The state and/or its contractor shall monitor the parking availability information and check each site for accuracy to ensure that the truck parking availability data is meeting the minimum requirements for accuracy.
- If parking availability is found to not be accurate, the availability will be manually reset to the correct availability number.
- Each state and/or its contractor will collect and log site data as part of the standard accuracy monitoring process for each parking site. This data will be used for performance metrics analysis.

- Each state and/or its contractor shall perform their standard accuracy monitoring process and input the results into the system at least once per week. This occurs when a manual reset is performed. Even if the number of available spaces is correct, a manual record must be input to document the accuracy of that system for use in performance measures.
- Each state or its contactor shall continuously monitor site uptime and equipment availability.

8.2 Maintenance Guidance

TxDOT will lead the coordination and collaboration between the states to discuss and agree on maintenance procedures for the I-10 TPAS in conformance with the System Requirements. Each state or its contractor is required to maintain TPAS for a minimum of three years after Go-Live. Below are the suggested maintenance guidelines for the system. Each state has flexibility to maintain their system under their typical state or FHWA division guidelines and requirements.

- Monitor system daily in order to identify malfunctions.
- Provide data continuously with allowances made for agreed upon maximum scheduled total system downtime for maintenance per year, during off hours for system users.
- Provide on-site or remote service interruption analysis at those sites identified as malfunctioning, dependent on the necessary action to remedy malfunction.
- Replace or repair non-functioning equipment. Respond on-site to service non-functioning equipment within the agreed upon response time.
- Develop a preventative maintenance plan. The preventative maintenance plan must be comprehensive and address all items in sufficient detail, including time durations.
- Perform preventive maintenance on all equipment, coinciding with on-site hardware maintenance when possible.

9.0 Operational Scenarios

This section presents ten operational scenarios that describe real-world situations that the TPAS program would be expected to encounter. Each operational scenario describes the users involved, the issues that are intended to be addressed, and the outcomes or benefits the users are expected to experience through the deployment of the strategy. The following operational scenarios, which are presented in detail in this section, do not address all of the desired TPAS improvements, nor do they represent a comprehensive set of use cases, but rather demonstrate some of the key situations that this system could help serve and improve:

1) TPAS Goes Offline and is Restored
2) TPAS Issue Across State Lines
3) Use of TPAS Data to Support Planning Applications
4) Routine Procedure for Operator to Reset TPAS
5) Fatigued Driver Needs Parking Soon Due to Route Disruption
6) Truck Driver Makes Strategic Selection among Multiple Truck Parking Options
7) Truck Driver Needs New Parking Option when Preferred Lot is Full
8) Temporary Closure of Truck Parking Area

9) Severe Weather Highway Closures Trigger Parking Need
10) Law Enforcement Officer Helps Prevent Unsafe Parking

These scenarios were developed and reviewed with the I-10 Corridor Coalition members during two webinars held on May 26, 2020 and June 8, 2020. I-10 Corridor Coalition members were presented with a general outline for the purpose and need of each operational scenario. Members were subsequently asked to respond on whether a given scenario was a priority concern and to identify any additional considerations to be included in the scenario. Scenarios are presented in the order that they were ranked by the I-10 Corridor Coalition members.

Note that some of these scenarios use real-world locations and agencies with basic assumptions made about how the system is deployed, operated, and maintained, but the main intent of these operational scenarios is to help readers envision how the system could operate in such a situation.

9.1 Scenario 1: TPAS Goes Offline and is Restored

On a Monday afternoon in November, a network communication failure unexpectedly occurs in the state DOT's IT system. The failure propagates quickly and causes system failures for many state-run systems, including the state Department of Transportation's ITS program and its I-10 TPAS. Other I-10 Corridor Coalition member states are not affected by the IT issue. State traffic managers and operators are quickly overwhelmed with efforts to manage the system with limited equipment, and the situation becomes an "all hands-on deck" situation to restore services and continue managing the state transportation system.

The I-10 TPAS program, fortunately, was designed with careful consideration for network issues. Each subsystem was designed to work collaboratively with other subsystems, but also operate to some capacity in isolation in the event of communication failures or IT issues like the one occurring at that moment. At each of the TPAS parking lots, sensor equipment continues to collect parking availability data and report it to local processors. Depending on the final architecture, parking availability data may be stored locally on the device or it may attempt to broadcast snapshots to the central system. With the central system being offline, the local processors receive notification of a communication issue, but continue to collect parking availability data, store data (if applicable), and attempt to transmit data as regularly scheduled.

On the DPAS installed along the I-10 corridor within the state, the local sign matrix controllers do not receive any data from the central system but continue to post the most recent parking availability data that they have received. The sign controllers have previously been programmed to switch to a "default" message after a specified duration of time of receiving no data from the central system, similar to how the larger DMS in the state change to a "blank out" message during communication outages. In this case, system designers have programmed the DPAS to switch to the default message of "XX" after not receiving any new data for 15 consecutive minutes. After 15 minutes, the DPAS change their messages to "XX" as designed, and motorists see the sign as nonoperational as opposed to issuing incorrect information.

Throughout the outage, the central system continues to log any available data that is received regarding parking availability for historical recordkeeping. Since the IT outage has prevented any parking availability data from being received, the central system receives no new updates to the data. Similar to the DPAS, designers had programmed the central system to recognize when data was “stale”, such as if no new data had been received in 15 consecutive minutes. Knowing that the data is stale, the central system logs in the record that the system was offline during this interval. Additionally, if it has abilities to communicate with other services—primarily the Advanced Traveler Information System (ATIS) in the state, the ATIS in other states, or the I-10 Corridor Coalition’s program—the central system would report that the data is considered stale so that those systems would not report erroneous data. Similarly, if the central system is unable to communicate, integrators for those other systems would utilize their own protocols for determining when to mark data as “unavailable” due to receiving no fresh updates. The data archiving system will include the reported “stale” data so that downtime can be calculated for performance measures.

After many grueling hours, the IT network is restored, and all services come back online. The TPAS program automatically restores itself upon restoration of the communications network. Data collection subsystems at the parking lots immediately report their latest parking count information to the central system and also upload any data records that have been stored locally to the centralized database. Depending on system configuration, TPAS operators may receive a notification alert from the system to request an operator’s confirmation that the system’s counts are correct with the current situation in the lots, which is issued every 24 hours anyway to help ensure accuracies. TPAS operators check the CCTV cameras and report the number of open parking stalls in each lot into the central system. With confirmed counts, the central system pushes updated parking counts to the remote DPAS assets, which immediately recognize the new data and replace the default “XX” message with the updated parking availability. Similarly, the ATIS services that subscribe to the TPAS program would receive updated counts and report those numbers through their services.

The TPAS program has been returned to full operation and routine operations are resumed.

This scenario is also applicable in architectures where the TPAS central system is operated on a regional basis by the I-10 Corridor Coalition, but the local DOT or the I-10 Corridor Coalition systems experience an IT outage.

9.2 Scenario 2: TPAS Issue Across State Lines

Sam is a Caltrans traffic manager who is part of its real-time traffic management program, including the TPAS deployment installed along I-10 as part of the I-10 Corridor Coalition. Being part of the multi-state TPAS program, Sam coordinates a lot with his counterparts at ADOT to make sure that the program functions properly across state lines.

Today, he receives a citizen complaint that one of the Caltrans-owned DPAS assets on eastbound I-10 near the Arizona border is showing a blank message. On a normal day, this DPAS would report real-time parking availability for several truck parking lots in Arizona. In order to diagnose the issue, Sam conducts a checklist of activities. He first sends a data request ping to the DPAS's field controller, at which he receives a ping response that confirms some of the cabinet equipment is still online. He checks the I-10 Corridor Coalition interstate data feed to see if data is still being reported by ADOT, which he finds to be still available. Just to be sure, he calls his counterpart over at ADOT and requests that they check their system. His ADOT counterpart confirms that, in fact, the ADOT TPAS program is still fully online and functional. ADOT needs to take no action, as the TPAS data feed is operating as it should.

Sam dispatches a Caltrans maintenance team to check the DPAS in the field. The maintenance team determines that—despite the local network switches being online to return a ping request—the sign controllers have malfunctioned and need to be reset. Upon resetting the sign controllers, they are reconnected to the TPAS program, receive the latest data feed from ADOT, and immediately post the parking availability. The maintenance team logs the issue for further action, but the sign returns to full functionality without additional effort.

Sam is able to return to his other duties. The TPAS program has been returned to full operation and routine operations are resumed. Sam is further affirmed that good processes are in place to support a multi-state operation of this program.

9.3 Scenario 3: Use of TPAS Data to Support Planning Applications

Three years after the rollout of the I-10 Corridor Coalition TPAS project, the TPAS program across the four states has been operating with great success. During this time, TxDOT has continued exploring opportunities to improve freight operations in its state. One item that is being discussed is expanding the truck parking capacity at five major safety rest areas. One of the candidate sites is the Colorado County Safety Rest Area, located outside of Houston. TxDOT has received a lot of feedback from freight stakeholders about the lack of adequate truck parking there, but it is unclear if the Colorado County Safety Rest Area is truly over-utilized compared to many other candidate sites. TxDOT planners and engineers wish to conduct an evaluation of current truck parking use, but funding dictates that only a portion of the system can be studied.

Fortunately, the Colorado County Safety Rest Area and a few other candidate sites were part of the I-10 TPAS project, and thus have a very comprehensive data record of historical use. The Colorado County Safety Rest Area in particular was instrumented with sensors that monitor each individual parking space for occupancy (i.e. space occupancy detection method), as opposed to the entrance and /exit counting method that assesses how many trucks have entered or left the parking lot. This data not only tells TxDOT whether a parking space is or was available (historically), but also how long the space was occupied between available periods.

TxDOT planners and engineers are able to generate a quick report on parking utilization at that lot. They learn that, over a three-year period, 50 percent of the truck parking stalls at the Colorado County Safety Rest Area were in use throughout the day, and the vast majority of the overnight hours saw over 95 percent use. Trucks that stopped at the Colorado County Safety Rest Area occupied their specific stall for an average time of 12 hours, although stalls closer to the rest room facilities saw occupancy times that exceeded 14 hours over 80 percent of the time. TxDOT learned through data visualization that truckers parking location preferences changed based on which stalls were available, with some trucker groups preferring to park away from the bathrooms to get a more peaceful rest. Additionally, TxDOT identified some unusual behaviors, such as recurrent parking activity far from the bathroom areas at odd times, which could indicate illegal activities and warrant implementation of more lighting and security cameras.

The Kerr County Safety Rest Area is also one of the other parking lots considered for potential expansion. This rest area was similarly instrumented with the I-10 TPAS program, but unlike the Colorado County Safety Rest Area, this lot deployed the entrance and exit counting method due to geometrics. Similar to the first case, TxDOT planners and engineers are able to retrieve historical data on parking availability in the lot, based on what the central system estimated based on counts in and out of the lot, as well as operators resetting the system on a daily basis. They learn that, over a three-year period, 20 percent of the truck parking stalls at the Kerr County Safety Rest Area were in use throughout the day, and the vast majority of the overnight hours saw more trucks parked in the lot than authorized striped spaces (i.e. many trucks entered the lot and parked along shoulders or in other unauthorized areas). However, unlike the Colorado County Safety Rest Area, TxDOT is not able to determine how long trucks were parked into the lot, which parking spaces were most frequently used, and how trucks elected to park in the lot (i.e. close to the restrooms, in the back of the lot) using the entrance and exit counting method at the Kerr County Safety Rest Area. Still, having some data allows TxDOT to assess parking lot utilization to determine if expansion is warranted.

TxDOT planners and engineers are able to quickly develop a business case for expanded parking and services at the Colorado County and Kerr County Safety Rest Areas without a need for a costly utilization study. With the depth of data, they are able to graphically illustrate the issues at the Colorado County Safety Rest Area to TxDOT administration in an easy-to-understand format. With this additional data on parking space utilization, duration of stay, and driver selection preferences regarding spaces near amenities or security features, TxDOT views the Colorado County Safety Rest Area as having a more clearly-defined issue with supporting data that can quickly prioritize it to the top of the list for funding.

This scenario shows the different data types that each count method can generate and is applicable to either count method. It also is applicable to any state that is looking to use data to justify parking utilization, regardless of state-specific prioritization or policies.

9.4 Scenario 4: Routine Procedure for Operator to Reset TPAS

As part of the I-10 Corridor Coalition project, NMDOT has equipped five trucking parking areas across New Mexico with TPAS. Due to the site design and pavement conditions, some of these sites were equipped with data collection devices that support the entrance/exit counting strategy. The entrance/exit counting strategy has a higher risk of “count drift” due to an entrance or an exit sensor miscounting a vehicle (i.e. double counts the vehicle or misses vehicle altogether). Since “count drift” is not self-correcting, there is a risk of parking availability not matching reality, which could cause driver frustration when pulling into a full lot that allegedly has reported availability. To overcome this issue, NMDOT implements a policy where a TPAS operator visually checks the parking availability through a CCTV camera at each parking lot twice each day to determine if the TPAS program is reporting the correct availability. TPAS operators usually conduct these checks during slow times throughout the day when there are no incidents or traffic issues to manage.

It is Wednesday, and John is the designated TPAS operator. The TPAS program's central system has been programmed to automatically remind the TPAS operator to check the system. At 9 AM, John receives the automated reminder. From his desk, he accesses a CCTV camera video feed at the respective TPAS parking lot and visually confirms that 20 parking stalls are unoccupied. He pulls up the TPAS software on his computer and enters "20" as the current availability. The central system logs John's count relative to the reported count for historical reporting. If the two counts match, no action is taken. If the two counts differ, the system notifies John of the reported difference and requests his confirmation. Upon confirmation, the system adopts John's count and continues normal operations.

One of NMDOT's parking lots utilizes the space occupancy detection strategy, which does not experience issues of "count drift". NMDOT policy also has the TPAS operator check the site to confirm that the availability is correct, mostly to determine if one count strategy was more accurate than the other. John receives the same notification to check the parking lot as he did for the other. He goes through the same procedure to check the parking availability via the CCTV camera at the lot and enters the availability into the system. He generally finds that this lot tends to report the correct availability each time, with only exceptions being times where parking lines are obscured and trucks park over several parking stalls.

The task overall takes less than 5 minutes of John's time per site, and he is able to resume normal duties while the TPAS program continues to operate on its own. John is further affirmed that, by having automated reminders and a clearly defined process, the effort to reset is necessary to do on a regular basis but requires a small amount of effort.

9.5 Scenario 5: Fatigued Driver Needs Parking Soon Due to Route Disruption

Ed is a truck driver who conducts routine trips through Texas and the American southwest. Today, he is on a trip from Houston to El Paso that is not going according to plan. On his way along I-10, Ed encounters heavy traffic due to an accident in San Antonio. Ed drives cautiously and safely through the traffic but is now significantly delayed. Once past the congestion, Ed notices that he is now 90 minutes from his HOS limits, and he will not reach his originally planned truck stop. He feels tired and worries that he would need to search for parking and exceed his HOS limits, or park in an unsafe location for his resting hours.

Now on the open road, Ed sees a DPAS along the side of I-10, indicating upcoming safety rest areas with real-time truck parking availability. The Kerr County safety rest area is the closest and the DPAS indicates that 7 parking spaces are available. Ed knows it will take an hour to reach the Kerr County safety rest area—well within his 90-minute HOS allowance—and therefore decides to drive to it.

Approximately 15 miles from Kerr County safety rest area, Ed sees another DPAS that confirms the availability of parking at the safety rest area. Once he arrives, Ed pulls into one of the free parking stalls, shuts off his engine, and immediately feels relieved that he was able to meet his HOS limitations. Given his experience, Ed realizes that he can rely on the I-10 Corridor Coalition's TPAS program to help him locate parking during his future trips.

9.6 Scenario 6: Truck Driver Makes Strategic Selection among Multiple Truck Parking Options

Ben is a truck driver who works at Transport Corporation in San Antonio, Texas. Every day, trucks are dispatched to complete cargo deliveries, but not always to the same destinations. Today, Ben is assigned a long-haul, multi-day trip to New Mexico. He sets out on I-10 but does not pre-plan any of his HOS requirement stops.

Upon reaching El Paso, Ben is feeling a bit tired and decides that he wants to stop somewhere. He sees a DPAS with parking availability information for three upcoming rest areas along I-10, one directly near El Paso and the other two closer to Las Cruces. All three rest areas have parking availability. With just over an hour remaining before exceeding his HOS limits, Ben decides to continue driving and stop at the rest areas near Las Cruces.

Along his way, Ben realizes he knows nothing about the public rest areas in Las Cruces. He contacts his dispatcher over the radio to communicate his plan and request any information. The dispatcher confirms that the two rest areas in Las Cruces are public truck stops with amenities, and he gets the confirmation on the real-time parking availability. Approximately 10 minutes before reaching the first rest area, Ben sees another DPAS confirming that it has five parking spaces available. Ben pulls into the rest area, parks in one of the stalls, and turns off his engine. Despite limited planning for this trip, he realizes that the TPAS program has helped him find parking, with options provided across jurisdictional lines. Without this, he realizes he might have pulled off to park at an unauthorized location or could have underutilized his HOS allowance by parking earlier in one of El Paso's private truck stops due to uncertainty of alternative options.

9.7 Scenario 7: Truck Driver Needs New Parking Option when Preferred Lot is Full

On a Wednesday night in February, a truck driver named Rob is driving along I-10 towards Phoenix. Rob's regular routes take him to Phoenix several times a week, and he has developed a soft spot for the TRK Truck Stop along the way. The TRK Truck Stop has everything a truck driver could want—ample parking, clean showers, cheap fuel, and a local diner with good food. Rob is part of the TRK "Big Truck" loyalty program and is only $5 away from a free meal.

Tonight, Rob sees a DPAS along the side of I-10, indicating that a rest area is 20 miles away and has fifteen available truck parking spaces. Rob is 30 minutes from his HOS limits, and he calculates that the rest area is about 20 minutes away. But Rob had set up this trip to stop at the TRK Truck Stop, which is prior to the rest area and well within his HOS limits. Besides, he has every intention of getting that free meal tonight. He ignores the DPAS and plans to stop at the TRK Truck Stop as planned.

Rob takes the exit and pulls into the TRK Truck Stop, but is horrified to see trucks everywhere. He realizes that recent winter storms in the north have delayed a lot of shipments that are now in transit again, causing a surge in truck traffic and demand for parking. Rob frantically navigates through the parking lot, but every single stall is occupied by a truck and at least 20 other trucks are circulating for parking as well. Although Rob is upset about not getting his free meal, the bigger problem at hand is that he suddenly has nowhere to park and his HOS limits are close at hand. Before knowing about the TRK Truck Stop, he had spent many sleepless nights parked on the sides of entrance ramps or under bridge overpasses. Neither alternative was legal or safe, which was why he worked so hard to plan his route so carefully.

Scrambling for an alternative, Rob remembers the DPAS back on I-10 that said the nearby rest area had parking availability. He quickly pulls over and accesses the mobile application for traveler information. The app—which receives parking information from the TPAS program—shows the same amount of availability as Rob had seen on the sign. Rob gets back on I-10 and drive to the rest area, arriving with just enough time to meet his HOS requirement. Rob parks safely in one of the free parking stalls, turns off the engine, and feels relieved that he was able to find an alternative so quickly. Even though he will have to wait until next time to get his free meal, having the DPAS provide parking availability has allowed him to be aware of safe parking locations when an alternative was needed.

This scenario is also applicable in situations where a driver's preferred TPAS public parking lot has no availability, and the driver makes an informed decision to divert to a private truck stop.

9.8 Scenario 8: Temporary Closure of Truck Parking Area

Caltrans has initiated a project to rehabilitate major truck parking lots within California to help improve the safety and efficiency of freight movement. One of the truck parking lots identified as part of the project is the Cactus City Rest Area, located along I-10 to the east of Los Angeles. The Cactus City Rest Area was instrumented with the I-10 TPAS program and regularly provides real-time parking availability for truckers, as well as historical data on parking lot use for Caltrans. Through this historical data, Caltrans is aware that truckers heavily utilize this parking lot, leading to its wear-and-tear. However, in order to rehabilitate the parking lot, the entire parking area of the lot would need to be closed for one day to allow crews to quickly work. Fortunately, the physical sensors for the TPAS program would not be affected by this work.

Caltrans posts the upcoming closure on their website but knows that many long-haul truckers will not think to look there. On the day of the closure, the Caltrans TPAS operator coordinates with the field crews that block the exit ramp by manually closing the parking lot in the TPAS central software. When the TPAS central system receives this closure notification, it immediately broadcasts the closure notification. It sends a special "CLD" message (for "closed") to the DPAS assets in the field, with their matrix panels showing "CLD" instead of parking availability. It sends "Parking Lot Closed" to the ATIS that receive the TPAS data feed. At the same time, while the sensors in the parking lot are still monitoring for parking activity and reporting it to the central system, the central system only logs in the database that the parking lot was closed to avoid any skews in data.

Will, a dispatcher working at Freight Express, Inc. receives calls from four truck drivers, requesting information on where to park before reaching their HOS limit. The truck drivers have passed a DPAS along their route on I-10, and immediately recognized that the Cactus City Rest Area parking lot is closed. Having access to real-time information on the location of the truck drivers and parking availability in the vicinity, Will is able to make timely decisions to guide the truckers to the nearest location with available parking.

When the rehabilitation work is complete, the Caltrans TPAS operator is informed that the lot is ready to receive vehicles again. The TPAS operator manually reopens the parking lot in the TPAS central software. Immediately, the operator receives a notification alert from the system to request an operator's confirmation that the system's counts are correct with the current situation in the lots, which is issued every 24 hours anyway to help ensure accuracy. The TPAS operator checks the CCTV cameras and reports the number of open parking stalls in each lot into the central system, all of which are currently available. With confirmed counts, the central system pushes updated parking counts to the remote DPAS assets, which immediately recognize the new data and replaces the default "CLD" message with the updated parking availability. Similarly, the ATIS services that subscribe to the TPAS program receive updated counts and report those numbers through their services.

The TPAS program returns to full operation and routine operations are resumed.

This scenario is also applicable to brief closures (e.g. police block off lot from public to conduct enforcement) and long-term closures (e.g. a year-long rest area reconstruction).

9.9 Scenario 9: Severe Weather Highway Closures Trigger Parking Need

On Tuesday afternoon, the ADOT TMC is informed of a large dust storm that is forming over the desert. TMC operators cycle through the various CCTV cameras along I-10 in the central part of the state to confirm that the dust storm is affecting the highway and impeding visibility. Due to severe winds, extremely poor visibility, and sheer magnitude of incidents that have already occurred, ADOT decides to close that section of I-10 out of an interest in safety. In addition to coordinating with State Patrol and local law enforcement, ADOT notifies Caltrans and NMDOT of the closure, and both states volunteer to post notifications on their respective DMS.

John, a truck driver at Movers LLC, is on his way to Tucson from the Port of Los Angeles. John had checked the weather forecast earlier, but the dust storm was not an issue at the time. While driving, John sees a DMS and realizes that I-10 between Phoenix and Tucson is closed. John knows that limited alternative routes around the storm exist, but he believes that he can drive all the way up to where the road is closed and find sufficient parking, given that he has always been able to find parking on normal days.

Despite the storm and its road closures, the I-10 TPAS program is monitoring parking availability in real-time at several rest areas along I-10 and publishing this availability on roadside signs and state ATIS services. When John contacts his dispatcher at Movers LLC to notify of having to stop, he mentions that he plans to stop near the closure. John's dispatcher quickly views the parking availability on the state ATIS website and confirms that, actually, the parking lots near the road closure are filling up fast. Many truckers who are just learning about the closure are quickly grabbing any available parking in order to re-evaluate their options, which is leaving limited availability in those lots. Fortunately, John is over 70 miles from the closure and a rest area is just ahead with at least 25 parking stalls available. With this newfound realization, John elects to drive to that rest area instead of driving all the way to where the road is closed. 10 miles from the rest area, he sees a DPAS that indicates parking is available at the rest area, but it has been reduced to 13 parking stalls due to other truckers having the same concerns. John also notes that the DPAS reports parking availability for lots further down the road as "LOW", further confirming that limited availability is on the road ahead if he does not park now. A nervous 10 miles goes by, but when John pulls into the rest area, he finds at least eight parking spaces left. He parks in one of the spaces, turns off his engine, and feels relieved that he made an informed decision on parking today.

When the weather clears, ADOT reopens the road and motorists are able to resume their driving. The TPAS program continues to operate with no further action needed.

This scenario is also applicable in situations where the closure of a section of I-10 is caused by other weather events (flood, snowstorm) or a major long-term incident (overturned HazMat truck).

9.10 Scenario 10: Law Enforcement Officer Helps Prevent Unsafe Parking

A California Highway Patrol (CHP) officer is conducting his routine patrol to the east of Joshua Tree National Park when he discovers a truck that is parked in an unauthorized location on an entrance ramp to I-10. The officer finds this a bit odd, as trucks have rarely parked on this ramp ever since the downstream rest area was instrumented with sensors and TPAS signs were posted on the roadside. The CHP officer conducts a routine enforcement stop and confronts the trucker, asking why he has elected to park in an unauthorized location on the ramp when there is a TPAS lot 15 miles downstream.

The truck driver informs the officer that he has 20 minutes remaining until his HOS limit but was not sure if he could trust the availability posted on the DPAS. The CHP officer pulls up his mobile device and checks the Caltrans 511 website, reporting to the driver that the rest area currently has 15 available parking spaces for trucks and that this information is real-time. The CHP officer reminds the driver that they are not authorized to park on highway ramps and that it is not safe to do so. The driver agrees to comply and be more mindful of the parking requirements. The officer elects not to issue a ticket for the unauthorized parking. The driver travels 15 miles along I-10, and then parks safely at the parking lot while still meeting his HOS requirement.

This scenario is also applicable in situations where law enforcement elects for the trucker to remain in the unauthorized location in lieu of traveling to a TPAS parking lot that has reportedly "LOW" availability.

10.0 Summary of Outcomes

Table 9 on the following page shows the impacts and outcomes that each stakeholder should expect to experience as a result of the project.

Table 9: Stakeholder Outcomes

Entity	Outcomes
FHWA	Positive economic and safety impacts on the NHS as a result of enhanced freight competitiveness on corridors where TPAS has been deployed.
I-10 Corridor Coalition Agencies	Positive economic and safety impacts as a result of enhanced freight competitiveness on corridors where TPAS has been deployed. Expansion of TPAS along other corridors or other I-10 states.
TxDOT	A successfully led grant funded multistate technology deployment. A template for TPAS deployment to other critical freight corridors in the state of Texas.
State Traffic Operations Centers (TOCs)/ Traffic Management Centers (TMCs)	Better distributed truck parking will reduce overcrowding in unsafe locations, resulting in a safer freeway network for all users.
State Highway Patrol/State Police	Better distributed truck parking will reduce overcrowding in unsafe locations, resulting in less required interactions with truck drivers for unauthorized parking and a safer freeway network for all users.
MPOs	Better truck parking demand data that can be used when making funding decisions for truck parking improvement projects.
Contractors	Financial benefit for providing a service to the I-10 Corridor Coalition agencies.
Third-party website/application developers	Financial benefit for providing enhanced information to users.
State Trucking Associations	More satisfied association members and additional data for use in advocating for truck parking improvements.
Fleet Dispatchers/Driver Managers	Easier to assist truck drivers in finding safe, reliable parking options – more efficient movement of goods throughout the I-10 corridor.
Truck Drivers (Independent, Contracted, and Company Truck Drivers)	Easier to find safe, reliable parking and have a more productive trip – don't have to spend as many service hours looking for a place to park and lose productivity.
Truck Stop Operators (TSOs)	An observable TPAS that can demonstrate its effectiveness directing truck drivers to available parking spaces. Those spaces could be at their truck stop increasing business if they are part of a future system expansion.
Industry Freight Organizations (NATSO, OOIDA, ATRI)	More satisfied users and enhanced truck parking data for research purposes.

11.0 Conclusion

The I-10 TPAS ConOps provides a high-level understanding of a proposed system to collect and disseminate real-time truck parking availability information within the I-10 Corridor Coalition states. The ConOps documents the shared understanding of project stakeholder's needs for the I-10 TPAS and how it will be operated and maintained. Elements of the ConOps, such as site location, type of technology and sign placement, may change as states continue to evaluate the system.

Appendices

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Appendix A: California System Details

Table 10, **Table 11**, **Figure 14,** and **Figure 15** provide an overview of the planned California I-10 TPAS deployment. **Table 10** summarizes the system components that will allow the system to function. **Table 11** provides a summary of how the system components will be procured, how the system will be operated, and how the system will be maintained. How the individual system components will interact to allow the TPAS to function is illustrated in **Figure 14**. The proposed truck parking sites to be monitored and sign locations are shown in **Figure 15**.

Table 10: Caltrans System Components

Parking Availability Monitoring	
Truck parking to be monitored	Trucks entering and existing the facility will be monitored.
Detection methodology	Entrance and exit counting sensors that will require at least once daily calibration.
Detection technology	Entrance and exit counting sensor technology undecided; video and video monitoring software will be used for validation and calibration.
Performance metrics data collection	The TPAS software developed for processing field data will focus on basic parking space counting through entrance and exit sensor counts. PTZ cameras will support both parking counting validation, as well as at least once-daily monitoring by Caltrans D8 Operations staff – this may be supported by specialized "VideoSync" software which can automatically relate the entrance and exit sensor counts to video analytics generated counts of trucks.
Parking area surveillance	PTZ cameras will be deployed at each parking area to allow for remote monitoring of the system. The PTZ cameras will provide flexibility to view I-10 mainline and the general rest area when practical. The cameras will be viewed and controlled by Caltrans D8 Operations Staff. Full motion video will be provided as long as communications network can support it. Video from the cameras will not be archived.
Data processing	Standalone software will be used to process parking site detection data and estimate the number of available spaces. This software will run on Caltrans D8 servers and managed by D8 Operations staff. Another option being considered would be integration of the TPAS functionality as an application on the potentially D8 "ActiveITS" ATMS upgrade.
Dynamic parking availability sign operation	The roadside dynamic messages will be controlled by the existing Caltrans D8 ATMS software (or as an element on the D8 Active ITS ATMS upgrade). This will require passing availability data from the TPAS to the ATMS for display on the signs.
Data feed (API)	The data feed (API) will be implemented on Caltrans D8 Go511 server or equivalent. Caltrans D8 Operations or consultant will develop the interface to access the availability data from the data processing system and will implement the webservice to provide the JSON data feeds.
Traveler information website upgrade	TPAS information shall be provided as an upgraded element to the Caltrans Go511 or equivalent website.

Network Communications	
Parking area to back office communications	Initially, the availably monitoring equipment and the surveillance camera will communication through, in order of preference, available fiber connections, available DSL connections, and leased cellular communication links.
Dynamic parking availability sign communications	If available, fiber connections will be used. Where fiber it not available, cellular communications shall be used.

Table 11: Caltrans Deployment, Operations, and Maintenance Responsibilities

Procurement	
Procurement method	A traditional design-bid-build approach will be used to implement the field equipment. A consultant will develop plans for the system and system requirements. A contractor will be hired to deploy the field equipment, develop the data processing software and integrate it with the ATMS and traveler information platforms. A best value evaluation process will be used to select contractor.
System Engineering and Design	
System engineering	Caltrans DRISI and D8 Operations staff will collectively oversee the system engineering process through completion of project.
System design	The field deployment design and system requirements will be developed by a consultant. Caltrans D8 Operations staff will manage the design consultant. Note here that Caltrans D8 may soon deploy an ActiveITS ATMS upgrade – this should significantly reduce the complexity of the TPAS design.
Deployment	
Construction administration and inspection	A contractor/integrator will be hired to construct and integrate the system. Construction inspection and administration will be led by Caltrans D8 Operations staff.
Software development	A contractor/integrator will provide the needed software development for the standalone data processing software. Caltrans D8 Operations staff will oversee this process.
Testing of field components	Testing will be conducted by the contractor with oversight by Caltrans D8 Operations staff
Testing of communication links	Testing will be conducted by the contractor with oversight by Caltrans D8 Operations staff
Testing of back-office systems	Testing will be conducted by the contractor with oversight by Caltrans D8 Operations staff
Testing and validating of complete system	Testing will be conducted by the contractor with oversight by Caltrans D8 Operations staff

Operations	
Day-to-day operations	The system will be operated by Caltrans D8 Operations staff. They will monitor the system, collect data for performance measures and update the system for anomalies like a rest area truck parking area being closed or system malfunctions. The area maintenance office must notify D8 Operations staff when a rest area is closed. If equipment malfunctions are identified by the rest stop maintenance personnel, they need to notify D8 Operations staff.
Performance measures	Caltrans DRISI Operations staff will be responsible for developing the performance measures defined by the project.
State trucking association coordination	Caltrans DRISI and D8 Planning staff will coordinate with the state trucking association periodically to obtain feedback on the system.
Maintenance	
Maintenance of field equipment	Caltrans D8 Maintenance staff will be responsible for routine and malfunction related maintenance of field equipment.
Maintenance of communications links	Caltrans D8 Maintenance staff will be responsible for routine and malfunction related maintenance of the communication links.
Maintenance back-office systems	Caltrans D8 Operations or IT staff will maintain the back-office systems.
Data feed (API) monitoring	Caltrans D8 Operations or IT staff will monitor and maintain the data feed.

Figure 14 is located on the next page

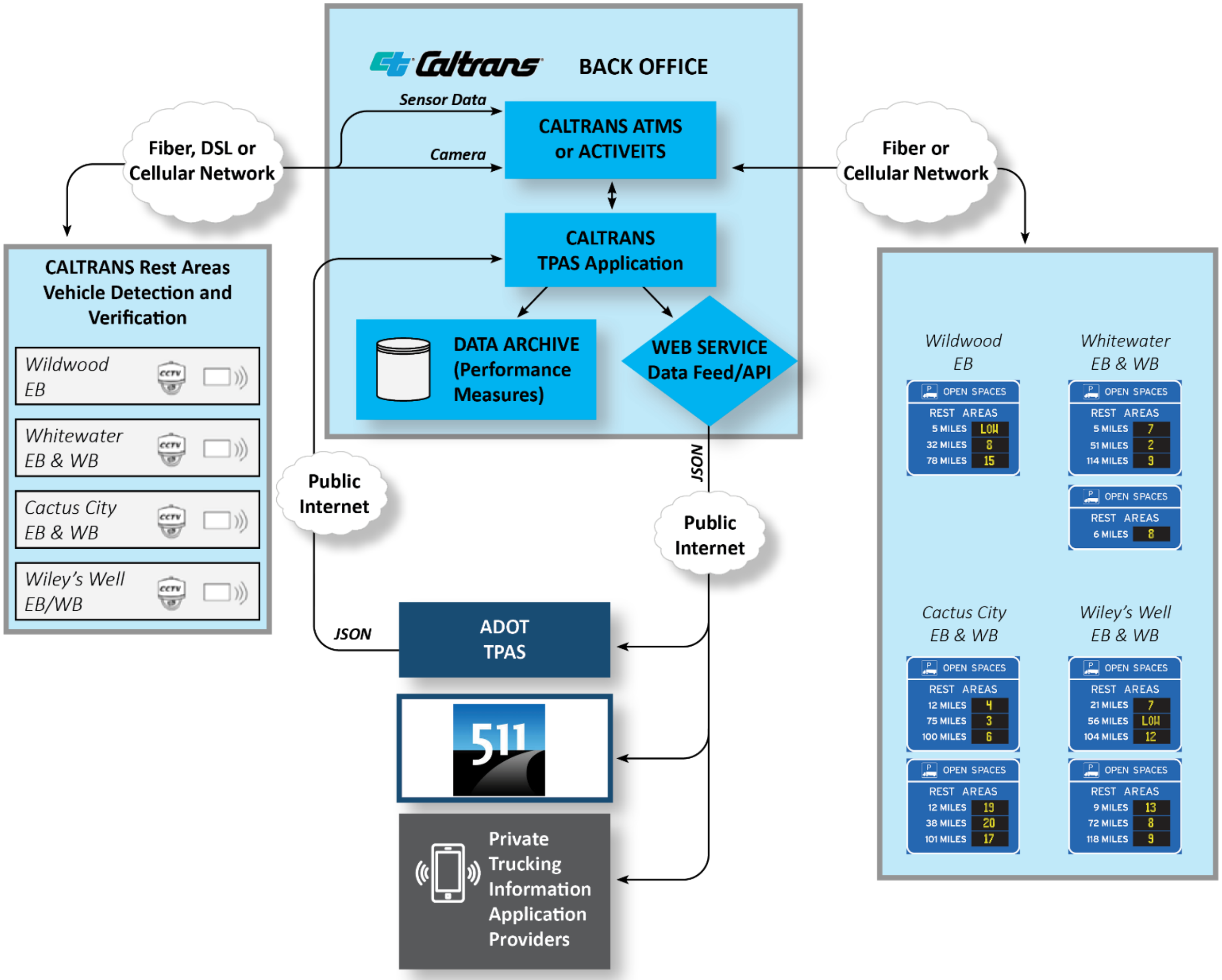

Figure 14: Caltrans Proposed Architecture

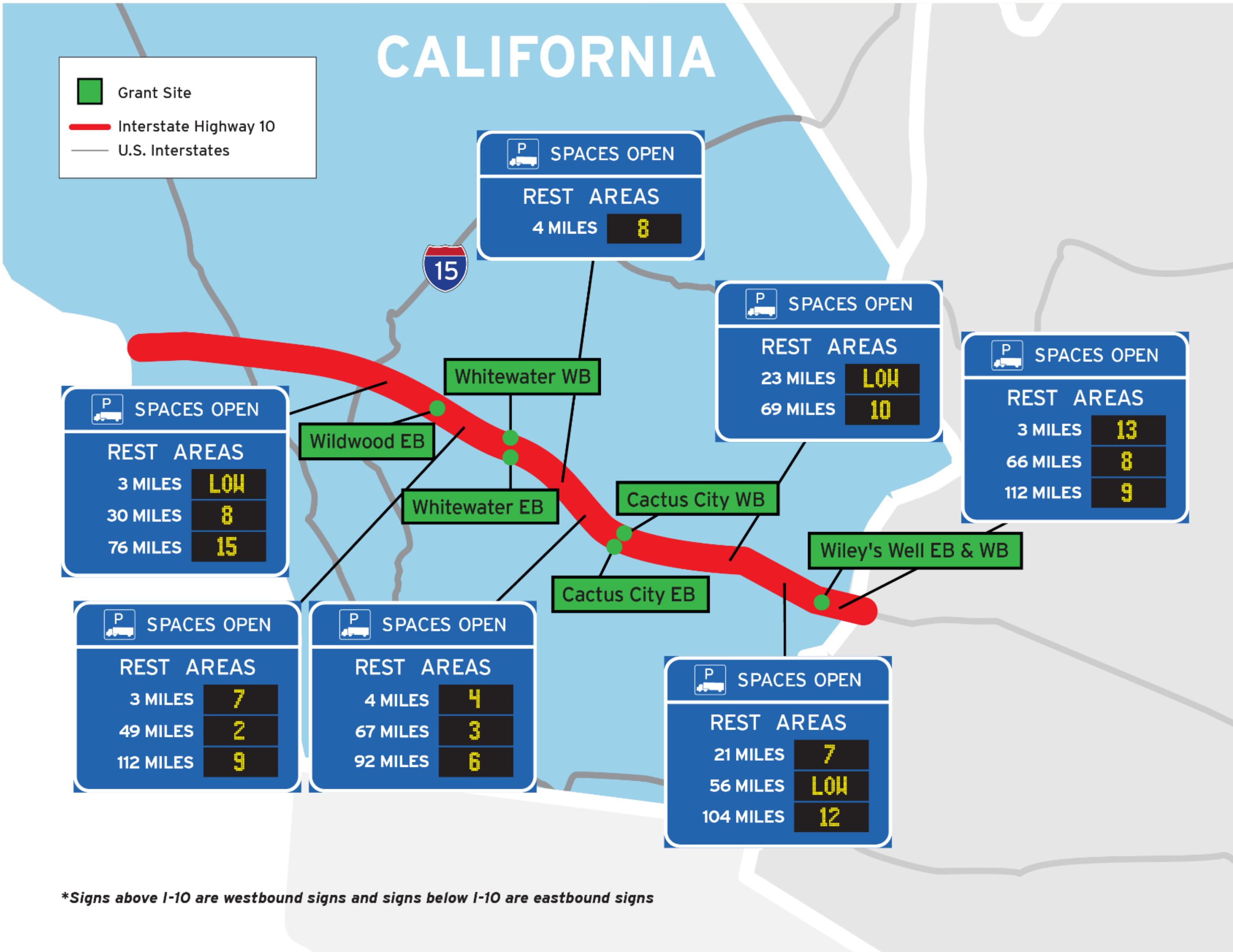

Figure 15: TPAS Proposed Sites and Sign Locations - California

Appendix B: Arizona System Details

Table 12, **Table 13**, **Figure 16**, and **Figure 17** provide an overview of the planned Arizona I-10 TPAS deployment. **Table 12** summarizes the system components that will allow the system to function. **Table 13** provides a summary of how the system components will be procured, how the system will be operated, and how the system will be maintained. How the individual system components will interact to allow the TPAS to function is illustrated in **Figure 16**. The proposed truck parking sites to be monitored and sign locations are shown in **Figure 17**.

Table 12: Arizona DOT System Components

Parking Availability Monitoring	
Truck parking to be monitored	Only formal marked truck parking spaces will be monitored.
Detection methodology	Since all the truck parking spaces are marked spaces they will be monitored for occupancy. This will reduce the ongoing operational cost.
Detection technology	A detection technology will be selected during the design of the project.
Performance metrics data collection	To minimize initial system development costs, the software developed for processing field data will focus on basic parking space availably determination. The system will archive data in a database for use in calculating performance measures. Future enhancements will implement advanced performance metric such as dwell time.
Parking area surveillance	Pan-tilt-zoom (PTZ) cameras will be deployed at each parking area to allow for remote monitoring of the system. The PTZ cameras will provide flexibility to view I-10 mainline and the general rest area when practical. The cameras will be viewed and controlled by the existing ATMS. Full motion video will be provided as long as communications network can support it. Video from the cameras will not be archived.
Data processing	Standalone software will be used to process parking site detection data and estimate the number of available spaces. This software will run on ADOT servers. At some time in the future, the system may move to cloud-based servers. The development and integration of the software will be done by a vendor.
Dynamic parking availability sign operation	The roadside dynamic parking availability signs will be controlled by the existing ATMS software. This will require passing availability data from the data processing system to the ATMS for display on the signs.
Data feed (API)	The data feed (API) will be implemented by the Information Technology Group. They will develop the interface to access the availability data from the data processing system and will implement the webservice to provide the JSON data feeds.
Traveler information website upgrade	The Communications Office is responsible for upgrading the 511 traveler information system to display truck parking availability information. The 511 traveler information system vendor will also enhance the website to display truck parking availability information.

Network Communications	
Parking area to back office communications	Initial communications for the availability monitoring equipment and the surveillance camera will be implemented through leased cellular communication links. There are future plans to deploy fiber optic cable along the corridor, so with that project the communications can be transitioned from cellular to a state operated fiber-based network.
Dynamic parking availability sign communications	As with the parking areas, cellular communications links will be used initially. When the fiber optic network is installed, a decision can be made on the benefit of connecting the signs to the fiber.

Table 13: Arizona DOT Deployment, Operations, and Maintenance Responsibilities

Procurement	
Procurement method	A traditional design-bid-build approach will be used to implement the field equipment. A consultant will develop plans for the system and system requirements. A contractor will be hired to deploy the field equipment, develop the data processing software and integrate it with the ATMS and traveler information platforms. A best value evaluation process will be used to select the contractor.
System Engineering and Design	
System engineering	The ADOT TSMO Systems Technology group will oversee the system engineering process through completion of project.
System design	The field deployment design and system requirements will be developed by a consultant. The ADOT Project Management group will manage the design consultant. The ADOT TSMO Systems Technology group will provide support and technical guidance.
Deployment	
Construction administration and inspection	A contractor/integrator will be hired to construct and integrate the system. Construction inspection and administration will be led by applicable District Construction with assistance from the TSMO Maintenance and TSMO Systems Technology groups.
Software development	A contractor/integrator will provide the needed software development for the standalone data processing software. The ADOT TSMO Systems Technology group will oversee this process.
Testing of field components	Testing will be conducted by the contractor with oversight by the ADOT TSMO Maintenance Group.
Testing of communication links	Testing will be conducted by the contractor with oversight by the ADOT TSMO Maintenance and IT groups.
Testing of back-office systems	Testing will be conducted by the contractor with oversight by the ADOT IT and TSMO Systems Technology groups.
Testing and validating of complete system	Testing will be conducted by the contractor with oversight by ADOT IT and TSMO groups.

Operations	
Day-to-day operations	The system will be operated by ADOT TOC staff. They will monitor the system, collect data for performance measures and update the system for anomalies like a rest area truck parking area being closed or system malfunctions. The rest area manager or Districts must notify the TOC operators when a rest area is closed. If equipment malfunctions are identified by the Maintenance group, they need to notify TOC operators.
Performance measures	The ADOT TSMO Systems Technology group will be responsible for developing the performance measure defined by the project.
State trucking association coordination	The ADOT Multimodal Planning Division will coordinate with the state trucking association periodically to obtain feedback on the system.
Maintenance	
Maintenance of field equipment	ADOT TSMO Maintenance group will be responsible for routine and malfunction related maintenance of field equipment.
Maintenance of communications links	ADOT TSMO Maintenance group will be responsible for routine and malfunction related maintenance of the communication links.
Maintenance back-office systems	ADOT IT group will maintain the back-office systems.
Data feed (API) monitoring	ADOT IT group will monitor and maintain the data feed.

Figure 16 is located on the next page

I-10 CONNECTS TPAS
TRUCK PARKING AVAILABILITY SYSTEM

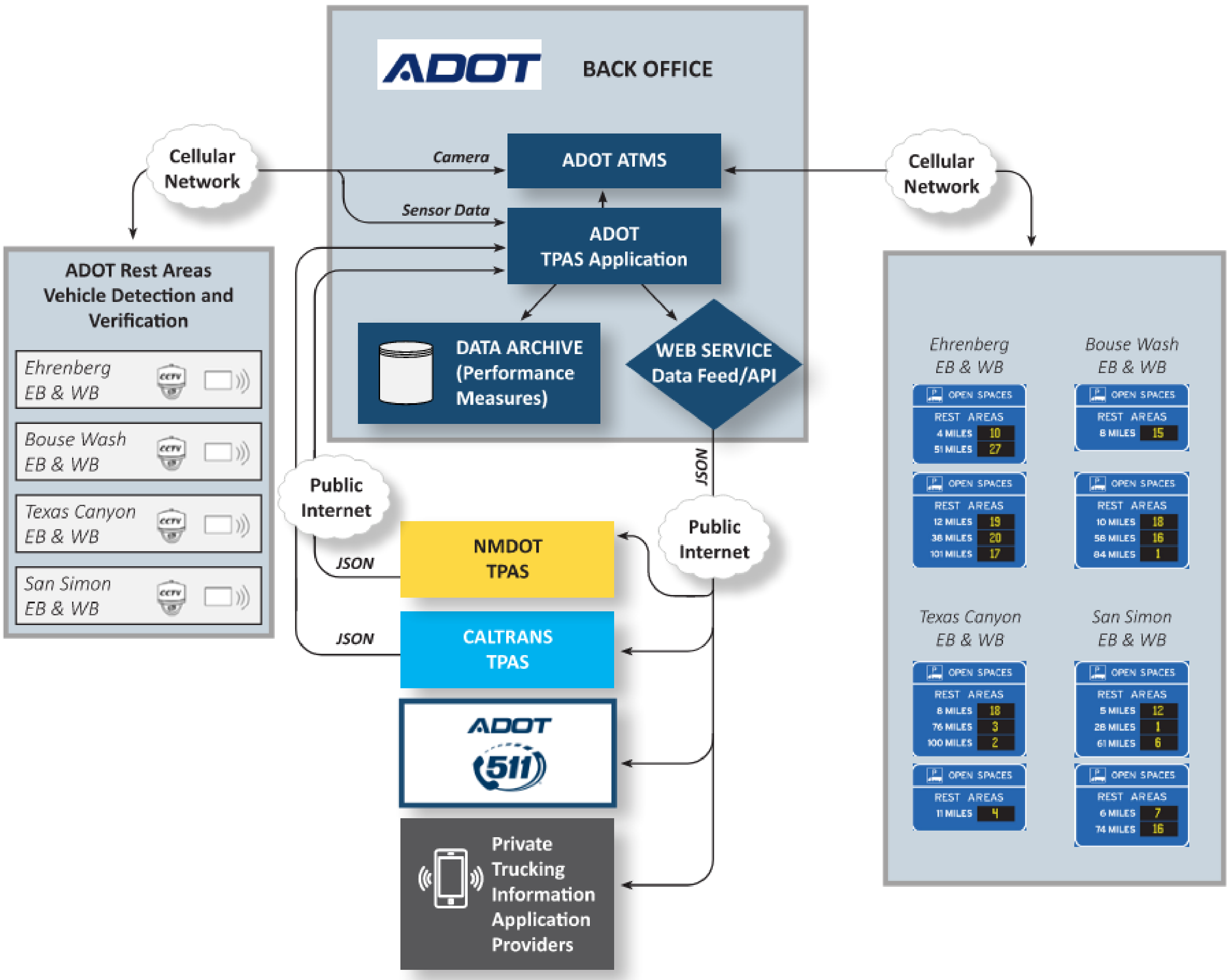

Figure 16: Arizona DOT Proposed Architecture

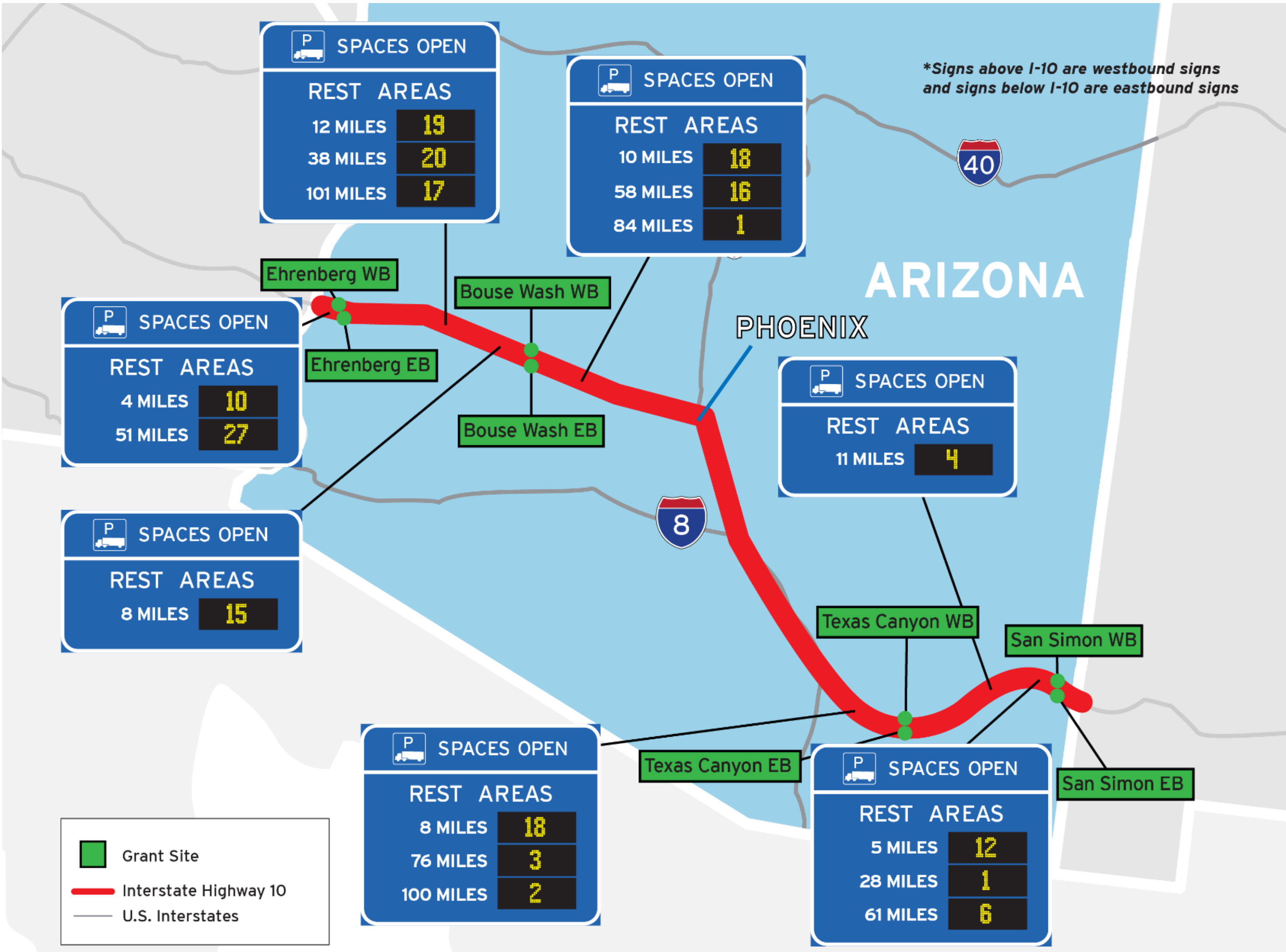

Figure 17: TPAS Proposed Sites and Sign Locations - Arizona

Appendix C: New Mexico System Details

Table 14, **Table 15**, **Figure 18**, and **Figure 19** provide an overview of the planned New Mexico I-10 TPAS deployment. **Table 14** summarizes the system components that will allow the system to function. **Table 15** provides a summary of how the system components will be procured, how the system will be operated, and how the system will be maintained. How the individual system components will interact to allow the TPAS to function is illustrated in **Figure 18**. The proposed truck parking sites to be monitored and sign locations are shown in **Figure 19**.

Table 14: New Mexico DOT System Components

Parking Availability Monitoring	
Truck parking to be monitored	Only formal marked truck parking spaces will be monitored.
Detection methodology	Given the challenge of classifying vehicle driveways with mixed traffic, a space occupancy methodology is preferred. For the three parking sites with marked spaces, occupancy of the spaces will be monitored. For the two parking sites with unmarked parallel parking, a system that monitors occupancy will be used to estimate available spaces by determining how much curb spaces are available that will accommodate a truck.
Detection technology	Wireless in-pavement radar/magnetometer sensors will be used as the most cost-effective available space occupancy technology.
Performance metrics data collection	Basic operations that monitor if system is working correctly is all that is needed for the initial phase. The system will archive data in a database for use in calculating performance measures. NMDOT could use the data to justify future funding for truck parking and rest area investments.
Parking area surveillance	Pan-tilt-zoom (PTZ) cameras will be deployed at each parking area to allow for remote monitoring of the system. The PTZ cameras will provide flexibility to view I-10 mainline and the general rest area when practical. Existing ATMS (ActiveITS) will be used to control the cameras. Cost saving option could be to take images rather than video. Traffic video will not be archived.
Data processing	Standalone software will be used to process parking site detection data and estimate the number of available spaces. This software will run on NMDOT servers. Using the TPAS module in the Southwest Research Institute (SwRI) ActiveITS ATMS software that NMDOT runs is still being considered.
Dynamic parking availability sign operation	The current ATMS (RoadRunner) will be used to control the signs.
Data feed (API)	A consultant service, Real Time Solutions, will develop the JSON data feed. The data feed will be openly available to the public.
Traveler information website upgrade	The consultant service, Real Time Solutions, will integrate TPAS into their system since they already host the traveler information system.

Network Communications	
Parking area to back office communications	Initial communications for the availability monitoring equipment and the surveillance camera will be implemented through leased cellular communication links. The New Mexico broadband initiative may provide fiber along the corridor at some point, so the deployed system needs to be flexible to accommodate a future fiber connection.
Dynamic parking availability sign communications	As with the parking areas, cellular communications links will be used initially. When the fiber optic network is installed, a decision can be made on the benefit of connecting the signs to the fiber.

Table 15: New Mexico DOT Deployment, Operations, and Maintenance Responsibilities

Procurement	
Procurement method	A traditional design-bid-build approach will be used to implement the field equipment. An on-call consultant will develop plans for the system and system requirements. A contractor will be hired to deploy the field equipment through a standard bid process. A software vendor will be hired to provide the data processing software and integrate it with the ATMS and traveler information platforms. A best value evaluation process will be used to select the software vendor.
System Engineering and Design	
System engineering	A consultant team will be responsible for system engineering with oversight from NMDOT's ITS Operations staff.
System design	A consultant team will be responsible for system design with oversight from NMDOT's ITS Operations staff.
Deployment	
Construction administration and inspection	NMDOT's district staff will administer the field equipment construction and will inspect the contractors work.
Software development	The TPAS software vendor will provide the software and integrate it with the ATMS and traveler information platforms with oversight from ITS Operations staff.
Testing of field components	ITS Operations staff will oversee testing of sensors, cameras and signs that will be conducted by the contractor.
Testing of communication links	ITS Operations staff will oversee testing of communication backhaul links that will be conducted by the contractor.
Testing of back-office systems	ITS Operations staff will oversee testing of the back-office systems that will be conducted by the TPAS software vendor.
Testing and validating of complete system	ITS Operations staff will oversee testing of the complete system that will be conducted by the TPAS software vendor.
Operations	
Day-to-day operations	District 1 staff will be doing recurring accuracy checks and resets. They will also be inputting special occurrences such as parking area closures and system malfunction notifications into the system. District 1 Maintenance will need to report closures of any truck parking areas to the operational staff.
Performance measures	The Statewide Planning Bureau will monitor performance measures for the TPAS system based on the overall program's performance monitoring plan.
State trucking association coordination	The Statewide Planning Bureau will communicate with specific state agencies and associations to promote TPAS and coordinate to review perceived performance of the system.

Maintenance	
Maintenance of field equipment	The ITS Bureau will maintain cameras and DPASs. The Signal Maintenance Lab will maintain the sensors. The sensor system must provide fault indications to the central system to provide notification of sensor malfunctions.
Maintenance of communications links	The ITS Bureau will maintain the communications equipment.
Maintenance back-office systems	ITS Operations staff will monitor back-office systems.
Data feed (API) monitoring	Real Time Solutions, the current provider of NMDOT's web-based advisory system, will monitor the data feed.

Figure 18 is located on the next page

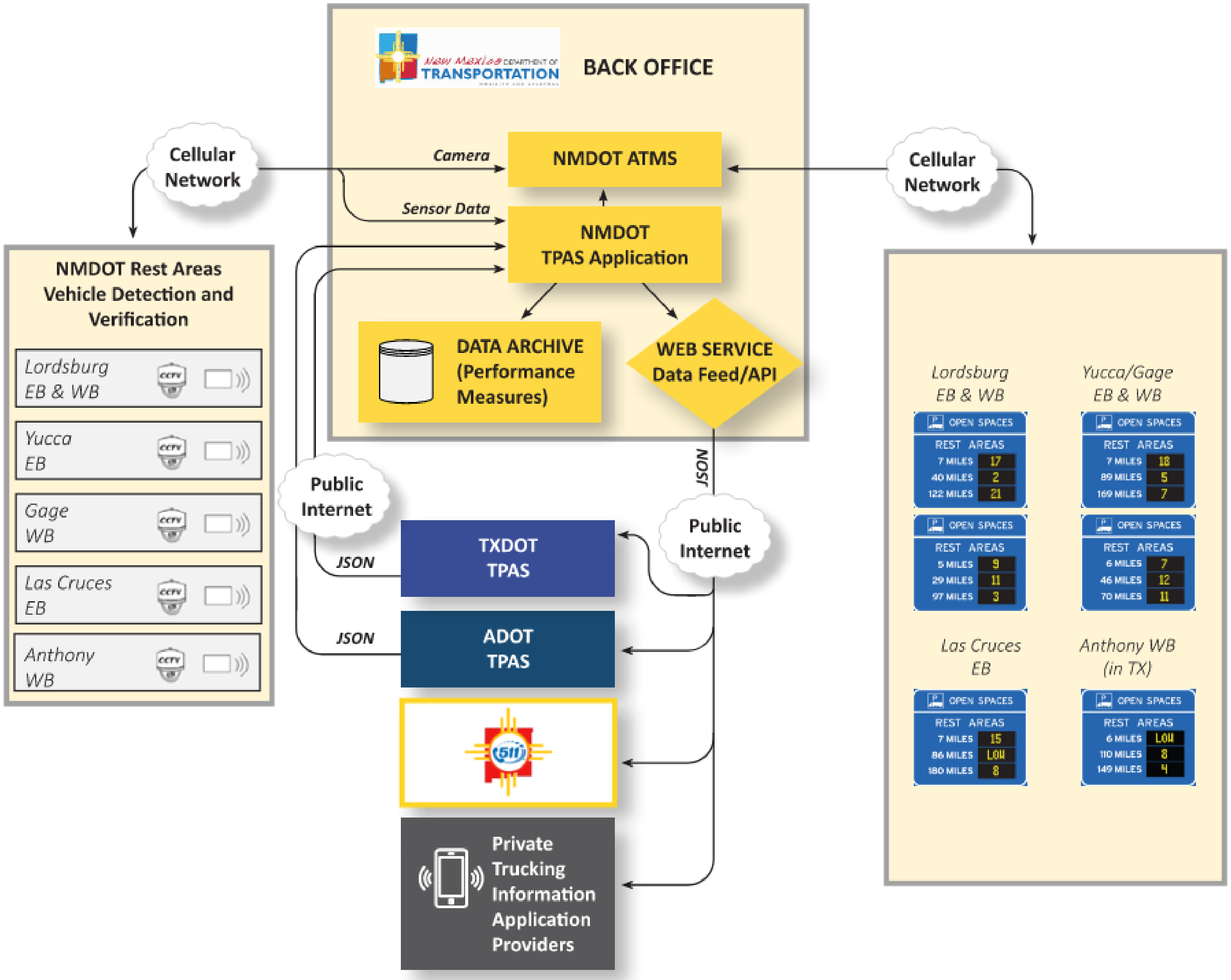

Figure 18: New Mexico DOT Proposed Architecture

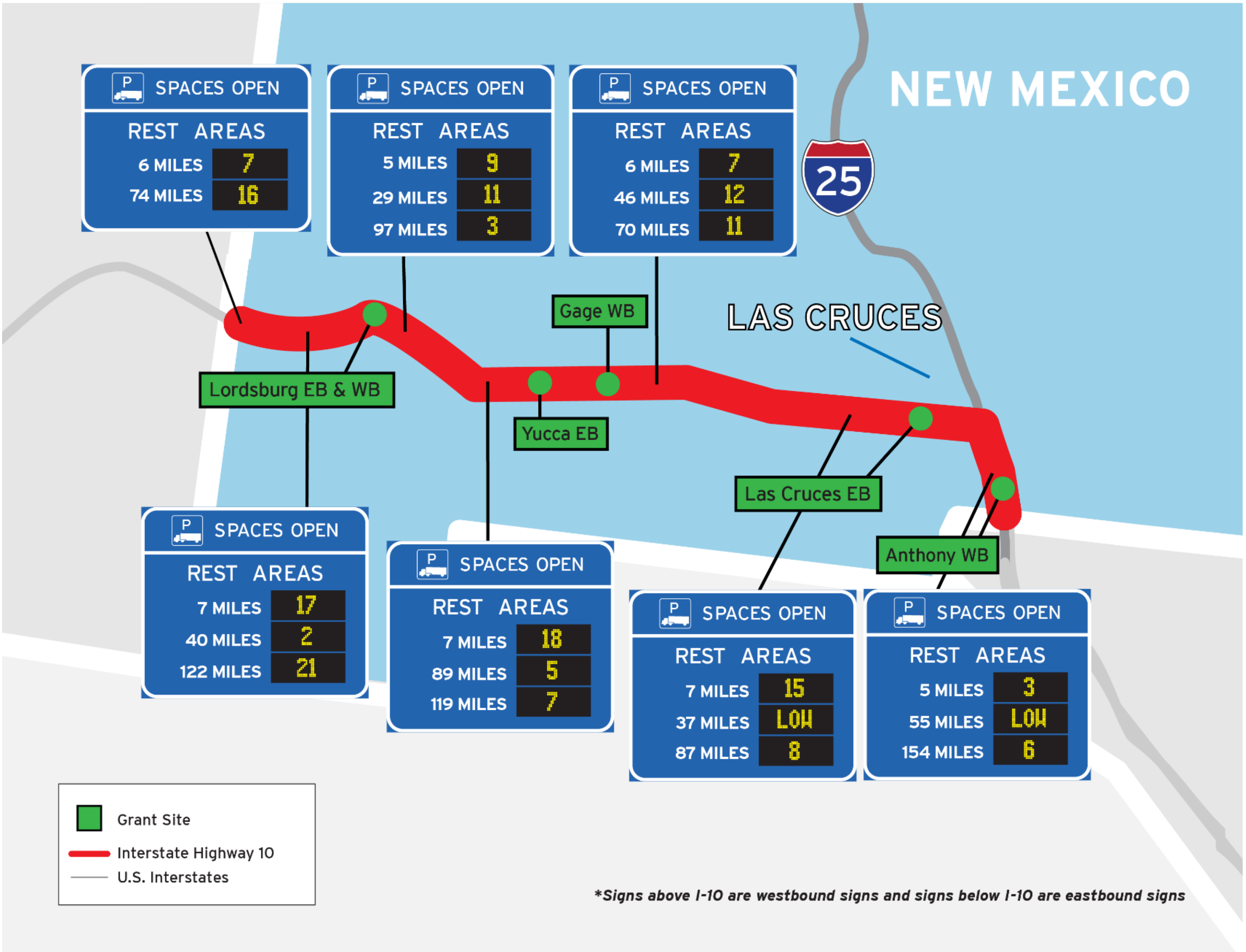

Figure 19: TPAS Proposed Sites and Sign Locations - New Mexico

Appendix D: Texas System Details

Table 16, **Table 17**, **Figure 20**, **Figure 21**, and **Figure 22** provide an overview of the planned Texas I-10 TPAS deployment. **Table 16** summaries the system components that will allow the system to function. **Table 17** provides a summary of how the system components will be procured, how the system will be operated and how the system will be maintained. How the individual system components will interact to allow the TPAS to function is illustrated in **Figure 20**. The proposed truck parking sites to be monitored and sign locations are shown in **Figure 21** and **Figure 22**.

Table 16: Texas DOT System Components

Parking Availability Monitoring	
Truck parking to be monitored	Only formal marked truck parking spaces will be monitored.
Detection methodology	Entrance and exit counting methodology will be used for sites with ingress and egress driveways that only carry truck traffic. At hybrid parking areas that have some diagonal truck spaces and shared parallel parking, the diagonal spaces will be monitored using space occupancy detection. The older safety rest areas that have mixed passenger vehicle and truck parking will require an entrance and exit monitoring methodology that tracks vehicle lengths. The total length of vehicles in the parking area will be compared to the total backing length to estimate available spaces.
Detection technology	To count trucks on truck-only driveways the preferred technology still needs to be determined. For space occupancy detection, radar/magnetometer wireless detectors will be used. To monitor vehicle lengths entering and exiting rest areas advanced lidar or radar technology will need to be used.
Performance metrics data collection	All that data that can be collected given the detection methodology and technology that will be used will be collected. The system will archive data in a database for use in calculating performance measures.
Parking area surveillance	CCTV cameras with pan-tilt-zoom and full motion video will be installed at each location. The cameras will have the ability to monitor site operations and the I-10 mainline. The existing Lonestar™ ATMS (ActiveITS) will be used to control the cameras. Video from the sites will not be archived.
Data processing	The TPAS will be integrated into the TxDOT Lonestar™ ATMS. The TxDOT ATMS is the Southwest Research Institute (SwRI) ActiveITS software. The TPAS module developed by the Florida DOT will be implemented within Lonestar™. Sensor data processing will be done in-house.
Dynamic parking availability sign operation	Sign control will be handled by the TxDOT Lonestar™ ATMS.
Data feed (API)	To be determined on who will lead the API development.
Traveler information website upgrade	The current vendor will upgrade to the DriveTexas™ website to display truck parking availability information. The Special Projects Group of the Travel Information Division is responsible for the DriveTexas™ website.
Network Communications	
Parking area to back office communications	Verizon cellular data will be used.
Dynamic parking availability sign communications	Verizon cellular data will be used.

Table 17: Texas DOT Deployment, Operations, and Maintenance Responsibilities

Procurement	
Procurement method	Traditional design-bid-build process will be used for the parking site monitoring and roadside sign deployment. Software development will be done by an existing software vendor, SwRI.
System Engineering and Design	
System engineering	Transportation Planning and Programming Division and Traffic and Safety Division will be responsible for systems engineering.
System design	Individual TxDOT districts with assistance from the Traffic and Safety Division will be responsible for system design.
Deployment	
Construction administration and inspection	Individual TxDOT districts with assistance from the Traffic and Safety Division will administer and conduct inspections.
Software development	The ATMS software vendor (SwRI) will implement the TPAS module originally developed for the Florida DOT's SunGuide ATMS and will do the integration. Traffic and Safety Division will manage SwRI work.
Testing of field components	Individual TxDOT districts will test all field components.
Testing of communication links	Individual TxDOT districts will test communication links.
Testing of back-office systems	The Traffic and Safety Division will test all back-office systems.
Testing and validating of complete system	The Traffic and Safety Division will test and validate the TPAS system.
Operations	
Day-to-day operations	The Traffic and Safety Division will handle day-to-day operations. They will monitor the system, collect data for performance measures and update the system for anomalies like a rest area truck parking area being closed or system malfunctions. The rest area manager or districts must notify Traffic and Safety Division staff when a rest area is closed. If equipment malfunctions are identified by the rest stop maintenance personnel, they need to notify Traffic and Safety Division staff. Phone calls concerning system information on the DriveTexas™ website will not be directed to the Travel Information Division. There will contact information for the Traffic and Safety Division when system is down.
Performance measures	The Traffic and Safety Division and Transportation Planning and Programming Division will monitor all performance measures.
State trucking association coordination	The Transportation Planning and Programming Division will coordinate with relevant associations and organizations.
Maintenance	
Maintenance of field equipment	TXDOT district staff will be responsible for routine maintenance of the field equipment.
Maintenance of communications links	TXDOT district staff will be responsible for routine maintenance of the communication equipment.
Maintenance back-office systems	The Traffic and Safety Division will be responsible for maintenance of back office systems.
Data feed (API) monitoring	The Traffic and Safety Division will be responsible for maintenance of the data feed (API).

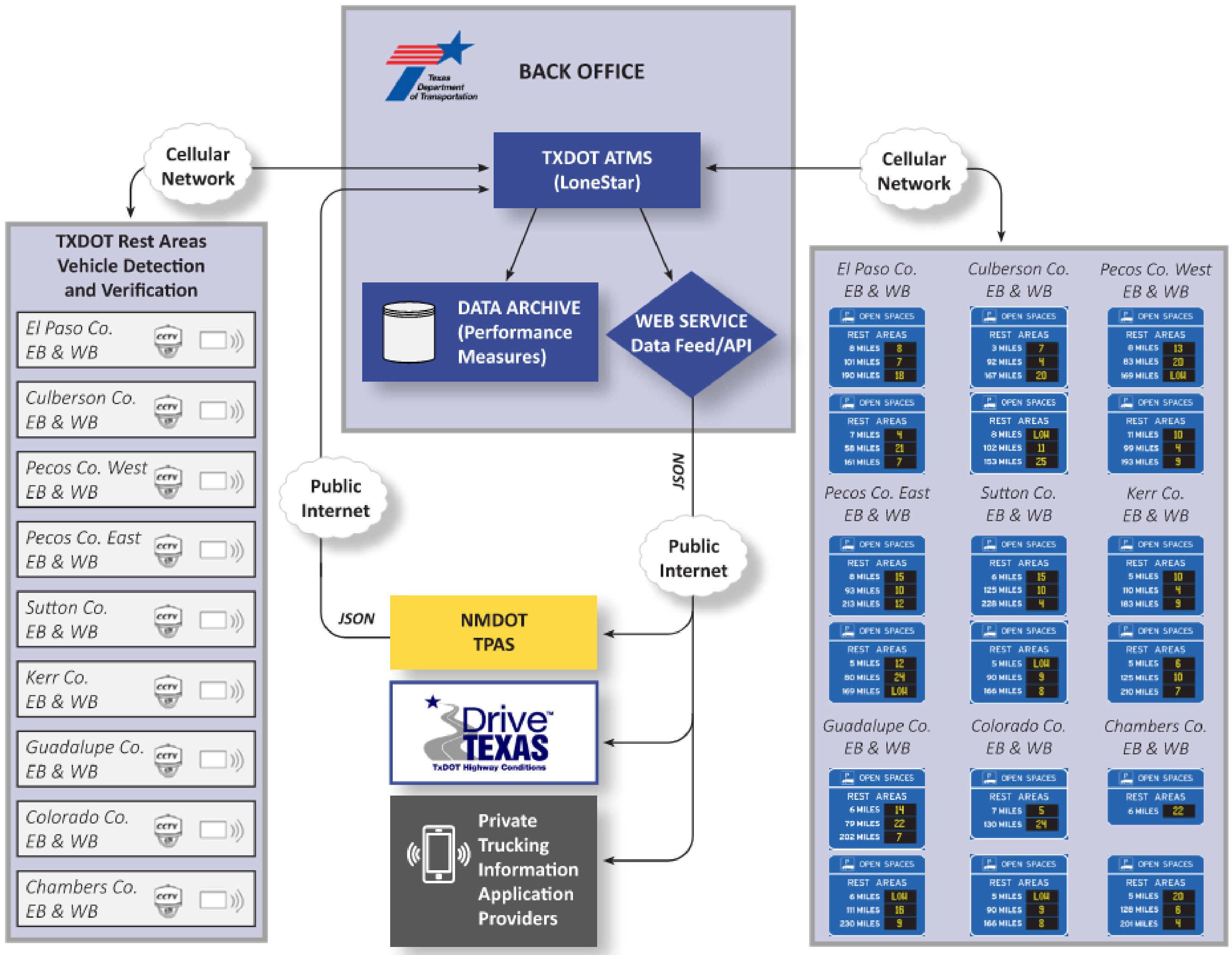

Figure 20: Texas DOT Proposed Architecture

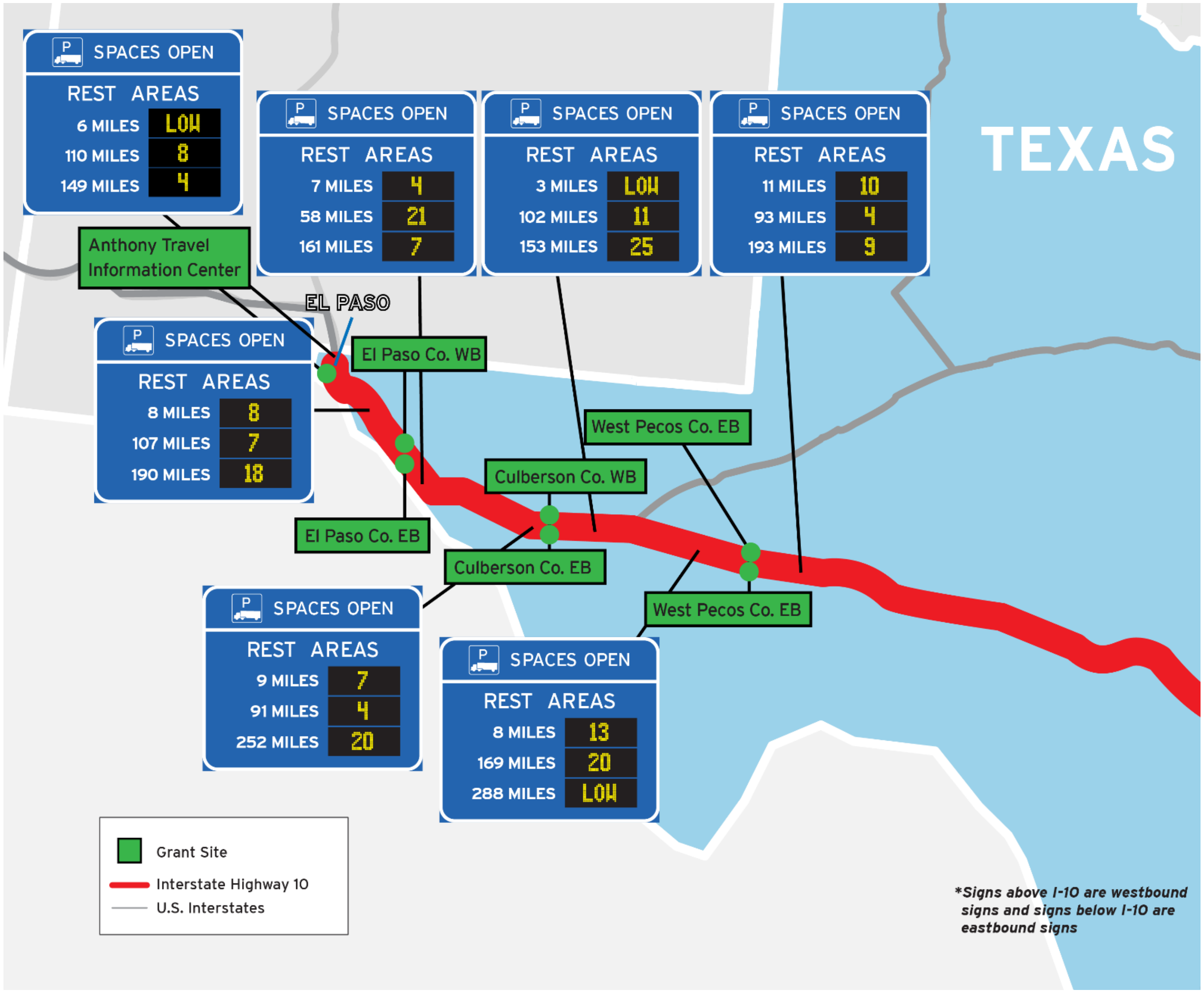

Figure 21: TPAS Proposed Sites and Sign Locations - Texas (West)

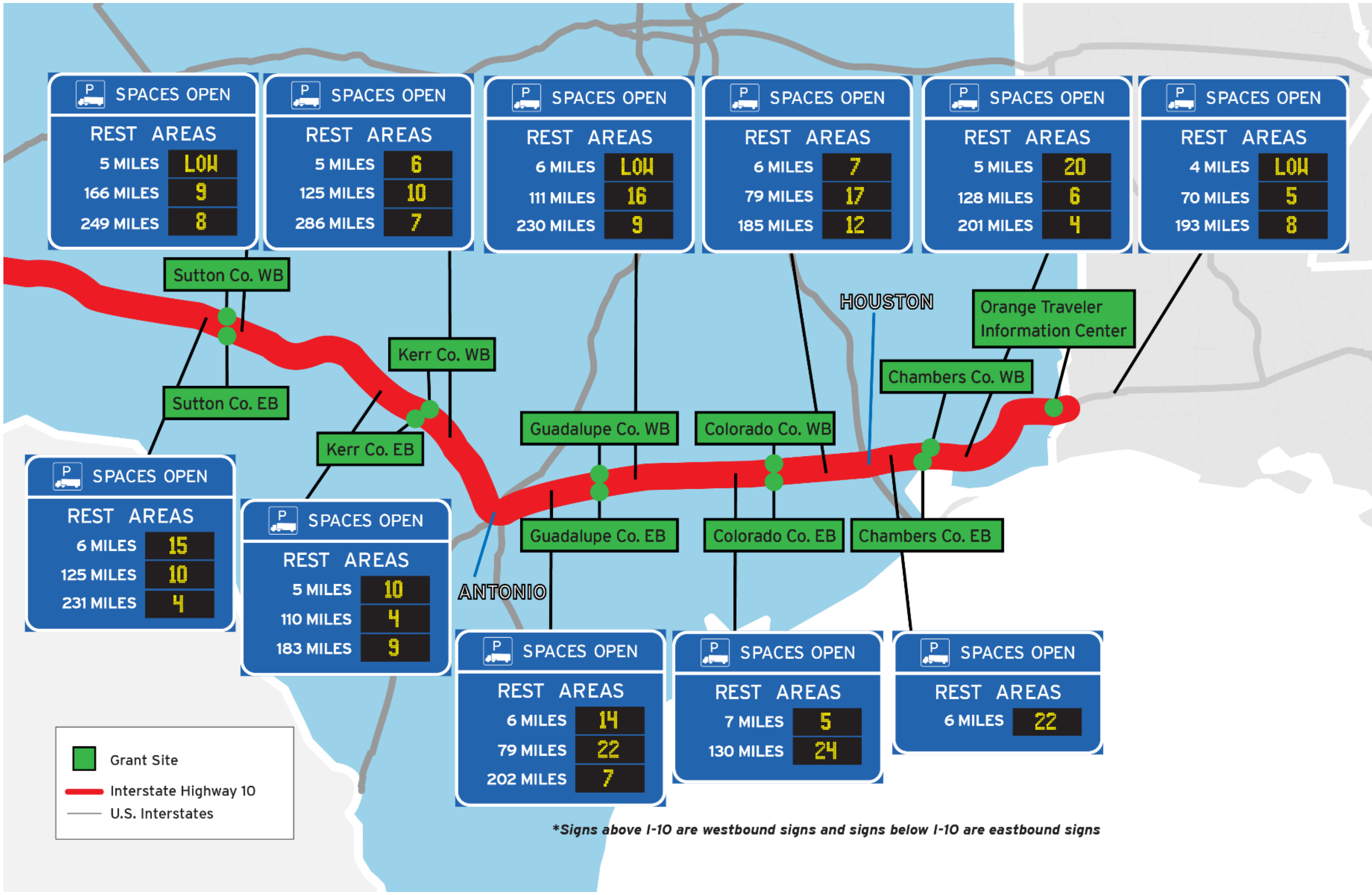

Figure 22: TPAS Proposed Sites and Sign Locations - Texas (East)

Appendix E: Pre-Deployment Survey

The I-10 Corridor Coalition (Coalition), a partnership of state departments of transportation from California, Arizona, New Mexico, and Texas, recognizes the importance of the safe and efficient movement of people and freight along the Interstate 10 (I-10) national trade corridor. The Coalition was awarded a $6.85 million U.S. Department of Transportation (USDOT) Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) grant in April 2019 to implement a truck parking availability system (TPAS) along the I-10 corridor in the Coalition states. The Coalition is implementing the TPAS to help commercial vehicle drivers and dispatchers find safe and convenient truck parking at public rest areas along the I-10 corridor. The I-10 TPAS will monitor, collect, and communicate real-time information about truck parking availability at 37 public truck parking locations along the I-10 corridor from California to Texas.

From August 26, 2020 to November 2, 2020, the Coalition conducted the TPAS Truck Driver and Dispatcher Baseline Survey through Survey Monkey to gather input from commercial vehicle drivers and dispatchers. The survey results help the Coalition better understand the challenges and issues drivers experience when attempting to park at locations along the I-10 corridor. Input from the survey provides valuable information for the development of the concept of operations (ConOps) to ensure the design of the TPAS system meets end-user needs.

The project team introduced the I-10 TPAS project to leadership representatives from the California Trucking Association, Arizona Trucking Association, New Mexico Trucking Association, Texas Trucking Association, and the Owner-Operator Independent Drivers Association (OOIDA). Representatives provided feedback on specific survey questions asked in the TPAS Truck Driver and Dispatcher Baseline Survey. Each of the associations distributed information to their membership about the I-10 TPAS project and provided a link to the survey.

The Coalition states also helped disseminate the survey by utilizing social media channels, displaying posters at the future truck parking sites, and writing press releases. Several media sites such as Land Line, trucker.com and freightwaves.com, also posted articles about the project and the survey.

A link to the survey was also available on the www.i10connects.com website.

Key Findings

The survey consisted of 27 questions related to truck parking behaviors, preferences for receiving truck parking availability information, roadway signage, other truck parking considerations, and driver demographics. The Coalition received 545 responses with an 87 percent completion rate. Results from the survey were consistent with input received from the meetings with the state trucking associations and OOIDA. The following key findings were identified and will be considered in the development of the TPAS Concept of Operations and inform future messaging about the system:

- Forty-one percent of the respondents indicated it takes 30 minutes to an hour to find parking; 37 percent responded it takes longer than an hour to find parking.

- Parking is needed to meet the mandated 10-hour HOS breaks for 93 percent of respondents and parking for 30-minute breaks for 62 percent of respondents.

- Respondents prefer roadside changeable message signs for receiving information, followed by technology applications such as private smartphone applications or in-cab navigation systems.

    - The survey presented five design options for the roadside changeable message signs. Of the five options presented, 56 percent of respondents preferred **Option 2** showing all rest areas within five to 45 miles and the number of total and available spaces. Twenty-eight percent of respondents preferred **Option 1** showing all rest areas within five to 45 miles and the number of available spaces. Options 1 and 2 presented in the survey are shown below.

1.

2.

- Respondents provided the following input on sign preferences:
    - Signs should include as much accurate information as possible.
    - Signs should display two or three upcoming sites.
    - Preferences for how far in advance parking availability information signage should be displayed vary in the survey results. Nineteen percent of respondents prefer three to five miles in advance, 20 percent prefer five to ten miles in advance, 27 percent prefer 11-30 miles in advance, and 25 percent prefer 31-60 miles in advance.

Survey Results

Respondents were asked to provide input on parking behaviors, information dissemination and communication, roadside messaging signs, oversize/overweight parking needs, and respondent demographics. The following section summarizes the responses.

Parking Behaviors

Respondents were asked a series of questions on typical truck parking behaviors. Overall results show most respondents traveled a significant percent of their miles in the Coalition states. Results also reveal respondents need longer parking breaks several times a week while on the corridor, park most often in private truck stops, have been experiencing difficulty in quickly finding appropriate parking, and have parked in unauthorized locations.

Please estimate the percentage of all miles you travel in the I-10 Corridor Coalition states, including CA, AZ, NM, and TX.

Figure 23 shows the percentage of miles respondents travel in the I-10 Corridor Coalition states.

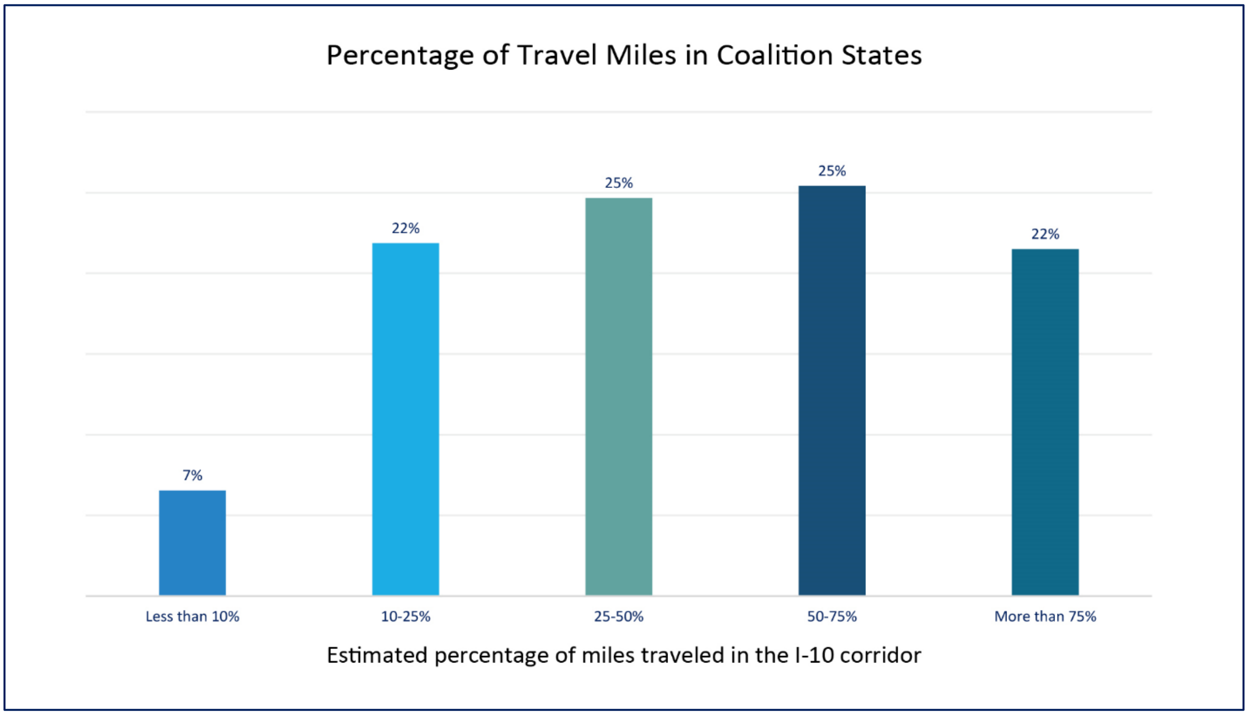

Figure 23: Percentage of Miles Traveled

As shown in **Figure 23**, approximately 47 percent of the respondents drive 50 to 100 percent of all their miles in the Coalition states, while only seven percent drive less than 10 percent in the corridor.

How often do you need truck parking in the four I-10 Corridor Coalition states (CA, AZ, NM, TX)?

Table 18 shows how often truck parking is needed in each of the Coalition states.

Table 18: Frequency of Truck Parking Needs

Frequency of Truck Parking Needs by State					
	Never	Once a week	2-4 times a week	5-6 times a week	Every day
California	14.72%	30.59%	34.61%	12.05%	8.03%
Arizona	11.26%	34.56%	41.94%	5.63%	6.60%
New Mexico	15.59%	40.74%	34.31%	5.65%	3.70%
Texas	11.05%	28.38%	41.71%	12.76%	6.10%

On average, how long does it take for you to find parking in the four I-10 Corridor Coalition states (CA, AZ, NM, TX)?

Figure 24 shows the amount of time it takes respondents to find parking in the Coalition states.

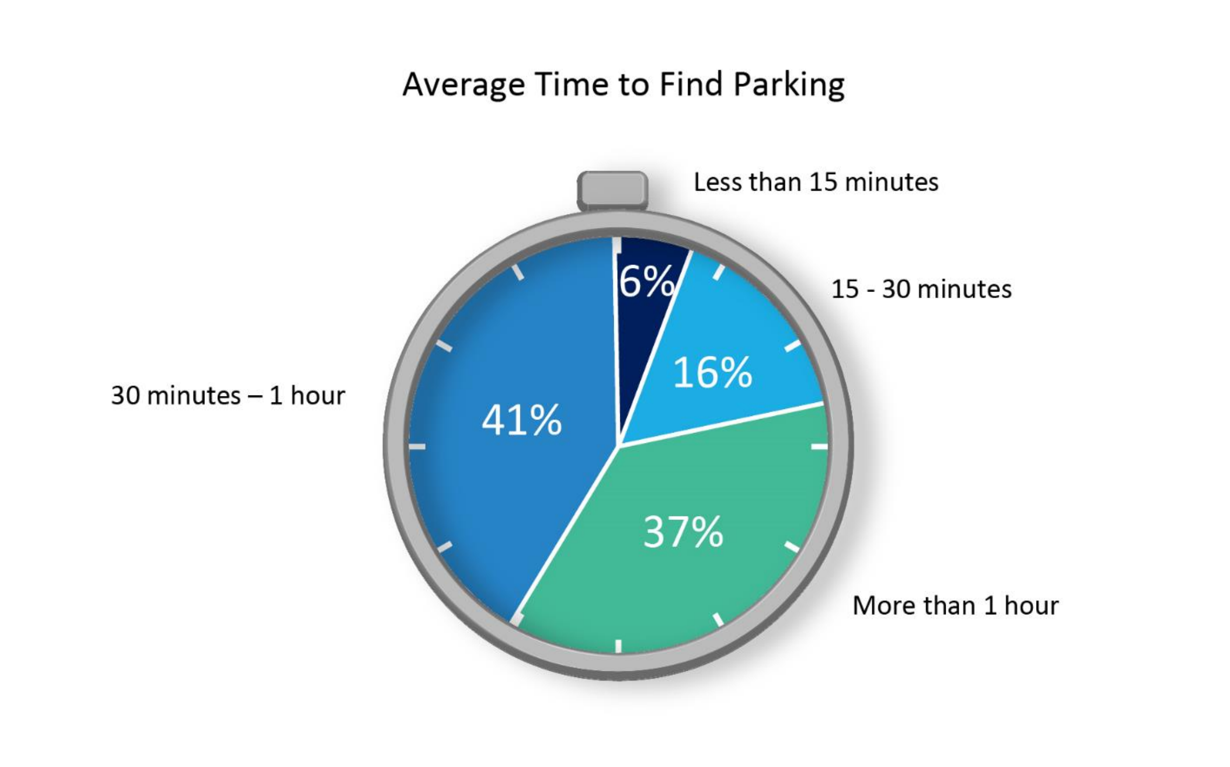

Figure 24: Average Time to Find Parking

As shown in **Figure 24**, 41 percent of the respondents indicated it takes 30 minutes to an hour to find parking and 37 percent responded it takes longer than an hour to find parking. These findings are consistent with other similar truck parking surveys conducted across the country including the 2018 Mid America Association for State Transportation Officials (MAASTO) Truck Parking Survey and the 2019 USDOT Jason's Law Truck Parking Survey. These surveys all indicate that a large percentage of drivers look for parking for at least 30 to 60 minutes.

Please indicate how often the following parking location types have available truck parking along the I-10 Corridor within the four Coalition states (CA, AZ, NM, TX).

Table 19 shows how often truck parking is available in each of the Coalition states.

Table 19: Truck Parking Availablity

Truck Parking Availability by State					
	Never	Rarely	Sometimes	Often	Always
Arizona Public Rest Areas	9.90%	36.57%	37.33%	10.29%	2.10%
Arizona Private Truck Stops	4.95%	32.00%	40.19%	14.86%	4.00%
California Public Rest Areas	32.38%	42.15%	13.60%	4.60%	1.34%
California Private Truck Stops	24.24%	42.18%	19.85%	5.15%	2.67%
New Mexico Public Rest Areas	9.89%	29.28%	39.16%	11.98%	2.28%
New Mexico Private Truck Stops	4.57%	23.81%	43.05%	17.14%	4.57%
Texas Public Rest Areas	7.33%	27.07%	36.65%	17.29%	4.51%
Texas Private Truck Stops	5.62%	24.16%	40.26%	16.67%	6.55%

Do you personally experience the following issues in the four Corridor Coalition states (CA, AZ, NM, TX)? (Check all that apply)

Figure 25 depicts the issues drivers experience when looking for truck parking in the Coalition states.

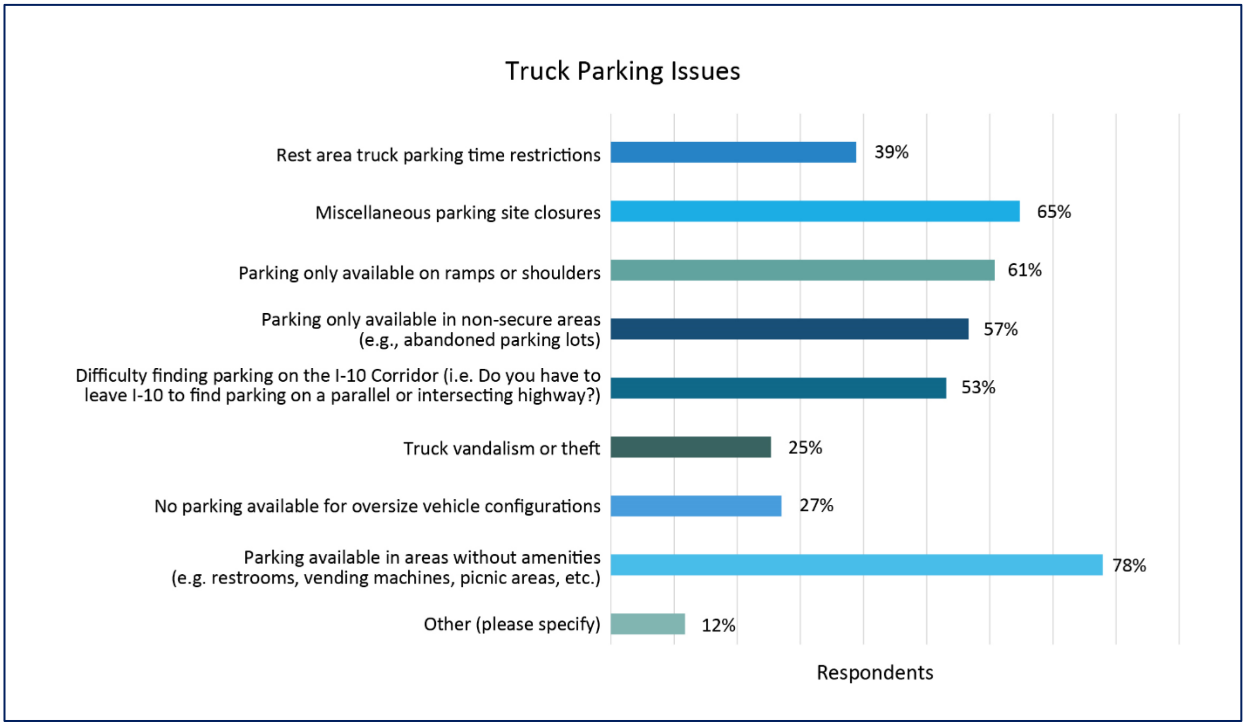

Figure 25: Truck Parking Issues

What type of truck parking do you need along the I-10 corridor? (Check all that apply)

Figure 26 depicts the type of parking respondents need along the I-10 corridor.

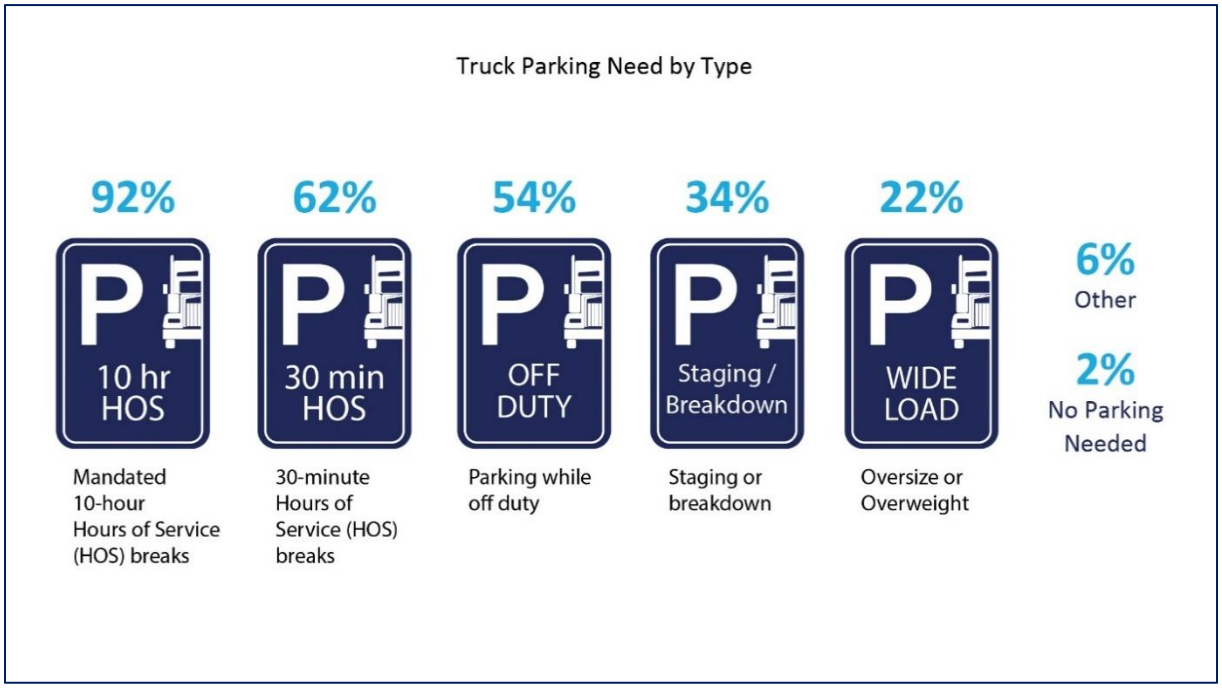

Figure 26: Truck Parking Need

Please indicate how often you park at the following location types in the four I-10 Corridor Coalition States. (CA, AZ, NM, TX)

Table 20 shows how often drivers park at specific location types along the corridor.

Table 20: Frequency of Truck Parking by Location

Frequency of Truck Parking by Location Type					
	Never	Rarely	Sometimes	Often	Always
Public Rest Areas	7.34%	21.28%	43.50%	25.24%	2.64%
Private Truck Stops	1.13%	11.30%	31.64%	45.39%	10.55%
Road Shoulder/Ramp	32.39%	28.44%	22.41%	15.82%	0.94%
Other Parking Locations (store lots, city streets, etc.)	19.62%	31.51%	36.23%	11.51%	1.13%
Shipper Facility	19.06%	33.21%	32.83%	12.45%	2.45%

If you do park in unauthorized parking spaces, what is the typical reason? (Check all that apply)

Figure 27 depicts respondents' reasons for parking in unauthorized parking spaces.

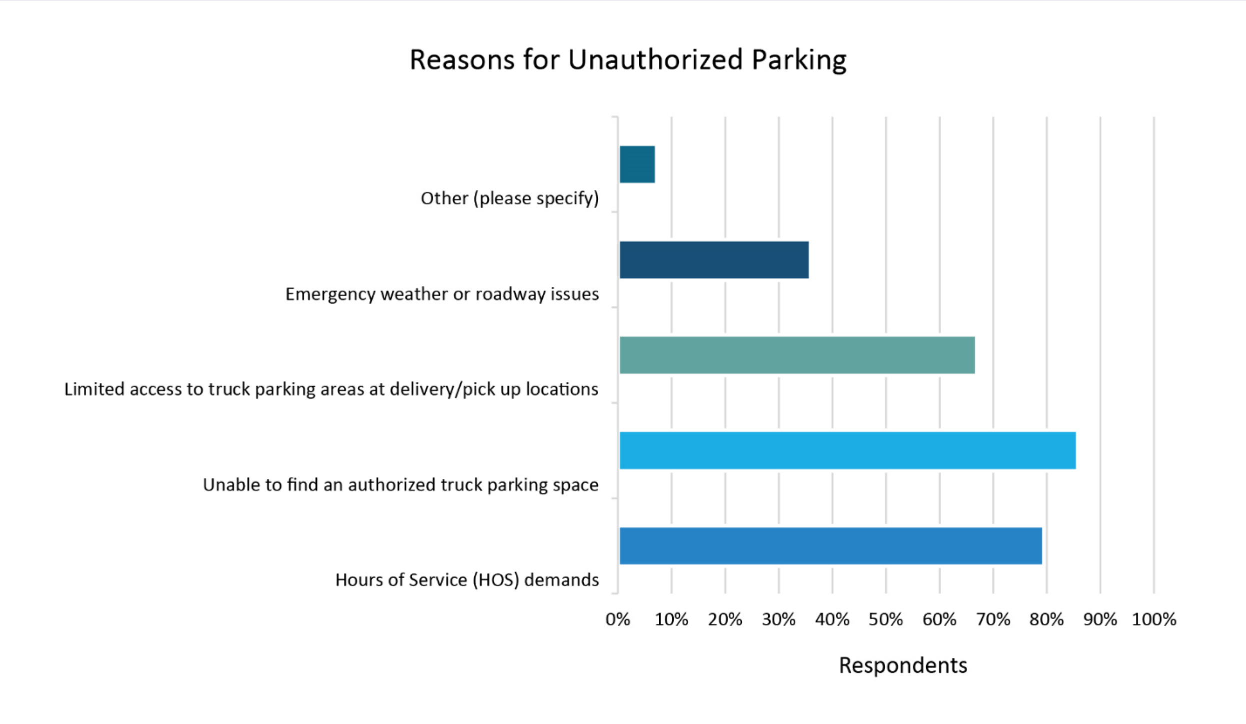

Figure 27: Reasons for Unauthorized Parking

Respondents indicated the most common reasons for parking in unauthorized parking spaces are HOS demands, inability to find authorized truck parking spaces, and limited access to truck parking areas at delivery/pickup locations. Of those that selected "Other" and provided a specific reason, many noted they do not park in unauthorized locations or only park in these locations due to a break-down or an emergency.

What amenities are important to you when selecting a truck parking site? (Select top three)

Figure 28 shows amenities considered when selecting a truck parking site.

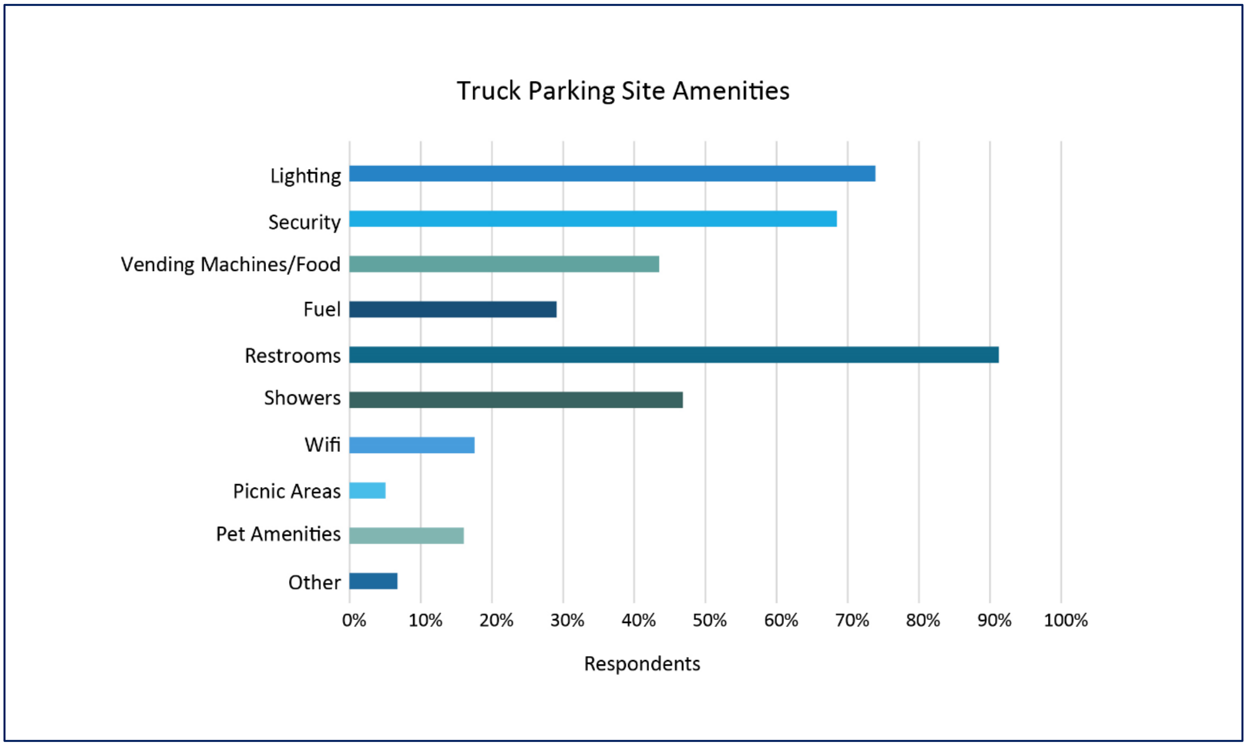

Figure 28: Truck Parking Site Amenities

Data Distribution and Communications

Respondents were asked a series of questions related to their preferred method to receive truck parking availability information. Responses indicated that most expressed a preference for receiving information from roadside signs or smartphone applications.

Are you aware of and do you use state 511 or travel-related information websites?

Figure 29 shows respondents' awareness and use of state 511 or travel-related information websites.

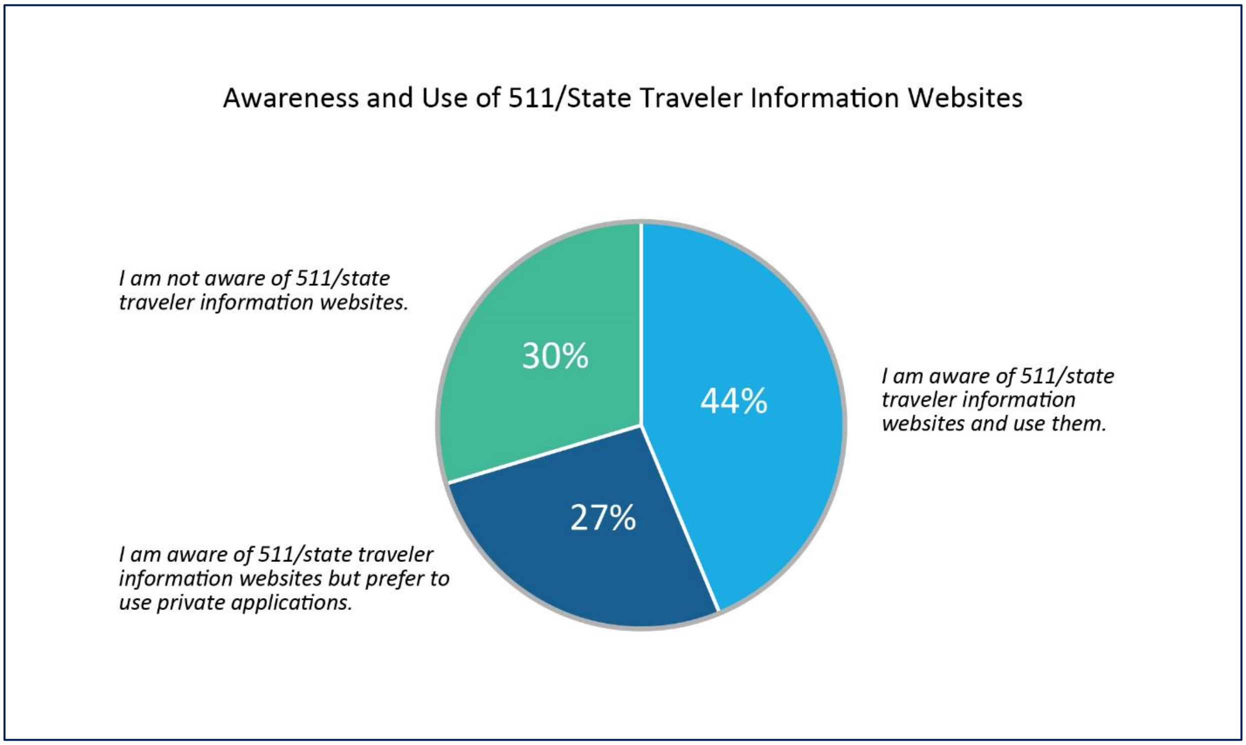

Figure 29: 511/State Traveler Information Websites

Please rank in order (1 to 7) your preferred method for receiving real-time truck parking availability information, with 1 being the MOST preferred.

Figure 30 shows respondents' preferred method for receiving real-time truck parking availability information.

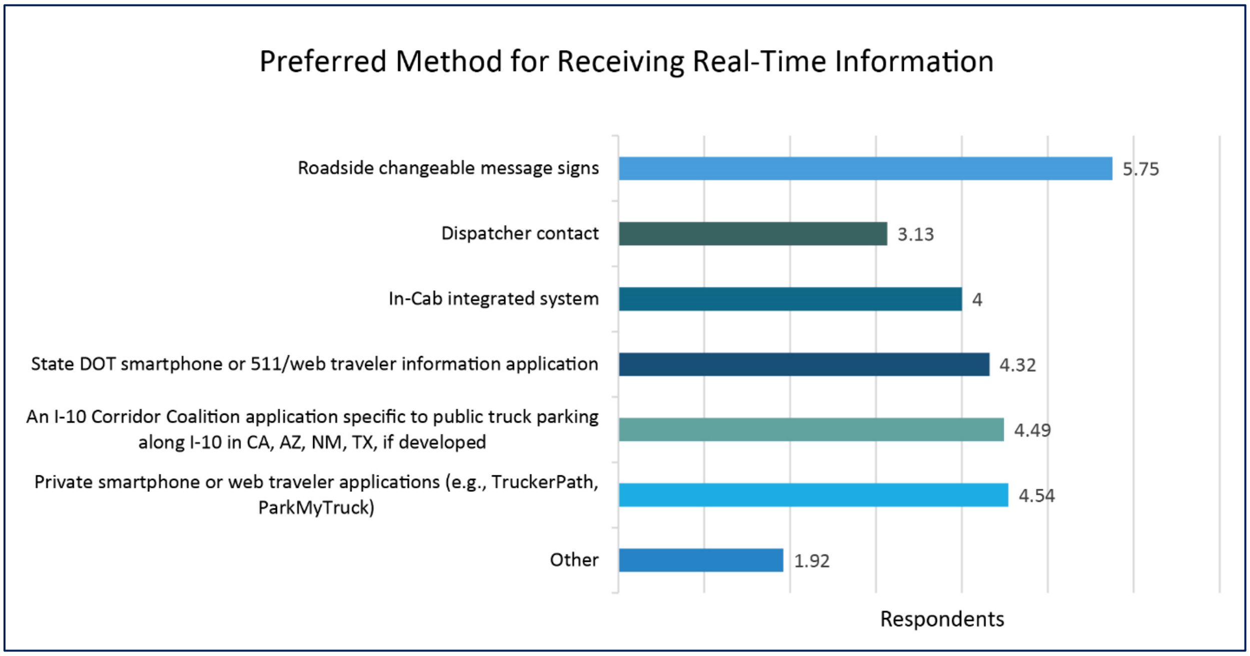

Figure 30: Preferred Method for Receiving Real-Time Information

Respondents who selected "Other" identified CB radio, word of mouth, and Google Maps as their preferred method for receiving truck parking availability information.

How often would truck parking availability information need to be updated for it to be relied upon as "real-time" information?

Figure 31 shows how often drivers prefer to have truck parking availability information updated.

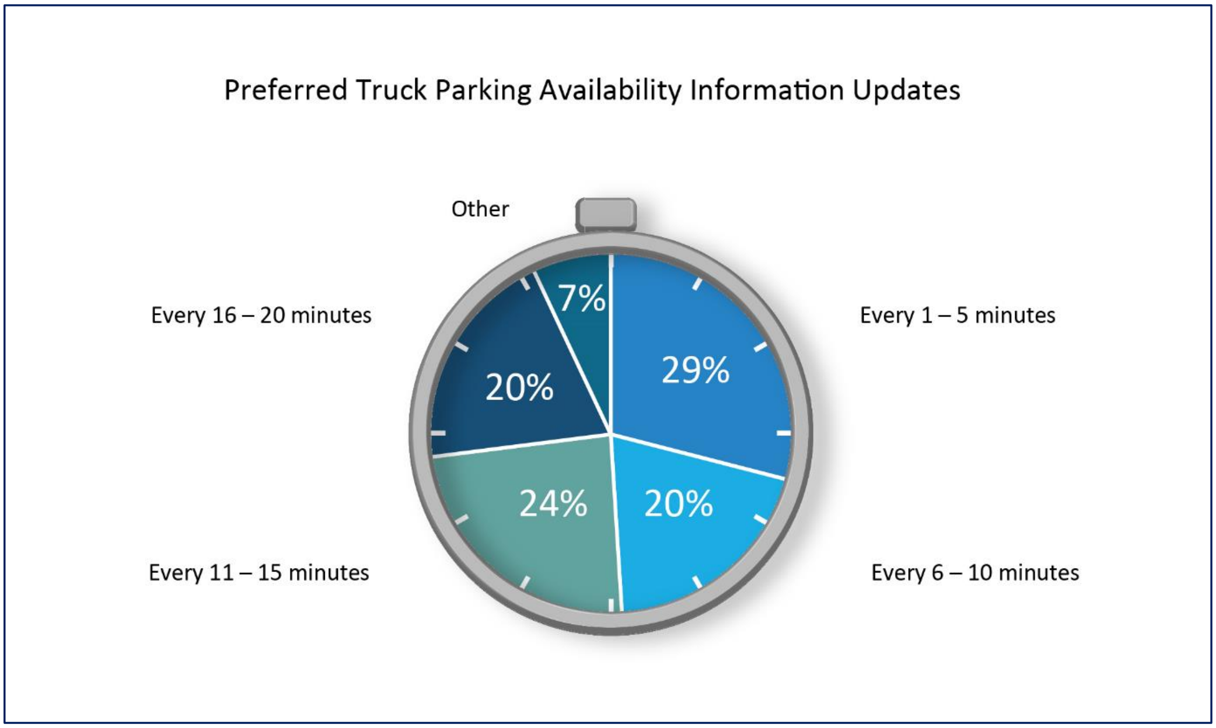

Figure 31: Preferred Truck Parking Availability Information Updates

Respondents who provided comments when selecting "Other" stated that every 30 minutes or hourly is sufficient time to update the parking availability information. The TPAS system is designed to update approximately every five minutes which will meet most drivers' expectations.

Roadside Messaging Signs

Respondents were asked a series of questions related to roadside messaging sign preferences. The survey presented five design options for the roadside changeable message signs.

? *Based on the images above, what truck parking information displayed on roadside changeable message signs is most helpful?*

Figure 32 depicts the sign options presented in the survey.

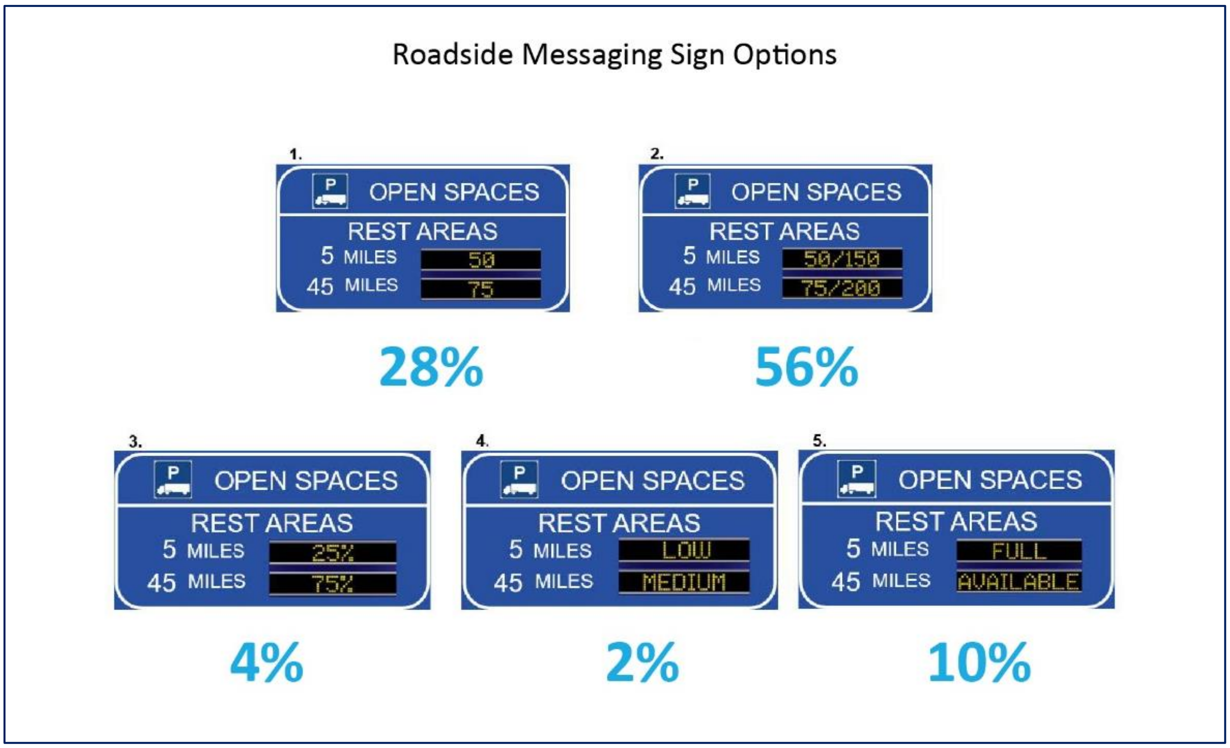

Figure 32: Roadside Messaging Sign Options

Of the five options presented, 56 percent of respondents preferred Sign 2 showing all rest areas within five to 45 miles and the number of total and available spaces. Twenty-eight percent of respondents preferred Sign 1 showing all rest areas within five to 45 miles and the number of available spaces.

When authorized truck parking locations are full or nearly full, how would you prefer roadside changeable message truck parking availability signs to read?

Figure 33 shows the respondents' preferred terminology for roadside messaging signs.

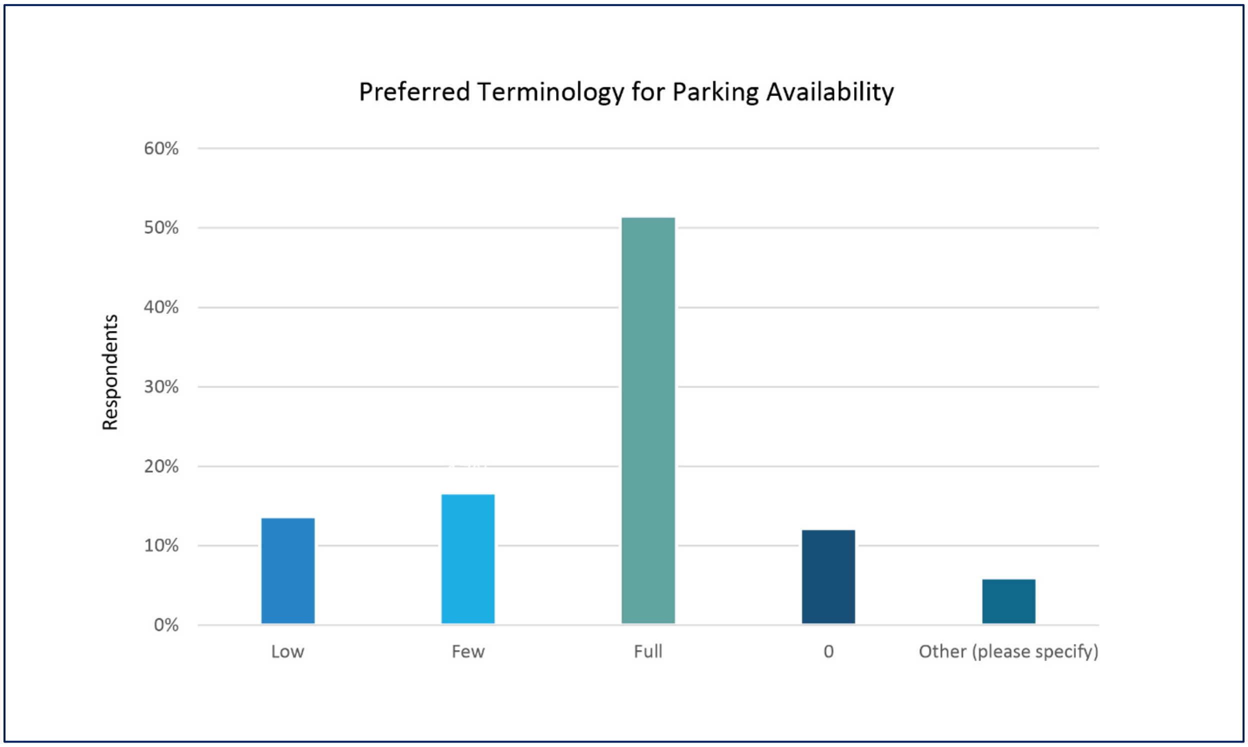

Figure 33: Preferred Terminology for Parking Availability

When authorized truck parking locations are full or nearly full, respondents preferred roadside changeable message truck parking availability signs that read as "full". This is consistent with the input received by representatives from the state trucking associations and OOIDA.

How far in advance do you want signage on parking availability information?

Figure 34 depicts respondents' preferences for sign locations.

Figure 34: Preferred Sign Locations

How many upcoming parking locations should be displayed on each of the roadside changeable message signs?

Figure 35 depicts respondents' preferences for the number of locations to be displayed on the signs.

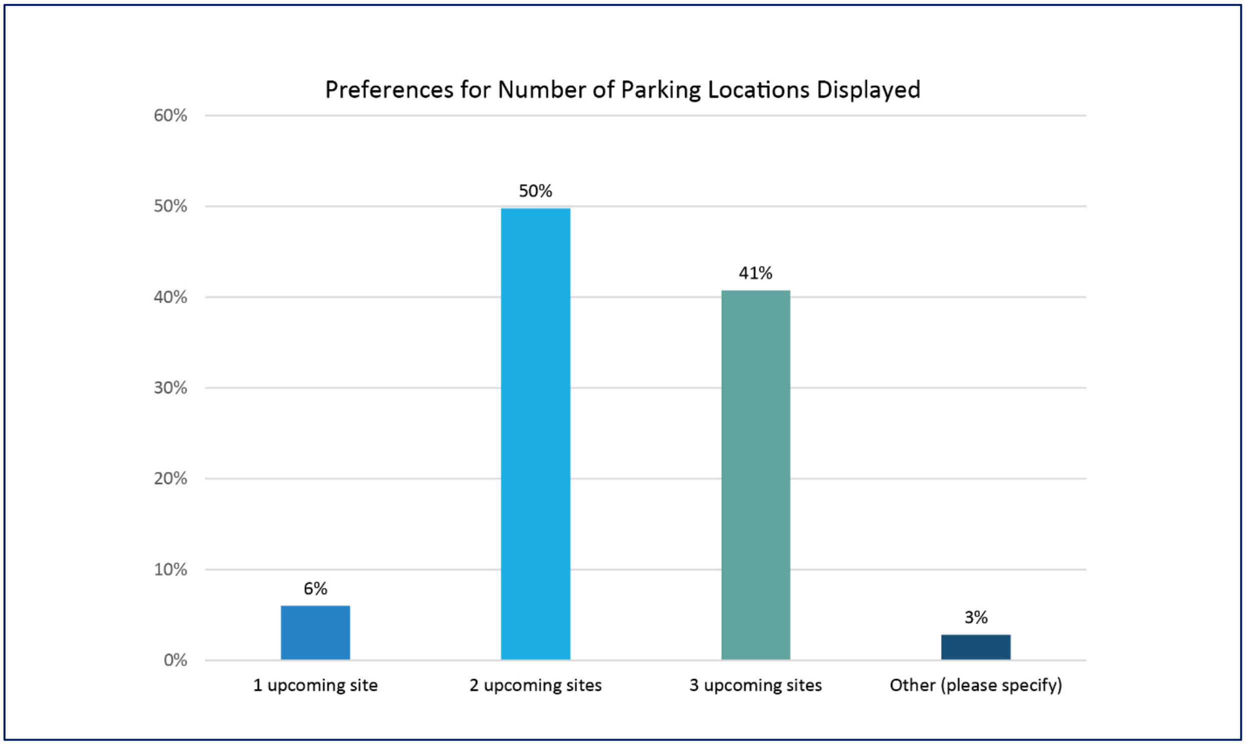

Figure 35: Preferences for Number of Parking Locations Displayed

Oversize/Overweight Truck Parking Considerations

While the ATCMTD grant only provides funds for the I-10 TPAS, respondents were asked a series of questions related to other parking concerns, including needs for oversize or overweight truck parking. The Coalition gathered this input to help inform future initiatives to improve public truck parking facilities along the corridor.

Over 80 percent of respondents indicated they do not need oversize or overweight (OS/OW) parking. Respondents who require OS/OW parking were asked to provide their desired location for OS/OW parking; however, responses varied and there were no recurring characteristics for specific locations. Respondents emphasized that, overall, more OS/OW parking was needed all along the I-10 corridor within the I-10 Coalition states.

Respondents were asked to provide input on the type of accommodations that should be provided for OS/OW parking areas. The most frequent answers included wider parking spaces, well-lit facilities, restrooms, food, WIFI, and showers.

Respondents were also asked if they had any privacy or other concerns about systems that monitor truck parking. Eighty-seven percent indicated they did not have privacy concerns related to the monitoring of truck parking.

Respondents were asked to provide additional comments related to challenges and issues they experience along I-10 Corridor in the Coalition states. The following issues were frequently noted in the survey responses:

- There is a lack of parking along the I-10 corridor within the four states due to rest area closures.
- More parking is needed, specifically improved parking with amenities such as better lighting, restrooms, and shower rooms.
- Cleanliness is a problem at truck stops/rest areas. More frequent trash pick-up is needed.
- Truck drivers commonly experience unsafe conditions on I-10 due to high speeds, hostility towards truck drivers, and bad pavement conditions or potholes.

Demographics

Respondents were asked a series of demographic questions to ensure stakeholder input was received by all truck parking end-user groups.

Which of the following best describes your employment within the trucking industry? (Check one)

Figure 36 depicts respondents' employment within the truck industry.

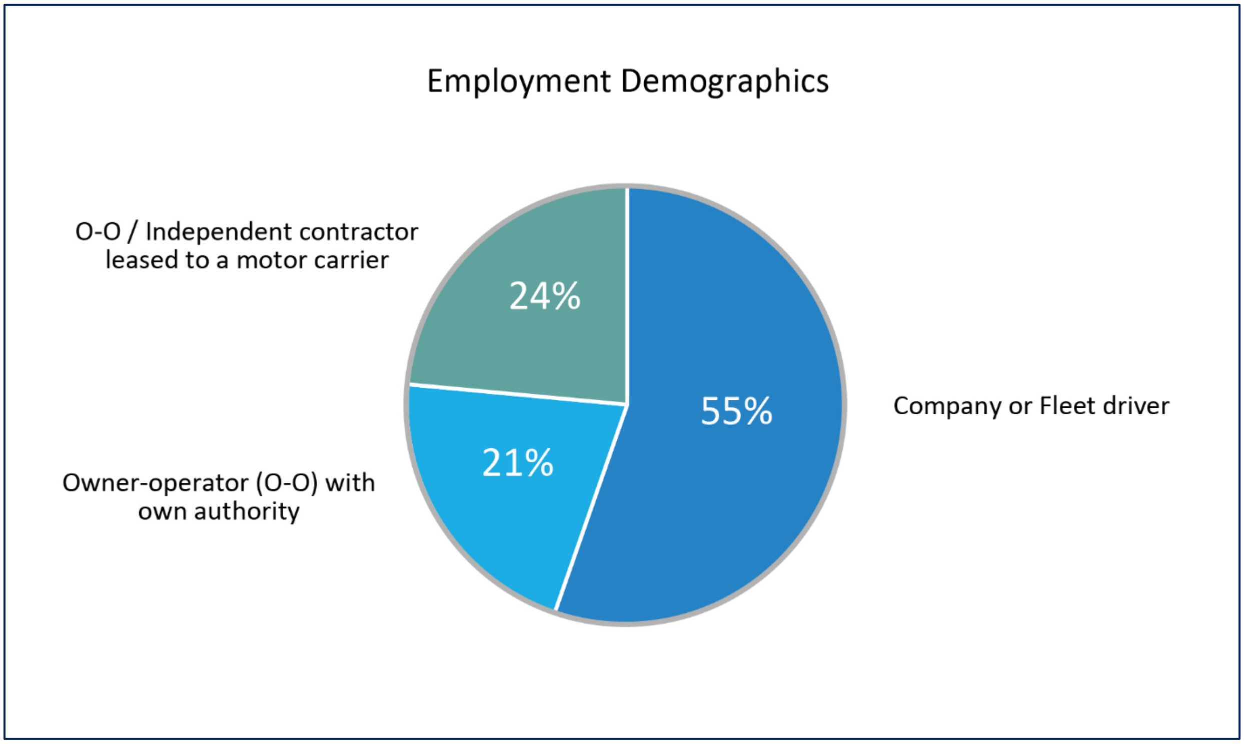

Figure 36: Employment Demographics

What is your average length of haul? (Check one)

Figure 37 shows respondents' average length of haul.

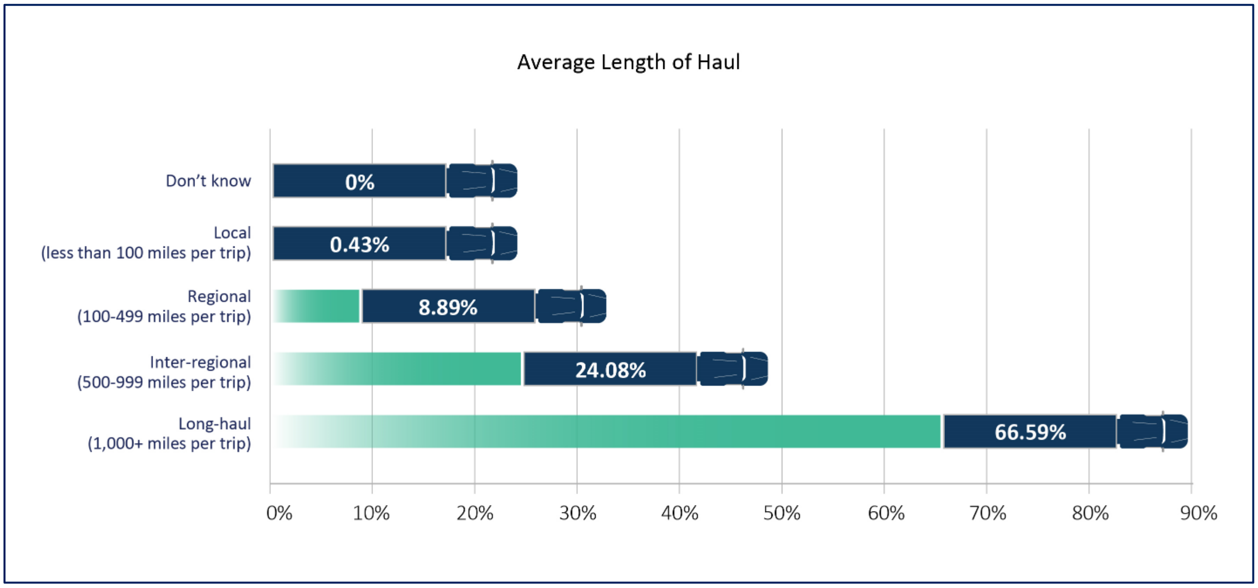

Figure 37: Average Length of Haul

Demographics of the survey respondents reflect typical age and gender demographics in the trucking industry. Respondents provided the following demographic information:

- Respondent Age
  - 3% – Age 25 or younger
  - 30% – Age 26 - 44
  - 58% – Age 45 - 64
  - 9% – Age 65 or older
- Respondent Gender
  - 80% – Male
  - 17% – Female
  - 3% – Prefer not to specify
- Respondent Home State
  - 15% – California
  - 23% – Arizona
  - 1% – New Mexico
  - 22% – Texas
  - 40% – Other